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Message from Organizing Committees

The International Conference on Frontier Computing – Theory, Technologies, and Applications (FC) was first proposed in early 2010 in an IET executive meeting. This conference series aims at providing an open forum to reach a comprehensive understanding to the recent advances and emergence in information technology, science, and engineering, with the themes in the scope of Communication Technology and Applications, Business Intelligence and Knowledge Management, Artificial Intelligence, and any related fields that prompt the development of information technology. This will be the 11th event of the series, in which fruitful results can be found in the digital library or conference proceedings of FC 2010 (Taichung, Taiwan), FC 2012 (Xining, China), FC 2013 (Gwangju, Korea), FC2015 (Bangkok, Thailand), FC2016 (Tokyo, Japan), and FC2017 (Osaka, Japan), FC2018 (Kuala Lumpur, Malaysia), FC ABH2019 (Taichung, Taiwan), FC2019 (Kitakyushu Japan), FC2020(Singapore, Online). Each event brings together the researchers worldwide to have excited and fruitful discussions as well as the future collaborations.

This year FC2021 is the 11th-anniversary event of FC conference series, it was planned to be hold in Seoul, Korea however, due to the CODIV-19 pandemic, our conference has to change to the online form and each presentation is planned as a video stream in the website. The papers accepted for inclusion in the conference proceeding primarily cover the topics of current frontier computing areas. The FC2021 is organized together with server workshops and special sessions. These events present the current developments of frontier computing.

We send our sincere appreciations to the authors for their valuable contributions and the other participants of this conference. The conference would not have been possible without their support. Appreciates are also due to the many experts who contributed to making the event a success. We hope we can have a next FC event, FC2022, in onsite form, and it is the next great event of FC conference series.

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Invited Speaker

Dr. Jia-Wei Chang

National Taichung University of Science and Technology, Taiwan

Title: Natural Language Processing for Potential Applications in Industries

Abstract

Natural language processing, or NLP for short, can utilize machine learning or deep learning to extract meaning from text. However, understanding human language, with all of its intricacies, dialects, inflections, and the like, is sometimes even difficult for people, let alone computers. AI has advanced to the level today where natural language processing can analyze, extract meaning from, and determine actionable insights from both syntax and semantics in text. In NLP areas, many valuable applications are rapid growth, such as smart assistants, text analytics, sentiment analysis, text classification, text summarization, market intelligence, intent classification, and so on. Therefore, NLP can be a revolutionary new solution that is helping companies enhance their insights and get even more visibility into all facets of their customer-facing operations than ever before. The most common applications of NLP in some of the biggest industries around the world, including (a) in financial institutions, investment decisions by sentiment analysis, or fraudulent detection by intent classification. (b) in manufacturing & supply chain, logistical process improvement by shipment documents analysis, or cost-saving by online resources scanning. (c) in retail, the brand development strategies and precision marketing by text analytics and sentiment analysis in social media comments or customers reviews. (d) in healthcare, the decision on medical priority of care by text analytics in the incoming email and live chat data from patients; or improvement of diagnosis and treatments by text summarization and named entity recognition. On the other hand, this talk also concludes the personal experiences of academic-industry cooperation by the NLP technologies for various industries.

Biography

Jia-Wei Chang is an assistant professor in Department of Computer Science and Information Engineering at National Taichung University of Science and Technology. Since January 2019, he is a Young Professionals Chair of the Institution of Engineering and Technology (IET) - Taipei Network. Since 2017, he is a consultant of NEXCOM Industry 4.0 Innovation Center. During February to July 2018, he was an adjunct assistant professor in Department of Engineering Science at National Cheng Kung University. He was a data scientist and project manager at IoT BU, Nexcom during 2016-2017. He received the Ph.D. degree from Department of Engineering Science, National Cheng Kung University in 2017. His research interests include natural language processing, internet of things, artificial intelligence, data mining, and e-learning technologies.

Report Talk

Ms. Tran Thi Thoa
University of Aizu, Japan

Title: An analysis of optimization performance on chaotic evolution algorithm using multiple chaotic systems with elite strategy

Authors: Tran Thi Thoa and Yan Pei

Abstract

Chaotic Evolution (CE) is simply a population-based algorithm applying the ergodic property of the chaotic system into the search process. With the help of the chaotic motion, the algorithm can visit any point with arbitrary accuracy and movement track. However, its search performance should be enhanced to get a better algorithm as CE spends a lot of invalid computation costs when solving the complex optimization problem due to premature convergence and/or slow convergence. In this paper, we introduce and discuss the effectiveness of the enhanced CE with Elite strategy (ECE), which is based on the heuristic information from the elite individuals of the current population. Moreover, because in CE, the distribution characteristic of the chaotic system plays a very important role in deciding the search power, we also make paired comparison and analyze the optimization performance between our proposed ECE algorithms using different types of chaotic map and the canonical CE by applying 12 well-known Benchmark functions as the test functions and some measurement tests. The investigation results indicate that the ECE algorithm is significantly better on the majority of the test functions

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An Automatic Pollen Grain Detector Using Deep Learning

Chengyao Xiong[1], Jianqiang Li[1] Yan Pei[2⋆],

Jingyao Kang[1], Yanhe Jia[3], and Caihua Ye[4]

[1] Faculty of Information, Beijing University of Technology, Beijing, 100124, China
chengyaoxiong@emails.bjut.edu.cn,
lijianqiang@bjut.edu.cn,
kangjingyao@emails.bjut.edu.cn

[2] Computer Science Division, University of Aizu, Aizu-wakamatsu, 965-8580, Japan,
*peiyan@u-aizu.ac.jp

[3] School of Economics and Management, Beijng Information Science and Technology University, Beijing, 100192, China
yhejia@bistu.edu.cn

[4] Beijing Meteorological Service Center, Beijing, China
ych681012@126.com

Abstract. In this paper, we propose a deep learning framework to automatically detect pollen grains instead of the manual counting of pollen numbers under an optical microscope. Specifically, we first establish a large-scale dataset of pollen grains, which contains 3000 images of five subcategories. All the images in our dataset are scanned by an optical microscope. Then, a pollen grain detector (PGD) based on deep learning is designed to eliminate the effects of noise and capture subtle features of pollen grains. Finally, extensive experiments are conducted and show that the proposed PGD method achieves the best performance (84.52% mAP).

Keywords: Automatic pollen identification, Pollen grain detector, Deep learning, Object detection, Pollen allergy

1 Introduction

As a common and frequently occurring disease in clinical practice, allergy has become one of the three diseases for key prevention and treatment in the 21-st century by the World Health Organization [13]. Pollen is the most important one of numerous allergens. A large number of plant pollen allergies floating in the air can induce a series of allergic diseases such as allergic rhinitis, bronchial asthma, dermatitis, and so on. The above-mentioned allergic diseases caused by pollen allergies are also called hay fever [11]. With the intensification of urbanization in human society and the expansion of plant cultivation areas, hay fever has become

⋆ Corresponding author.

a seasonal epidemic disease with a very high incidence. In the United States, the population incidence rate is about 5%, and even as high as 15% in some areas. The incidence rate in Europe has reached 20%, and will up to nearly 35% in the next 20 years [5]. And in China, with the continuous increase in recent years, the incidence rate is around 0.5% to 1% and reaches 5% in the high incidence area [4]. Therefore, accurate identification of pollen grains is of great significance to patients with hay fever. With the continuous development of deep learning and its application in various fields [8, 9, 14, 21, 23], it is undoubtedly a good choice to apply deep learning to automatic pollen detection.

Traditional pollen identification generally includes three steps: pollen collection, sample dyeing, recognition, and microscope counting. In the recognition and counting, experienced biologists are required to manually locate the pollen grains in the microscope image, which is a time-consuming and labor-intensive process. Therefore, many studies have been proposed automatic pollen identification methods with computer vision technology [2,3,15,19,20,22]. These methods mainly rely on image processing to detect and extract pollen objects. However, there are many impurities in the microscope image (such as air bubbles, dust, etc.), which could be misclassified as pollen under simple image processing.

To address this problem, we firstly built a pollen dataset with bounding box annotation for automatic detection of the pollen grain. This dataset contains 5 kinds of common airborne allergen pollens collected from March to October (i.e., the main flowering period of the whole year) in Beijing, thus has rather good representativeness. Based on this dataset, we propose a CNN-based pollen grain detector (PGD), applying matching strategy and hard negative mining, to eliminate the effects of pollen clumping, cracking deformities, numerous impurities in pollen images. Meanwhile, the focal loss is adopted to solve the imbalance problem to improve the prediction accuracy of hard samples. The experiment results show the mAP of our PGD reached 84.52%, which has achieved the best detection performance.

Following this introduction section, previous related works that have already employed for automatic pollen grain classification are presented and reviewed in Section 2. In Section 3 we then provide our dataset, image processing method and pollen grain detector model. Section 4 shows the experimental results and related parameters of our model. Finally, some conclusions are presented in Section 5.

2 Related Works

At present, existing methods mainly designed multiple descriptors for various characteristics of pollen grains to segment pollen grains and background in the image. These studies usually only use predefined features, such as contour, shape, texture and brightness [2,15–17,19,20,22]. For example, Travieso et al. proposed a contour feature descriptor based on a hidden Markov model [22], which can greatly reduce the dimensionality of image feature vectors. However, the noise interference of the secondary image will cause the change of the original image information, making the later-learned descriptor become unstable, which affects the accuracy of similarity matching. A descriptor based on brightness and shape [19] was proposed by Rodriguez Damian et al. This method uses the Hough transform to roughly estimate the contour of the pollen grains and then combines the active contour model to obtain an accurate boundary. However, these features are only applicable to specific data types of specific tasks with poor scalability and limited application scope.

Since manual features require a lot of experienced knowledge, automatic feature extraction based on the convolutional neural network has become the mainstream for automatic pollen identification tasks. Amar et al. [6] utilized a convolutional neural network with 6 convolutional layers to further improve the performance of pollen detection. Battiato et al. [1] proposed a pollen detection method, which uses an image processing method to extract pollen image features according to the color of stained pollen grains and then sends them to a CNN classifier (such as AlexNet, VGG) for detection and classification. The processing of this method is still complex and its accuracy is low. Besides that, some CNN-based pollen detection methods literally achieved good experimental results, however, the data they adopted and detected are only the pollen samples that have been carefully processed in the laboratory environment. In fact, pollen samples in reality usually contain a lot of impurities, such as plant debris, other spores, bubbles, and so on, which will have a great impact on pollen detection. Besides, pollen data has its particularity. Different types of pollen grains can look similar in a specific perspective, and that will cause a lot of trouble in determining label information of pollen grains.

In this paper, we establish a real-world pollen dataset with a bounding box labeled by experts. Base on this, we propose an object detection network (named PGD), to extract subtle features of different species of the pollen grain. Besides, the focal loss is also adopted in our PGD, which is expected to improve the prediction accuracy of hard samples.

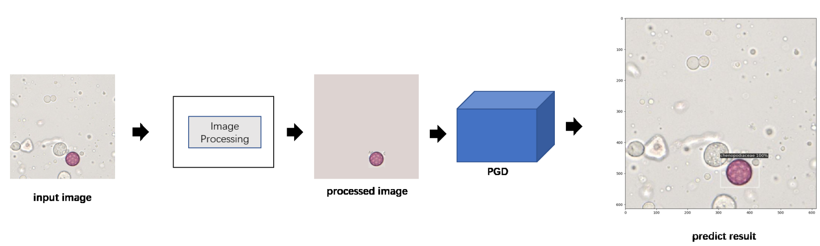

Fig. 1: The overall prediction pipeline.The original image is processed to remove air bubbles and other impurities, the processed image enters the PGD model, and the pollen is detected

3 Material and Our Method

Our pollen detection process is shown in Fig.1. An image needs to be processed before prediction. And then the prediction result is obtained through PGD. We introduce the data set and image processing method in section 3.1. In section 3.2, we will introduce our PGD in detail.

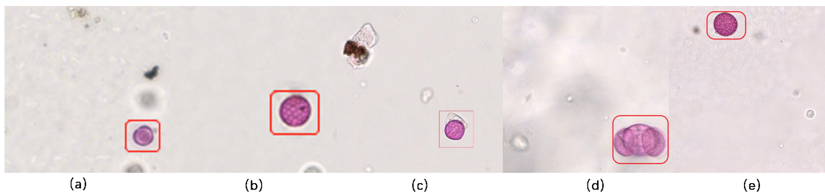

Fig. 2: Images of various pollen samples in PDD. Pollen grains locate in the red box. (a)Artemisia, (b)Chenopodiaceae, (c)Moraceae, (d)Gramineae, (e)Pinaceae

3.1 Dataset and Image Processing

Dataset In this work, we have built a dataset that contains 3000 pollen grain objects. The glass slides with pollen grains are provided by the Beijing Meteorological Service of China. Pollen collection is done by a botanist, who applies a thin layer of adhesive to the glass slide, next place it in a sampler, then expose the glass slide to the air, and take it back 24 hours later to complete the collection. The next step is to use an appropriate amount of dye, put it on the part of the glass slide coated with adhesive, melt it slowly with low heat, and then add a cover glass.

After collecting and staining the pollen, a pathological section scanner is used to scan the glass slide. The pathological section scanner is an automated optical microscope that can connect to a PC device and the scanned image will be presented on the PC. We put the glass slide into the scanner, set the scanning area, the number of focal planes, the distance between the focal planes, the magnification, and other parameters to complete the focusing operation, and finally get the scanned pathological section image. We then divide a whole slide image into 512×512 pixels images by using OpenSlide [5] and NDPITools. [6]. Finally, the images that contain pollen grains were selected and sent to botanical experts to mark the pollen labels and locations. After the above steps, the Pollen Detection Dataset (PDD) was built. Five common types of allergenic pollen in Beijing have been included in PDD, which are: (1) Artemisia, (2) Chenopodiaceae, (3) Moraceae, (4) Gramineae, (5) Pinaceae. (see Fig.2).

[5] https://openslide.org/api/python/
[6] https://www.imnc.in2p3.fr/pagesperso/deroulers/software/ndpitools/

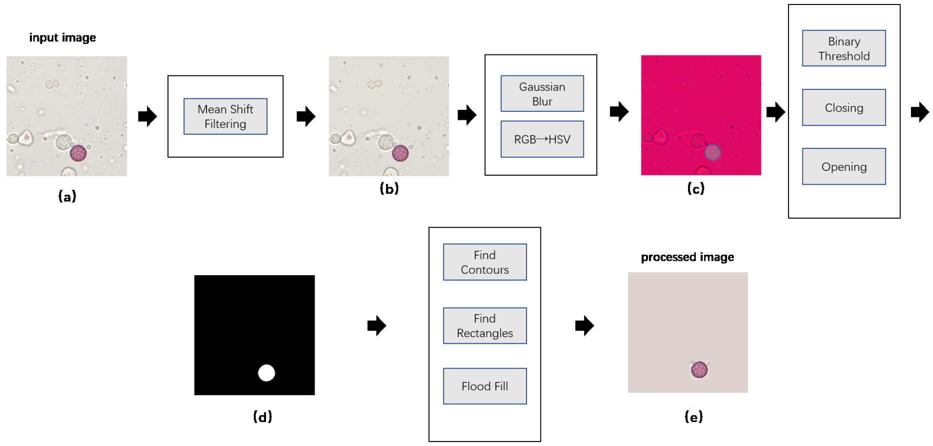

Fig. 3: The details of image processing. (a) Image sample under optical microscope, (b) smooth image processed by mean shift algorithm, (c) HSV image after Gaussian blur and color space conversion, (d) the binary image after the opening and closing operations, (e) the image after contour extraction, calculating the smallest rectangle containing the contour and flood fill algorithm

Image Processing Some transparent bubbles in the pollen image have similar size, texture, and shape to pollen grains, thus may make the PGD model confused. To eliminate the influence of bubbles, the image needs to be processed before using PGD for pollen detection. Since the dyed pollen in the image appears magenta (see Fig.), we extract pollen color to remove bubbles. The operation steps are as follows. First, we use the mean shift algorithm[7] to smooth the image. Then, we use the Gaussian blur to reduce noise and convert the RGB image to an HSV image. After that, we binarize the image according to Equation 1, where $(\mathrm{HSV})_{min}$ and $(\mathrm{HSV})_{max}$ are the thresholds we set. Next, a closing operator and an opening operator are employed using a 30×30 kernel and a 10×10 kernel, respectively, for the binary image.

$$dst = H_{min} \leq src(H) \leq H_{max} \cap S_{min} \leq src(S) \leq V_{max} \cap V_{min} \leq src(V) \leq V_{max} \tag{1}$$

After this, we get a binary image named mask. After extracting the contour of the mask image and calculating the minimum vertical boundary rectangle of the contour, the pollen color is finally extracted. The whole image processing process is demonstrated in Fig.3. And from Fig.3 (e), the image obtained after processing, we can observe that the bubbles in Fig.3 (a) are removed.

[7] https://docs.opencv.org/2.4/modules/imgproc/doc/filtering.html?highlight=meanshiftfiltering

Fig. 4: The architecture of our PGD. PGD receives a 512 × 512 size picture. Three branches are selected for detection to reduce parameters, because they have receptive field similar to the size of pollens.

3.2 Our Automatic Pollen Grain Detector

As shown in Fig.4, more details of our PGD model will be shown in this section. Specifically, there are three main parts: **Default boxes:** For each feature map cell, we use two corresponding default bounding boxes, each is used to predict the offsets and category scores of this box. For an m × n feature map, each default box is used to calculate c category scores and 4 location information. Therefore, we need to use 2×(c+4) convolution kernels to filter the feature map, and the output size of the m × n feature map is 2×m×(c+4). In our data set, since the pollen is mostly round, so the two default boxes are all set to squares rather than rectangles, which can also reduce the model parameters.

Matching strategy and Hard negative mining: If the IoU of the default box and a ground truth box is greater than 0.5, the default box is regarded as a positive example, otherwise it is a negative example. This will make a significant imbalance between the negative and positive cases because the number of negative cases is much larger than the number of positive cases. Therefore, we follow the work [18] to sort negative cases according to the confidence loss, and the ratio of positive and negative examples is controlled as 1:3.

Loss function: Let x_{ij}^{p}={1, 0} be an indicator for matching the i-th default box to the j-th ground truth box of category p. The overall loss function is a weighted sum of the localization loss (loc) and the confidence loss (conf):

$$L_{(x,c,l,g)} = \frac{1}{N}(L_{conf}(x,c) + \alpha L_{loc}(x,l,g)) \tag{2}$$

where N is the number of matched default boxes. The weight term α is set to 1 by cross-validation. Our classification loss function is Focal Loss [10]. This function can reduce the weight of samples that are easy to classify so that the model can focus more on samples that are difficult to classify during the training process.

$$L_{conf}(x,c) = -\sum_{i\in\{Pos,Neg\}} \beta(1-\hat{c}_i^p)^\gamma log(\hat{c}_i^p) \tag{3}$$

The localization loss is a Smooth L1 [7] loss between the predicted box (l) and the ground truth box (g) parameters. The offsets for the default bounding box (d) center(cx, cy) and its width (w) and height (h) can be regressed by optimizing the following loss:

$$\begin{aligned} L_{loc}(x,l,g) = \sum_{i\in Pos}^{N} \sum_{m\in\{cx,cy,w,h\}} x_{ij}^k smooth_{L1}(l_i^m - \hat{g}_j^m) \\ \hat{g}_j^{cx} = (g_j^{cx} - d_i^{cx})/d_i^w, \hat{g}_j^{cy} = (g_j^{cy} - d_i^{cy})/d_i^w \\ \hat{g}_j^w = log(g_j^w/d_i^w), \hat{g}_j^h = log(g_j^h/d_i^h) \end{aligned} \tag{4}$$

4 Experiments

In this section, we will show the training details and the experimental results.

4.1 Training Detail

To solve the problem of data imbalance, we used the following data Augmentation strategies:

- Random horizontal flip
- Randomly selects the size of the crop box, analyzes the IoU value of the crop box and the GT box in the picture, and updates the GT box as a rectangular box where the crop box and the GT box overlap.

For the parameter setting in training, the Xavier method is employed to initialize all the parameters, and the SGD optimizer is adopted with an initial learning rate set as 10^{-4}, momentum as 0.9, weight decay as 0.0005, and batch size as 32. 30k training iterations are carried out in total, among which, 10^{-4} learning rate is used for the first 10K training iterations, then 10^{-5} for the next 10K, finally 10^{-6} and 10^{-7} for the last two 5K iterations, respectively. In the Focal Loss function, balanced variant β is set to 0.25, and focusing parameter γ is set to 2. We use conv10, conv12, conv14 to predict both location and confidences. Two default bounding boxes are associated with each feature map cell. The scale of these default boxes is (35,52), (76,107), (153, 188), respectively.

Table 1: Object detection comparison on our pollen detection dataset. This table shows that the PGD has the highest detection accuracy of Moraceae, Artemisia, Pinaceae and Chenopodiaceae, and it has the highest mAP value.

Methods	AP-Artemisia	AP-Chenopodiaceae	AP-Moraceae	AP-Gramineae	AP-Pinaceae	mAP
Faster R-CNN [18]	90.84%	91.67%	70.27%	73.06%	88.95%	82.96%
SSD [12]	98.11%	91.26%	58.46%	***75.10%***	88.32%	82.25%
PGD	***99.11***%	***91.94%***	***71.15%***	66.94%	***93.49%***	***84.52%***

4.2 Results

We adopt the same evaluation metrics that are used by PASCOL VOC, report the mean average precision(mAP) at IoU=0.5, and average precision of every pollen category at IoU=0.5. Table 1 shows our experimental results using four models. Faster R-CNN [18] obtains an mAP score of 82.96 %. Similar to Faster R-CNN, SSD300 [12] obtains an mAP score of 82.25%. While our PGD outperforms three other models with an mAP score of 84.52%. For Artemisia, Chenopodiaceae, Moraceae, and Pinaceae, PGD has the best AP scores as 99.11%, 91.94%, 71.15%, and 93.49% respectively. As shown in Fig.5, the Precision & Recall Curves also indicates PGD outperforms two other state-of-the-art methods. The above experimental results all verify the effectiveness of our PGD.

In addition, we use the k-fold cross-validation method to perform 20 trials on the pollen dataset, and use mAP as a parameter to perform the Wilcoxon Signed Rank Test. We perform bilateral tests on PGD and Faster R-CNN, PGD and SSD, and the p-values obtained are 1.11×10^{-4} and 9.57×10^{-5}. It proves that there is a significant difference between the results of PGD and these two models.

Furthermore, we perform some positive prediction examples by PGD in Fig.6. Fig.6(a) shows that PGD can still detect pollen well even though pollen grains are covered by impurities. Fig.6(b), Fig.6(c), and Fig.6(d) show that PGD has good detection performance for densely distributed pollen grains. Fig.6(e) and Fig.6(f) show that PGD can perform well when the pollen grain is at the edge of the image and some part of it is missing. From these positive examples, we believe that our PGD has an excellent generalization ability to detect pollen grains in different conditions.

5 Conclusions

In this paper, we propose an automatic pollen grain detector (PGD) based on deep learning, which aims to automatically detect and classify pollen grains. Specifically, we first establish a pollen dataset. Then, a new structure of PGD, including matching strategy and hard negative mining, is designed to extract

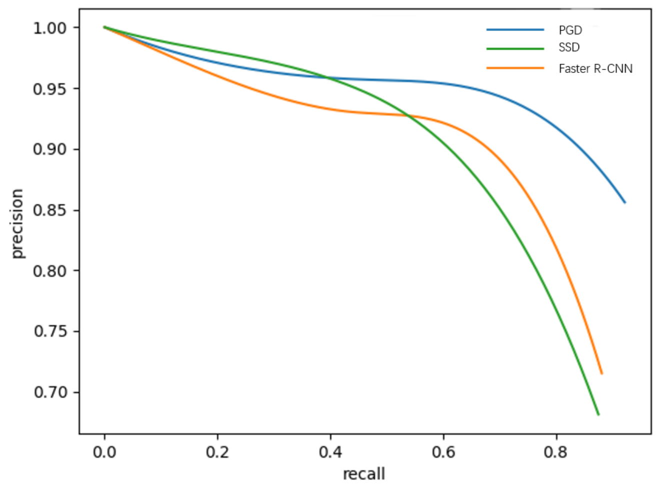

Fig. 5: Precision & Recall Curves. It shows that the PGD model has the highest mAP value and its performance is better than the other two models.

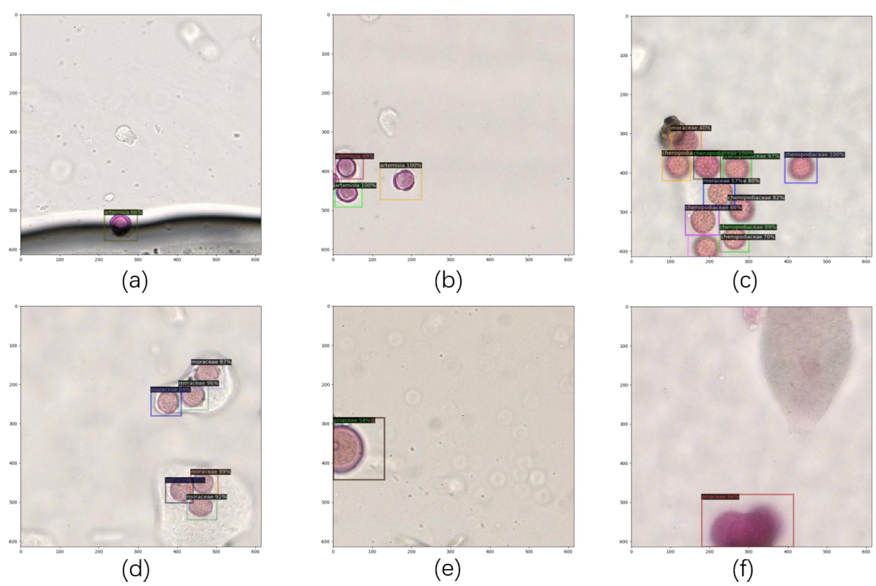

Fig. 6: Positive examples predicted by PGD. PGD still performs well when pollen is densely distributed, covered by debris or blurred in focus.

subtle pollen features. Besides, the focal loss is applied in our PGD to solve the imbalance problems. Extensive experiments on real-world datasets show that our PGD has obtained state-of-the-art detection results. This interdisciplinary research developed an automatic pollen detection and identification method by integrating the knowledge of botany, medicine, and computer graphics, therefore, enables the timely forecast of pollen grains concentration in the air and guides the prevention of pollen allergy.

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Detection of HVDC Interference on Pipeline Based on Convolution Neural Network

Zerui Ma[1], Jianqiang Li [2], Jing Li[1*], Xi Xu[2],Yanan Wang[2],

1. Faculty of Science, Beijing University of Technology, Beijing, China
mazerui@126.com, leejing@bjut.edu.cn*
2. Faculty of Information, Beijing University of Technology, Beijing, China
lijianqiang@bjut.edu.cn, gcaxuxi@163.com, yananm99@163.com

Abstract. High voltage direct current (HVDC) interference is the stray current discharged from HVDC transmission line to the ground during operation, which will cause great damage to the pipeline. Pipeline corrosion protection personnel use pipeline potential as monitoring data to monitor interference from HVDC in real time and determine the health of the pipeline. At present, the corrosion protection industry relies on human experience to judge HVDC interference, but no machine learning methods have been used to detect HVDC interference. In this study, one-dimensional convolutional neural network(1-D CNN) was used to analyze the time-series data of pipeline potential, and a classifier of HVDC interference was constructed to realize the automatic detection of HVDC interference. The experimental results show that the classification accuracy of 1-D CNN in the pipeline spontaneous potential time series data reaches 91.6%, which is better than the general feature extraction method, and can effectively detect HVCD interference.

Keywords: Convolution Neural Network, HVDC, Pipeline Protection.

1 Introduction

1.1 Research Background

Oil and gas pipelines are the medium used to transport oil and gas over long distances. Oil and gas resources are generally stored in oil and gas fields or reservoirs, and transported to cities and regions in need through pipelines. Oil and gas pipeline is the blood vessel in the national energy security system, which bears a very important task. Therefore, the safety protection of pipeline is very important. Oil and gas pipelines are buried deep in the ground and are often affected by two factors, one is from man-made mechanical damage, the other is from chemical corrosion[1]. Mechanical damage refers to the damage to the outer wall or internal structure of the underground pipeline caused by construction workers and facilities during the construction process due to the unclear location of the underground pipeline, resulting in pipeline damage and oil and gas leakage. The damage is often accidental, but the damage is enormous. Chemical corrosion is due to the influence of pH value and stray current in the soil, the pipeline and the soil electrochemical reaction, resulting in the oxidation reaction of its metal structure caused by corrosion. This damage can occur from the time the pipe is buried in the ground, and is not obvious and usually takes a long time to show up.

In order to be able to detect more secret chemical corrosion, intelligent continuous monitoring devices are generally set along the pipeline to detect potential changes in different positions of the pipeline, so that the potential changes of the pipeline can be detected in real time and the health status of the pipeline can be analyzed in time. There are three types of factors affecting pipeline potential: high voltage direct current transmission line interference (HVDC), direct current track interference and alternating current track interference[2]. Among them, the interference of high-voltage transmission line refers to the interference caused by the current released into the soil during the operation of the high-voltage transmission system to the pipeline. The duration of such interference is short, but the soil potential change is very obvious, which will cause great damage to the pipeline. In this paper, based on the time series data generated by the intelligent detection device, the interference detection of high-voltage transmission lines is realized by using one-dimensional convolutional neural network.

The potential change caused by the interference of HVDC transmission is shown in the Fig. 1. Its characteristic is that in a period of time, the power off potential and the power on potential will produce a relatively large offset to the positive or negative direction, and in this process, the potential remains relatively stable. The fluctuation of HVDC is random, so it is impossible to predict the disturbance through the change of waveform. It can only be monitored in real time through technical means. When the potential waveform changes occur, it can be monitored and recorded, so as to evaluate the corrosion situation of the pipeline.

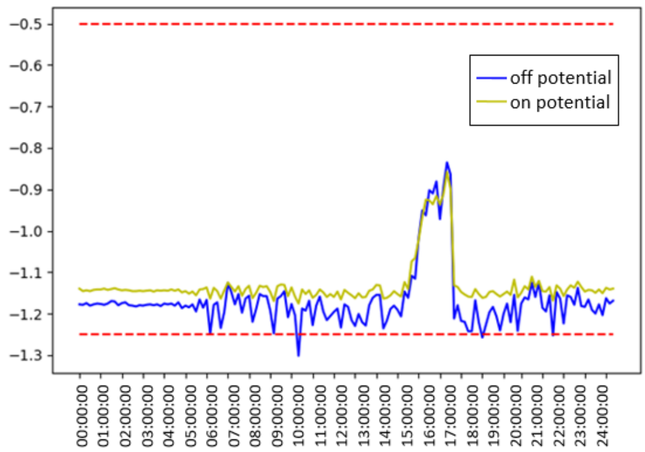


Fig. 1. Potential curve under HVDC interference

1.2 Related Work

At present, the research progress of stray current in oil and gas pipeline is divided into several aspects. In order to evaluate the corrosion of pipelines, it is necessary to analyze the interference sources of real-time detection data and record the relevant electrochemical parameters of pipelines when the stray current is generated. When interference occurs, parameter changes such as potential are analyzed manually, and researchers rely on professional knowledge and experience to determine the specific cause of stray current generation[3]. Some studies[4-5] also use signal analysis for data processing and research. For example, denoising and signal separation methods are used to separate potential data generated by AC interference, and Fourier transform method is used to extract the symbolic features of potential changes. In addition, some studies[6-7] focus on the correlation between stray current and corrosion degree of metal pipes. There is a correlation between stray current data and load during operation of grounding pole, and factors such as chemical properties of soil also have an impact on this. It can be seen that the current research on the stray current of pipelines still remains on the traditional method, and there are few automatic detection of stray current on pipelines, especially the detection of stray current generated by HVDC.

For time series data similar to pipeline potential, there are many methods at present. With the proposal of deep learning, one-dimensional convolutional neural network has become one of the most common methods for feature extraction of time series data. One-dimensional convolutional neural network is widely used in the classification and detection of time series data. For example, in literature[8], one-dimensional convolutional neural network is used to extract the features of seismic waves, so as to extract the special waveforms corresponding to earthquakes from the interference waveforms. In the literature[9], the timing data of electrocardiogram can detect the corresponding sleep apnea events, and the study on electrocardiogram can also judge the health status of the heart, and the study on intelligent diagnosis methods of atrial fibrillation. It is used in the industrial field to analyze the fault state of the machine[10]. It is also applied to power system transient stability assessment[11].

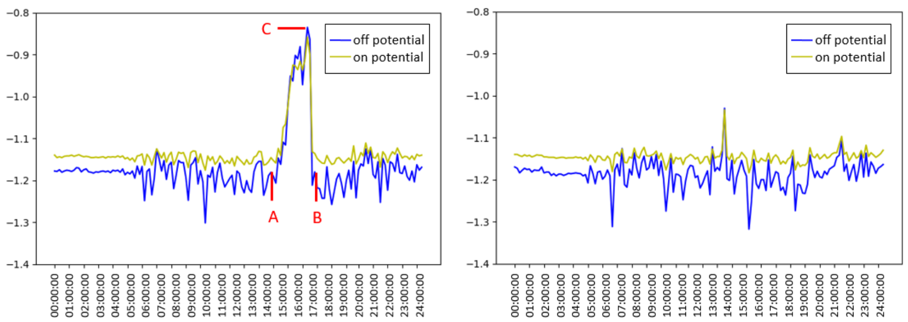
In this study, for the stray current interference signals generated by HVDC, the one-dimensional convolutional neural network is used to extract the features and detect the characteristic waveform of HVDC.

2 Materials and Method

2.1 Dataset

The data in this study were taken from the real-time cathodic protection monitors of an oil and gas pipeline system. There were 240 monitoring points in total for nearly 6 months, and the data were obtained by the intelligent test pile for cathodic protection. In order to detect the health condition of the pipeline in real time, a large number of cathodic protection intelligent test piles are buried along the oil and gas long-distance pipeline, which are used to detect the potential, current and insulation performance of the pipeline. Each test pile is equipped with a wireless communication chip, which can transmit data to the server in real time through the Internet of Things, and then the server will analyze the transmitted data using machine and manual methods to analyze the possible interference problems in the pipeline.

The collected data include pipeline potential, soil environment, pipeline current, etc. Among them, the power-on potential and power-off potential of the pipeline are sensitive to HVDC interference, so we use these two values as the main data sources for detection. The typical curve of the pipe potential after the interference of HVDC is shown in the Fig. 2(a). Point A represents the beginning of interference, C represents the peak, and B represents the end of interference. Fig. 2(b) is the potential curve without HVDC interference.



(a) (b)

Fig. 2. HVDC interference and normal potential curve

2.2 Data Processing

In order to realize the effective analysis of the data, we first clean the data and manually delete the obviously wrong data. These data are usually distributed discretely within the time range and have significant differences with the values of the surrounding moments. In addition, the test pile may send data repeatedly to the remote server, and we deleted the completely duplicated data. The data were marked by professionals in such a way that the potential curve presented by the device was significantly offset if HVDC interference occurred during a certain period of time, and the data marked for that time range were characteristic data.

In order to use the convolutional neural network to extract the features of the data, the data is firstly segmented. Usually, the discharge time of HVDC transmission line is about 30min-4h, and a data is collected every 10min. In order to improve the classification accuracy of the model, we used a random way to divide the time segments. Starting from the first data after 0 o 'clock every day, every L data is divided into a time segment until the data of the day is clipped. The criteria for determination are as follows: if the segment contains HVDC data, the segment shall be marked as a positive sample; otherwise, it shall be marked as a negative sample. Finally, the data were artificially screened to eliminate the segments marked with obvious errors in the positive and negative samples. According to different L, we can get different sample numbers. Sample number statistics are shown in the Table 1.

Table 1. Sample Size of Dataset

L	Positive	Negative	Total
15	825	823	829
20	828	814	837
25	836	823	845
30	834	828	843
40	844	837	850
50	839	832	841
100	825	821	831

2.3 1-D CNN

Convolutional neural network is usually used in image correlation analysis, and convolutional neural network is gradually applied to feature analysis of one-dimensional time series data. In this study, one-dimensional convolutional neural network is used to detect the time sequence segments of HVDC interference. When HVDC interference occurs, the potential data will have obvious characteristic changes.

Simple 1-D CNN principle as shown in Fig. 3. The input feature vectors is the data to be analysed, convolution layers is used to extract the local regional characteristics of input vector. after multiple convolution operations and pooling operations, the feature maps is transformed into a feature vector by flattening or global pooling. Multiple fully connected layers are used to further extract feature. The final output vector represents the result of the classification.

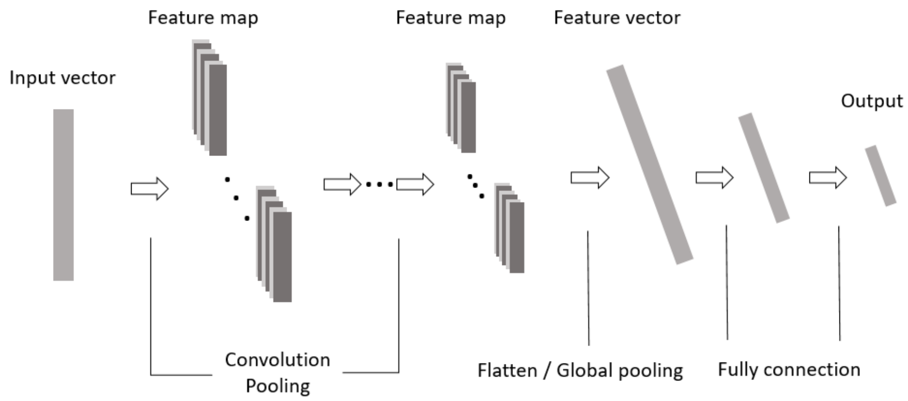


Fig. 3. The structure of 1-D CNN

Due to the small dimension of data to be classified, appropriate convolutional kernel and layer number should be taken into consideration when designing convolutional neural network. According to the corresponding literature, any larger convolution kernel can be replaced by several smaller convolution kernels. A one-dimensional convolution kernel of length 3 can be used as the basic structure of the network. After every two convolution kernels, the maximum pooling layer is added. The number of layers of the network is appropriately increased according to the length of the input sequence. The design networks of different length sequences are shown in the table. In order to utilize the extracted features as much as possible, the feature map is transformed into a one-dimensional feature vector by using flattening operation. In order to improve the speed of convergence, ReLU is used as the activation function to conduct nonlinear processing on the features of each layer.

Table 2. Parameter setting of 1-D CNN

L	Layer	Size	Stride
15,20,25	CONV1	3	1
	CONV2	3	1
	POOL1	2	2
	FC1	-	-
	FC2	-	-
30,40,50,100	CONV1	3	1
	CONV2	3	1
	POOL1	2	2
	CONV3	3	1
	CONV4	3	1
	POOL2	2	2
	FC1	-	-
	FC2	-	-

Taking the data with L of 30 as an example, the parameters, input and output of the model are shown in Fig. 4.

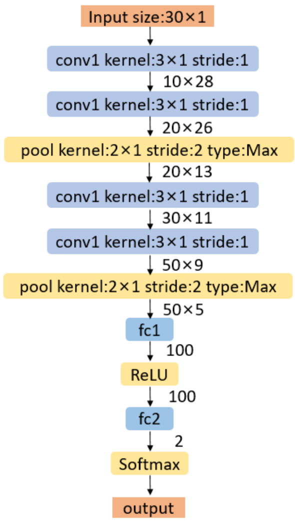


Fig. 4. The inputs and outputs of each layer in 1-D CNN

3 Experimental Result and Analysis

There are two groups of potential data: power-on potential and power-off potential. According to experience, we chose the power-off potential as input. At the same time, we also do a comparative experiment, which proves that the characteristics of the power-off potential are more obvious than the power-on potential. The results of the experiment are shown in Table 3.

Table 3. Performance comparison between on-potential data and off-potential data

L	On-potential data			Off-potential data		
	Acc	Rec	Pre	Acc	Rec	Pre
15	0.825	0.823	0.829	0.882	0.875	0.887
20	0.828	0.814	0.837	0.893	0.883	0.899
25	0.836	0.823	0.845	0.905	0.891	0.914
30	0.834	0.828	0.843	0.913	0.904	0.919
40	0.844	0.837	0.850	0.916	0.922	0.912
50	0.839	0.832	0.841	0.894	0.901	0.886
100	0.825	0.821	0.831	0.885	0.862	0.893

It can be found from the experimental results that the performance of the model on the power-off potential is better than that on the power-on potential, because the power-on potential is affected by the protection current, and the characteristics of HVDC are relatively weakened. When L is considered as the power-off potential, the best result of the experiment is when L is selected at 40. This is in line with our expectation, because as the length of the segment L increases, the more data L contains, the more complete the segment containing HVDC data will be. When L exceeds 40, the accuracy rate drops somewhat, which may be due to the decrease of data volume and the performance decline caused by model overfitting. In addition, the feature distribution is relatively scattered due to the large L, and the network can not capture HVDC features well.

Secondly, the comparison between the one dimensional convolutional neural network classifier and other classifier models is presented. DTW[12] and Wavelet transform[13] are common feature extraction methods in time series data classification. Segments of fixed length L=40 were selected, and different classification methods were used to extract and classify the features of the data. The results of comparison are shown in Table 4.The experimental results show that 1-D CNN has better performance than DTW and Wavelet transform. This indicates that convolutional neural network can be selected as the HVDC interference detection method.

Table 4. Comparison with other time series data classification methods

Methods	Acc	Rec	Pre
DTW+KNN	0.846	0.839	0.850
Wavelet transform + SVM	0.855	0.861	0.849
1-D CNN	0.916	0.922	0.912

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Detection of Human Relaxation Level Based on Deep Learning

Zhouzheng Wang[1,2,*],ChenYang Hu[1,2]

[1] Faculty of Information Technology, Beijing University of Technology, Beijing, China

[2] Intelligent Signal Processing Laboratory, Beijing University of Technology, Beijing, China

E-mail: wangzhuozheng@bjut.edu.cn

Abstract. as the pace of life accelerates, the psychological pressure on people is increasing day by day. It is a very meaningful measure to use wearable devices to monitor heart activity in real time, and to monitor the degree of physical and mental relaxation by acquiring heart rate variability (HRV). Based on the physiological similarity, the pulse data which is collected by the wearable smart bracelet is processed as the heart rate signal. The paper analyzes the HRV signal to obtain the three-dimensional input characteristics of the CNN network: time domain features, frequency domain features, and nonlinear features. The designed CNN network in this paper consists of two layers of convolutional layers, maximum pooling layer, average pooling layer, and fully connected layer. According to the three classifications, the CNN network outputs the level of the relaxation index H. The prediction results are embodied by the confusion matrix. The experimental results show that compared with the traditional human body relaxation state evaluation model, the results obtained by using CNN network prediction have higher accuracy. The research results of this subject are expected to initially realize the daily monitoring applications of wearable devices in homes and hospitals.

Keywords: wearable smart bracelet, heart rate variability, CNN network, relaxation index.

1.Introduction

With the acceleration of the pace of life, more and more people are plagued by psychological pressure, and the number of patients with mental and mental illnesses is increasing. How to effectively assess the individual's physical and mental relaxation state has become a hot research topic in recent years. By accurately assessing the relaxed state of the human body, individuals can learn about their own vital sign changes and psychological stress changes in time, so as to adopt effective intervention and adjustment methods to avoid the trouble caused by stress. Therefore, based on this purpose, this study aims to monitor human physiological signals at any time to predict human relaxation levels. At present, it is a more objective and convincing method to assess the degree of physical and mental relaxation of the human body through physiological parameters. When the heart is doing cyclical diastolic and contraction movements, the vibration generated by it will form a pulse wave with certain characteristics, which contains a wealth of human pathological and physiological information [1-3]. Based on the physiological similarity, this article processes the collected pulse signal as the heart rate signal. The original pulse data were processed to obtain HRV signals with multiple features.

HRV refers to the small variation characteristics between heartbeat intervals. It is a method to check the heartbeat interval variation. It is a sensitive and non-invasive index that can quantitatively evaluate the function of the heart's autonomic nerves. The HRV signal contains a lot of information about cardiovascular regulation. The extraction and analysis of this information can qualitatively assess the tension and balance of cardiac sympathetic nerve and vague nerve activity and its influence on cardiovascular system activity. Therefore, HRV is an effective feature for monitoring individual relaxation levels.

In the field of detection and evaluation of the degree of psychological relaxation, a lot of methods have emerged at home and abroad. Picard et al. [4] studied the stress level of 9 call center employees. These employees wore a skin conductance sensor on the wrist for a week and reported the stress level of each call. The improved support vector machine (SVM) was used for training and testing. The recognition accuracy rate of stress level reached 78.03%. Hongyang Sun of Shanghai Jiao tong University et al. [5] used IAPS image library and mental arithmetic tasks to induce three types of emotions and three levels of psychological stress in the laboratory, and established a database of related physiological signals. The particle swarm optimization (PSO) algorithm and the K nearest neighbor (KNN) algorithm were combined to classify and recognize three kinds of emotions and three kinds of pressures, and the recognition accuracy of the three kinds of emotions reaches 75%.

In this paper, the RR interval was calculated based on pulse data. Heart rate variability (HRV) was analyzed using RR interval data in time domain, frequency domain and nonlinear domain to obtain a suitable feature set. The feature set was sent to the CNN network to assess the psychological relaxation of individuals.

2.Related Work

2.1 Hardware Construction

This article uses Zigbee technology to network the coordinator and watch. The overall hardware network is shown in Fig. 1. The overall hardware network consists of two steps: the first step is the initialization of the coordinator. At first, the JLink_V490 software needs to be installed on the server side. The jlink debug line connects the coordinator with the server, and then J-Flash software is used to download the SB.jflash file and the SB_Code.bin file to the coordinator. The second step is to burn the program of the terminal device. At first, use the J-Flash software to open the MB.jflash project, and then load the watch motherboard program MB_Code.bin into the J-Flash project in the new project interface, and next connect the jlink debug line to the watch board in the corresponding hole positions, finally complete the burning of the program through the Auto button in the J-Flash software interface.

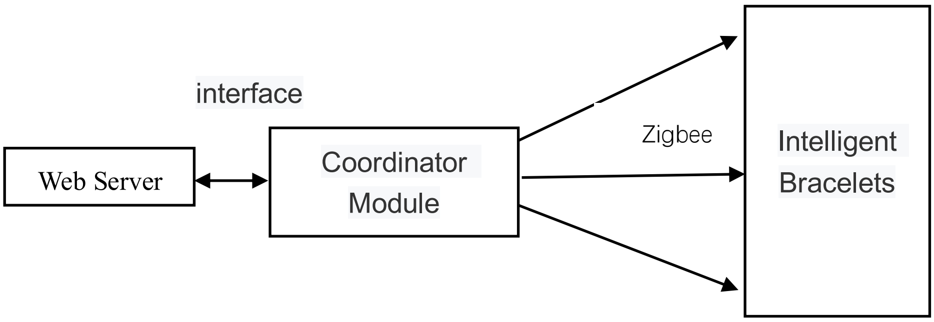


Fig. 1. Schematic diagram of hardware networking.

2.2 Software Debugging

According to the communication protocol of the coordinator, this article adopts postman software or group decompression and relaxation training system for online debugging. The original data collected by the smart bracelet is transmitted to the server through the Zigbee network and serial port, and the 28-dimensional original characteristic data is calculated by the algorithm program.

3.Data Analysis

The normal heart rate signal is shown in Fig. 2. The duration between two R waves is represented by the RR interval, and the normal RR interval data is between 600 and 1200 ms. For the abnormal value not in this range, the value less than 600ms is calculated as 600, and the value greater than 1200ms is calculated as 1200ms. Based on the RR interval, the heart rate variability analysis includes time domain, frequency domain and nonlinear analysis methods.

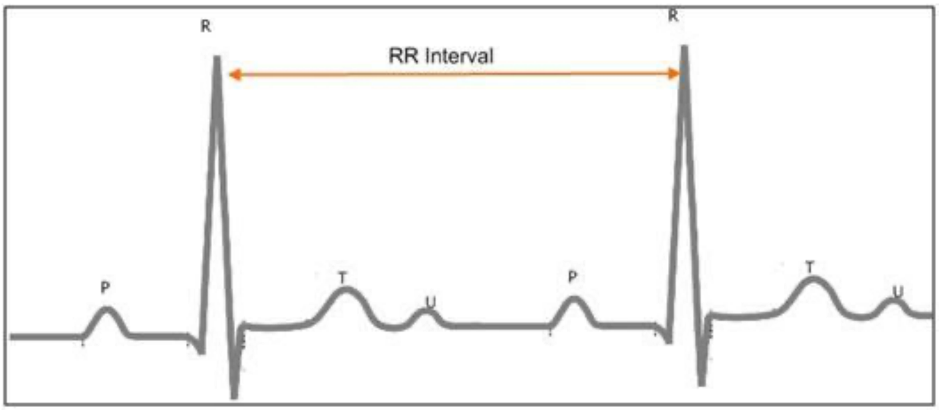


Fig. 2. Heart rate signal graph.

3.1 HRV Time Domain Analysis

Among the 28-dimensional features obtained, there are 18-dimensional time-domain indicators, and several typical features are shown in Table 1.

Table 1. Typical time domain characteristic parameters.

Feature name	Description
mean_nni	Average value of RR interval.
SDNN	The standard deviation of the time interval between consecutive normal heartbeats.
SDSD	The standard deviation of the difference between adjacent RR intervals.
rmssd	The square root of the mean of the sum of squared differences between adjacent RR intervals. Reflect the impact of high frequency (rapid or parasympathetic) on HRV.
pnni_50	The ratio obtained by dividing nni_50 (the interval difference between consecutive RR intervals greater than 50 ms) by the total number of RR intervals.

Among them, SDNN is the standard deviation of all RR intervals, the unit is ms, and the normal reference value is 141±39 milliseconds. SDNN reflects the total evaluation of heart rate regulation by the autonomic nervous system, and the specific calculation formula is as follows:

$$SDNN(ms) = \sqrt{\frac{\sum_{i=1}^{N}(NN_i - \overline{NN})^2}{N-1}} \tag{3.1}$$

3.2 HRV Frequency Domain Analysis

Perform a fast Fourier transform on a relatively stable RR interval or instantaneous heart rate variability signal (usually greater than 256 heartbeat points) in the time domain to obtain a power spectrum with frequency (Hz) as the abscissa and power spectral density as the ordinate. The frequency domain characteristic parameter has 7 dimensions, among which there are several typical indexes. Some are shown in Table 2 below. The heart rate spectrum curve of normal people in the basic state is between 0-0.4Hz, 0.003-0.04Hz is the very low frequency (VLF), 0.04-0.15Hz is the low frequency (LF), 0.15-0.4Hz is the high frequency (HF), 0 -0.40Hz is the total power (TP). The recording time for short-range recording is 5 minutes.

Table 2. Division of frequency bands for short-range recording and spectrum analysis.

Index	Unit	Description	Frequency band
5min total power	ms×ms	Change of NN interval in 5min	≤0.40
VLF	ms×ms	Very low frequency power	≤0.04
LF	ms×ms	Low frequency power	0.04-0.15
HF	ms×ms	High frequency power	0.15-0.40
LF/HF		LF to HF ratio	

The physical and mental control index is determined by the balance between the sympathetic nervous system and the parasympathetic nervous system. It is specifically expressed as the value of LF/HF. Normally, the ratio is about 6:4.

The original pulse data is collected through a wearable smart bracelet, and appropriate features are selected through feature extraction and sent to the neural network for training. There are three different states of relaxation to divide of human body: fatigue, calm, and excitement, corresponding to different ranges of the relaxation index H. This paper extracts the time domain feature SDNN and the frequency domain feature LF/HF and mean_nni to analyze the relaxation index.

4. CNN Neural Network

Convolutional Neural Networks (CNN) is a type of Feedforward Neural Networks which includes convolution calculations and deep structure. It is one of the main representative algorithms for deep learning. The CNN network has the characteristics of strong self-learning ability, good self-adaptation ability and the ability to optimize the network structure through the back propagation algorithm. It is a good pattern classifier.

4.1 CNN Network Structure

The network structure with 5 hidden layers designed in this paper is shown in Fig. 3.

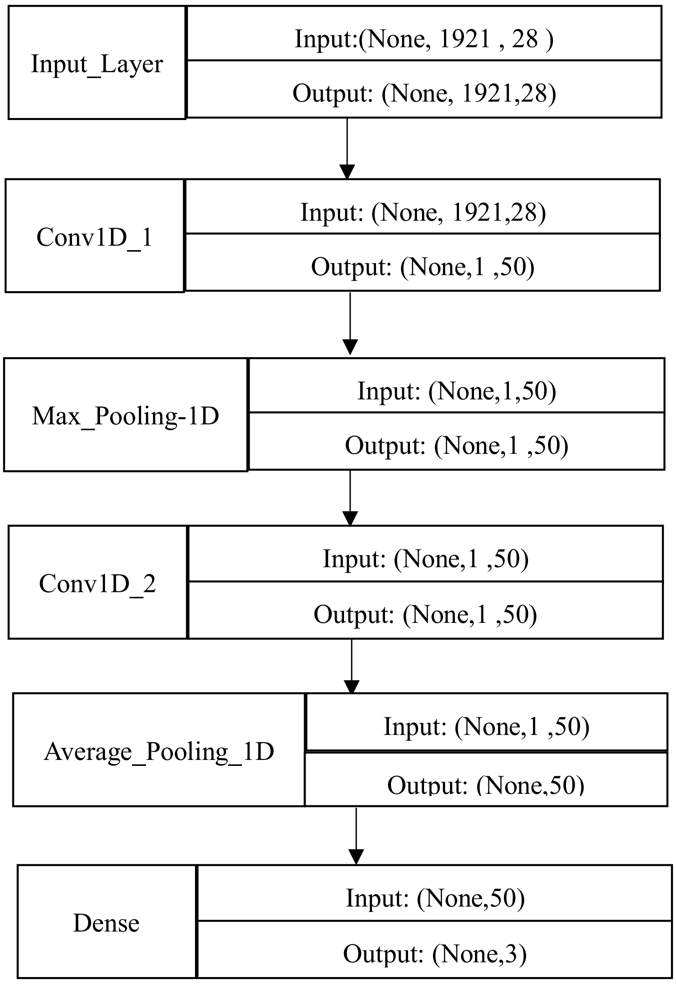


Fig. 3. CNN network structure.

The first is the input layer. The CSV file composed of selected features is used as the initial input. It passes through the one-dimensional convolutional layer, the maximum pooling layer, the one-dimensional convolutional layer, the average pooling layer, and the fully connected layer. Finally, the three classification results are obtained, and then print out the accuracy, loss function and confusion matrix of the training set and test set.

4.2 The Design of CNN Network

There are 1921 experimental data in this paper, and two convolutional layers are designed. The size of the convolution kernel of the first convolution layer is 1, that is, the step size is also 1, and the ReLU (The Rectified Linear Unit) activation function is used. It is characterized by fast convergence and simple gradient calculation. The expression of the ReLU function is as follows:

$$f(x) = max\ (0, x) \tag{4.1}$$

In the above formula, $x = w^T x + b$, where w is the weight matrix and b is the bias matrix. That is, for the input vector x from the upper layer of the neural network that enters the neuron, the neuron using the linear rectification activation function produces an output.

The pooling layer is sandwiched between successive convolutional layers to compress the amount of data and parameters and reduce overfitting. The first pooling layer uses maximum pooling, that is, each window selects the largest number as the value of the corresponding element of the output matrix. The convolution kernel and activation function of the second convolution layer are the same as those of the first convolution layer. The following second pooling layer uses average pooling, that is, the average value of the elements in each window is used as the value of the corresponding element of the output matrix. The last is the full link layer, where Softmax is used as the activation function, and its expression is as follows:

$$p(x_i) = \frac{exp\ (x_i)}{\sum_{i=1}^{n} exp\ (x_i)} \qquad i = 1,2,3 \dots \dots n \tag{4.2}$$

Where x_i is the input and $p(x_i)$ is the output. Numerator: Through the exponential function, the real number output is mapped from zero to positive infinity. Denominator: Add all the results together and normalize them. The optimizer chooses adam. The purpose of the Softmax function is to convert multi-class output into probability. The classification evaluation indicators are precision, recall, and F1 score.

5. Results and Analysis

Based on the CNN network to predict the degree of physical and mental relaxation, this paper has done two sets of comparative experiments. The first is to change the epoch of the model and the number of convolutional layers of the CNN network for horizontal comparison; then the CNN model is compared with the LSTM (Long Short Term Memory Network) and SVM (Support Vector Machine) models longitudinally.

5.1 Horizontal Comparative Experiment

5.1.1 Influence of Convolution Layer Number on Results

When the data volume was 1921, the epoch was 300, and the batch-size was 200, the number of convolutional layers was changed from 2 to 4. Comparison results of accuracy and loss function are shown in Table 3.

Table 3. Influence of the number of convolution layers on the results.

the layer number of convolution	Accuracy	Loss
2	**0.811**	**0.257**
3	0.768	0.384
4	0.757	0.421

As can be seen from the table, when the number of convolution layers is 2, the accuracy is the highest, which is 81.1%. Increasing the number of convolution layers will decrease the accuracy of prediction, which may be caused by the limited amount of data. It can be seen that the more layers of convolution is not always better. The number of convolution layers should be reasonably set according to the specific experimental situation.

5.1.2 Influence of Iteration Number on Results

The number of iterations is the quotient of the amount of data and the size of the batch. When the data volume is 1921, the epoch is 300, the convolutional layer is two layers, the batch size is 100,200,300 respectively, i.e. the number of iterations is 20, 10, and 7 respectively. The results of accuracy and loss function comparison are shown in Table 4.

Table 4. Influence of the number of iterations on the results.

the number of iterations	Accuracy	Loss
20	0.712	0.459
10	**0.811**	**0.384**
7	0.783	0.347

As can be seen from the table, when the number of iterations is 10, the effect is the best. The number of iterations should be reasonably optimized according to the size and composition of the data set.

5.2 Longitudinal Comparative Experiment

In the experiment, LSTM network and SVM (support vector machine)[6] were selected as the reference of CNN network to carry out comparative experiments. Precision, recall and F1-score were selected as evaluation indexes. The experimental results are shown in Table 5.

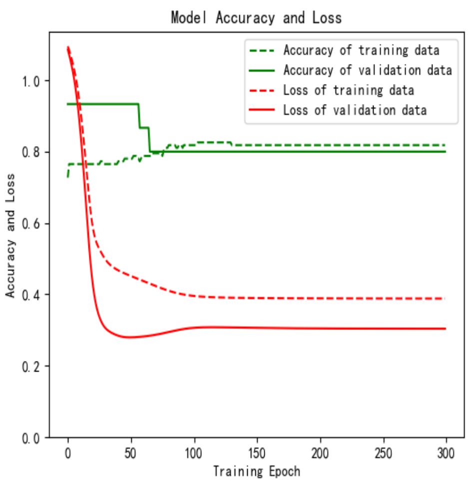
Table 5. Comparison of different results of CNN, LSTM and SVM.

model	Precision	Recall	F1-score
CNN	**0.735**	**0.910**	**0.802**
LSTM	0.651	0.814	0.763
SVM	0.602	0.798	0.639

As can be seen from the table, CNN network has the highest accuracy, recall rate, F1 score, and the best classification effect and stability. When observing different indicators, the value of recall rate is the highest, indicating the highest recognition rate for positive samples.

5.3 Experimental Results of CNN Network

When the CNN network is used for experiments, 80% of the data set is taken as the training set and 20% as the test set. The accuracy and loss rates on the training set and test set are shown in Fig. 4, and the confusion matrix is shown in Fig. 5.



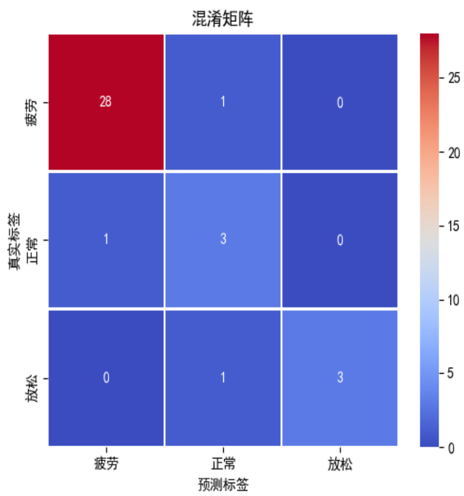


Fig. 4. Accuracy and loss degree under CNN. **Fig. 5.** Confusion matrix under CNN.

Fig. 4 shows that the accuracy of CNN network on the training set reaches more than 80%, and the test set curve and the training set curve are basically consistent when the epoch is greater than 50,indicating that the prediction effect is very good. For the confusion matrix, when there are 36 prediction samples, the prediction classification of 34 samples is correct, indicating that the classification effect of the model is very nice.

6. Results and Prospects

In this experiment, the relaxation index was predicted through CNN network, and the prediction of H relaxation index was basically realized, with an accuracy of about 80%. What is more, compared with LSTM and SVM, it is found that CNN network has higher accuracy. However, there are still some shortcomings in the work that need to be further improved in the future researches. Therefore, this paper put forward the following prospects for future researches:

1) Further expansion of training samples. Increase the number of subjects on the basis of different states of subjects. Increasing the number of subjects can not only improve the accuracy of classification, but also help to reduce errors and overfitting in the classification model.

2) Excavate more characteristics that can be used to identify psychological stress. In addition to the HRV pressure features extracted in this paper, more hidden features can be mined, and then these features can be fused and sent into the classifier to improve the recognition rate of the index.

3) Study more objective labeling methods. In this paper, the correlation of H relaxation index is labeled subjectively according to different characteristics, and we need to find a more optimized labeling method to improve the scientificity of results.

7. Acknowledgement

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Human physiological signal detection based on LSTM

ZhuoZheng Wang[12*], YuYang Wang [12] and ChenYang Hu[12]

[1] Faculty of Information Technology, Beijing University of Technology, Beijing, China
[2] Intelligent Signal Processing Laboratory, Beijing University of Technology, Beijing, China
*E-mail: wangzhuozheng@bjut.edu.cn

Abstract. In this paper, a wearable device is used to obtain the human pulse signal and analyze the heart rate variability. Heart rate variability is affected by respiration or breathing process, so it can estimate the human body's breathing rate and then get the body's relaxation index through the neural network. The Zigbee network and serial port transmit the collected raw data to the server, perform HRV analysis at a fixed sampling frequency, and calculate various characteristic data. A Long Short-Term Memory Network algorithm is proposed to classify the physical and mental relaxation index into three categories when performing deep learning to analyze feature data. This experiment shows that compared with SVM, LSTM is faster, and the optimal parameters of the model are found by the method of controlling variables. The accuracy reaches more than 90%, which aligns with expectations, verifying the algorithm's effectiveness. Wearable watches can be used for daily monitoring in hospitals or families and have good application value.

Keywords: Zigbee, HRV, LSTM

1 Introduction

In the context of the rapid development of the times, people in all fields of life are concerned about convenient life, physical health, and life safety. In terms of the convenience of life, wearable devices allow people to make calls and take photos anytime, anywhere. In terms of life safety, it can monitor people's fatigue and emotions while driving and can issue warnings in time to reduce traffic accidents. In terms of physical health, with the aging of the population, busy young people cannot always pay attention to the physical condition of the elderly at home. Wearable devices provide safety guarantees for the elderly. The smartwatch detects any physical condition of the elderly and feeds it back to the family members' mobile phones. Due to the impact of the COVID-19 epidemic, many young people also attach great importance to their health problems. It is practical to analyze their H relaxation index by wearing smartwatches and adjusting their status in time.

Many previous studies on wearable devices, such as G. Paolini[1], presented research about a 5.8 GHz system for vital signs monitoring, specifically human breath. The system was designed to be fully wearable; it could be mounted inside a plastic case and worn by the user under test at chest–level position. B.Xiang[2]presented iMask, a non-invasive and cost-effective wireless wearable respirator that measured breathing parameters in real-time. W.S.Johnston[3]demonstrated the feasibility of extracting accurate breathing rate information from a photoplethysmographic signal recorded by a reflectance pulse oximeter sensor mounted on the forehead subsequently processed by a simple time-domain filtering and frequency domain Fourier analysis.

In recent years, many articles have had their methods of analyzing heart rate variabilities, such as In 2017, H. Dubey[4]designed a wearable PPG system and proposed a technique that uses spectral kurtosis along with the state-of-the-art respiratory-induced frequency, intensity, and amplitude features. In 2018, Y. Shang[5]mentioned the error backpropagation network and its improved algorithm are used to realize the initial recognition of HRV signals. In 2020, A. C. Podaru[6]designed a device capable of simultaneously recording the ECG, PPG, and a pulse signal acquired from the earlobe biological signals to determine the heart rate variability (HRV) parameters. In 2021, M. Hussain[7]proposed in-vehicle breathing rate monitoring by exploiting channel state information (CSI) available in Wi-Fi signals.

In the analysis of heart rate variability, time domain and frequency domain are usually used to analyze the impact of HRV on the user's stress level. In the frequency domain analysis, the user's psychological stress state is analyzed by observing the increase and decrease of the low-frequency and high-frequency parts of HRV. In the time domain analysis, the user's psychological stress state is analyzed by observing the changes in SDNN, heart rate, and RMSSD.

In previous studies, there are very few articles that analyze the human mental state through neural networks, and many of them use machine learning to analyze the degree of relaxation of the human body. This article uses the LSTM network in deep learning to analyze the degree of relaxation of the human body. Compared with the previous SVM network, this network has higher accuracy and the model can converge faster. First, the pulse signal is measured by a wearable watch, and the required feature data is calculated through time-domain analysis and frequency domain analysis. According to a certain standard, the tester’s physical and mental relaxation index is scored from 0-100, and the scores are divided into three categories, which are sent to the LSTM neural network for learning. Among them, the score is positively correlated with the degree of physical and mental relaxation.

2 Data acquisition and analysis

2.1 Data acquisition

During the experiment, psychosocial stress was induced with the three states of sitting, walking, and jogging. The wearable smartwatch can obtain pulse data. The watch and the coordinator were networked through Zigbee technology, and the data was sent to the server. The sampling frequency is 200 Hz.

The watch is shown in Figure 1(a). The outer end has a power interface and a handset interface. The time can be displayed in the upper left corner of the page, and the battery capacity can be displayed in the upper right corner of the page. In Figure 1(b), the watch has four options. The system settings can query the device number, device name, Bluetooth MAC address, and Zigbee address, as shown in Figure 1(c). On the physiological signal page, the wearer's heart rate curve can be observed in real-time. The music library provides main melody music and background music for users to choose from. Training topics are divided into three types, namely Meditation breathing, Active breathing, and Sleeping breathing. The coordinator is the manager of the network organization [8], as shown in Figure 2.

Fig. 1. Watch style display, (a) wearable watch (b) watch page function (c) system setting page in watch page.

Fig. 2. coordinator

The RR interval is obtained by analyzing the pulse data. The RR interval reflects the distance and time of the R wave peak in two adjacent heartbeats. The original pulse data is shown in Figure 3. The unit is ms.

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0,0,3,12,22,31,39,43,48,52,58,65,73,83,92,103,111,120,125,126,124,116,103,84,59,31,18,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
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0,411,369,326,281,235,190,147,107,72,39,16,3,0,0,0,0,0,6,23,44,73,105,138,171,203,233,259,283,302,320,334,347,355,
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Fig. 3. Raw pulse data

2.2 Data analysis

During the experiment, abnormal data caused by poor contact of the watch needs to be processed for abnormal values. Studies have shown that the RR interval data outside the range of 600-1200 are caused by external factors, such as severe shaking, abnormal contact, and sudden instability of network signals, rather than the body's breathing rate. Therefore, the range of filtering outliers is selected between 600 and 1200.

After the RR interval is processed, time domain and frequency domain analysis are performed to obtain 27-dimensional data and 1822 rows of data. Through reading the literature, we can see that in the 24-hour measurement data, the SDNN value in the time domain has a more significant impact. In the 5-minute measurement data, SDNN in the time domain, HF, LF, LF/HF, LFNU, and HFNU in the frequency domain has a more significant impact on the H relaxation index. In contrast, other data have a more negligible effect on the relaxation index. The experiment in this article uses short-term measurement data and scores the H relaxation index according to the reference value. The reference value is shown in Table 1 below. Since HRV is affected by gender, age, and environment, this expected value is measured in a sitting environment with male experimenters aged 20-40. This paper classifies the H relaxation index into three categories to explore the impact of characteristic data on the H relaxation index. The classification rules are shown in Table 2 below.

Table 1. Typical characteristic reference value

Feature name	Reference threshold(unit)
SDNN	20-70(ms)
LF	754-1586(ms2)
HF	772-1178(ms2)
LFNU	30-78(nu)
HFNU	26-32(nu)

Table 2. Three classifications of H relaxation index

H relaxation index	Label
0-40	0
41-70	1
71-80	2

The H relaxation index is used as an index to measure the body's degree of mind and mind relaxation. The H relaxation index score is calculated according to the threshold under certain conditions. The physical and mental control index depends on the balance between the sympathetic nervous system and the parasympathetic nervous system, specifically, the ratio of LF/HF. So it can be scored manually through some typical feature data.

3 Heart rate variability analysis

HRV signal contains much information about cardiovascular regulation. The extraction and analysis of this information can quantitatively evaluate the tension and balance of cardiac sympathetic nerve and vagus nerve activity and its influence on cardiovascular system activity. The detection of HRV has been widely used in clinical practice at home and abroad. When the sympathetic nerve activity increases, the HRV decreases, and when the parasympathetic activity increases, the HRV increases.

After HRV refers to the slight variation characteristics between heartbeat intervals, it is a method to check the heartbeat interval variation. It is a sensitive and noninvasive index that can quantitatively evaluate the cardiac autonomic nerve function [9]. HRV analysis methods generally include time-domain analysis, frequency domain analysis, linear analysis, and nonlinear analysis.

3.1 Time-domain feature analysis

The RR interval values arranged in time sequence or heartbeat sequence are directly analyzed by statistics or geometry for the collected time-series signal of RR interval.

The time-domain characteristic parameters have 18 dimensions, of which there are several typical indicators, as shown in Table 3 below.

Table 3. Time-domain characteristic parameters

Feature name	Description
MEAN_NNI	The mean of RR-intervals.
SDNN	The standard deviation of the time interval between successive normal heart beats
SDSD	The standard deviation of differences between adjacent RR-intervals.
RMSSD	The square root of the mean of the sum of the squares of differences between adjacent NN-intervals. Reflects high frequency (fast or parasympathetic) influences on HRV.

PNNI_50	The proportion derived by dividing nni_50 (The number of interval differences of successive RR-intervals greater than 50 MS) by the total number of RR-intervals.

SDNN refers to the average of all normal sinus heartbeat intervals (NN), the unit is ms, and the calculation formula is as follows:

$$SDNN(ms) = \sqrt{\frac{\sum_{i=1}^{N}(NN_i - \overline{NN})^2}{N-1}} \tag{1}$$

RMSSD refers to the root mean square of the difference between adjacent NN intervals throughout the entire process, and the unit is MS. The calculation formula is as follows:

$$RMSSD(ms) = \sqrt{\frac{\sum_{i=1}^{N-1}(\Delta NN_i)^2}{N-1}} \tag{2}$$

SDSD refers to the standard deviation of the difference between the lengths of adjacent NN intervals in the whole process, the unit is MS, and the calculation formula is as follows:

$$SDSD(ms) = \sqrt{\frac{\sum_{i=1}^{N}(\Delta NN_i - \overline{\Delta NN})^2}{N-1}} \tag{3}$$

PNN50 refers to the ratio of the number of adjacent NN intervals greater than 50 ms to the total number of NN intervals in the record of all NN intervals, expressed as a percentage. The SDNN reflects the total evaluation of the autonomic nervous system on the regulation of heart rate, while RMSSD and PNN50 reflect the Vagus nerve tension [10].

3.2 Frequency-domain feature analysis

The principle of frequency domain analysis decomposes the randomized chance of RR interval or instant heart rate signal into different frequency components of energy, which converts the heart rate curve to the frequency domain to analyze in other words. It provides the basic information of energy varying with frequency. The data in each group are processed by FTT operation to get the power spectrum [11]. From the spectrum curve, observe the sympathetic nerve's regulation and the Vagus nerve on the heart rate.

The frequency-domain characteristic parameter has seven dimensions, among which there are several stock indexes, as shown in Table 4 below:

Table 4. Frequency-domain characteristic parameters

Feature name	Description
LF	variance (= power) in HRV in the low Frequency (.04 to .15 Hz).
HF	variance (= power) in HRV in the High Frequency (.15 to .40 Hz by default).
LF/HF	lf/hf ratio is sometimes used by some investigators as a quantitative mirror of the sympathy/vagal balance.

4 Experiment Results and Conclusion

This article mainly explores the Long short-term memory (LSTM) network results on the H relaxation index multi-classification problem. Compared with SVM, LSTM has a better classification effect and higher accuracy. LSTM is a special RNN, mainly to solve gradient disappearance and gradient explosion in the training process of long sequences. Compared with ordinary RNN, LSTM can perform better in longer sequences.

4.1 Design of LSTM network

In network design, many experiments have shown that setting the number of LSTM layer units to 256 has the best effect. The optimizer Adam has a more noticeable effect than RMSprop instead of stochastic gradient descent. The activation function uses Softmax for multi-classification. The layered design of the model and the parameters of each layer are shown in Table 5 below:

Table 5. Frequency-domain characteristic parameters

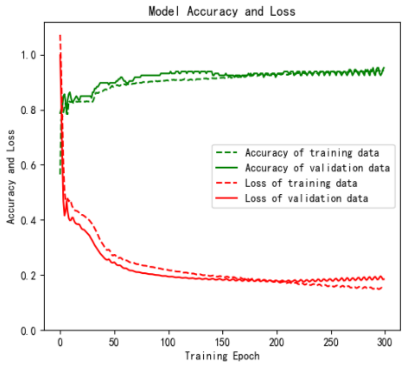
Layer (type)	Output Shape	Param
lstm_1 (LSTM)	(None, 5, 256)	264192
lstm_2 (LSTM)	(None, 256)	525312
dense_1 (Dense)	(None, 3)	771

4.2 The effect of modification of different parameters on experimental results

In this experiment, 80% of the data set is used as the training set. The running time and the accuracy of the test set are observed by modifying the iterations and batch size, as shown in Table 6 below. The model loss curve for 300 iterations is shown in Figure 4 below. Nevertheless, when the number of iterations exceeds 200, the loss of the verification set is overfitted.

Table 6. Experimental results of different parameters

epoch	batch_size	time(s)	Test accuracy	Test loss	batch_size	time(s)	Test accuracy	Test loss
50		26.9	0.9	0.27		23.2	0.86	0.34
100		43.6	0.92	0.23		42.2	0.9	0.25
150	500	61.6	0.91	0.21	1000	61.4	0.91	0.24
200		79.2	0.92	0.2		80.1	0.92	0.22
250		97.2	0.93	0.19		102.76	0.93	0.2
300		118	0.94	0.19		121.2	0.92	0.2



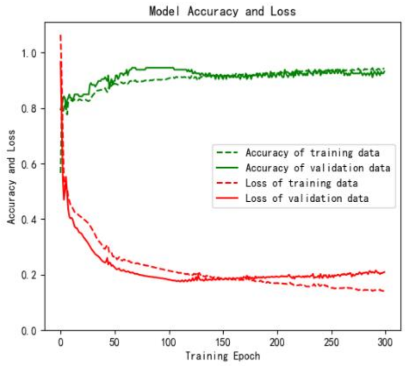


Fig. 4. (Left)The accuracy and loss rate of the LSTM model

Fig. 5. (Right)The accuracy and loss rate of the Bidirectional LSTM model

4.3 Bidirectional LSTM networks

This section adds a two-way LSTM network layer to the network design, keeps the batch size unchanged at 500, and modifies the number of iterations to get the accuracy and loss of the test set, as shown in the following Table 7. The model loss curve for 300 iterations is shown in Figure 5. Similarly, when the number of iterations exceeds 100, the loss of the validation set is overfitted.

Table 7. Bidirectional LSTM experiment results

epoch	batch_size	Running time (s)	Test accuracy	Test loss
50	500	36.6	0.9	0.25
100	500	69	0.92	0.23
150	500	102	0.91	0.21
200	500	129	0.92	0.2
250	500	163.8	0.92	0.2
300	500	201	0.92	0.2

4.4 Comparison of LSTM network and SVM network

Comparing the LSTM network with SVM, the Table 8 lists the Running time, Recall and F1-score value of the three.

Table 8. LSTM network and SVM network experiment results

	Running time (s)	Test accuracy	recall	f1-score
LSTM	79.2	0.92	0.84	0.84
Bidirectional LSTM	129	0.92	0.82	0.82
SVM	0.3	0.84	0.6	0.57

4.5 Conclusion

Experiments show that when the number of iterations is 300, and the batch size is 500, the accuracy of LSTM is 0.94, and the running time is 118s, but there will be overfitting. Therefore, when the number of iterations is 200, and the batch size is 500, the LSTM accuracy rate is 0.92, and the running time is 79.2s. Therefore, the LSTM network proposed in this paper is better than the previous SVM method to classify the body relaxation index. In general, we have the following conclusions:

(1) It is feasible to conduct data analysis on wearable watches through neural networks.

(2) Through the improvement of the LSTM network structure, the addition of a Bidirectional LSTM network did not make the accuracy rate better than the previous results and more time requirements.

(3) The application of wearable watches in hospitals and homes has practical significance.

5 Future work

This experiment realized the multi-classification problem of the H relaxation index through the LSTM network, the accuracy rate is about 90%, and it can be used in clinical or daily life. However, there are still some shortcomings, and further research is needed:

1. The sample data set is too small. The 1989 original data collected this time are far from enough, and a more extensive data set is needed to improve the model's accuracy.
2. Find other feature inputs that affect the H relaxation index and add them to the original data to make the original data more complex to improve the model's accuracy.
3. Explore the possibility of the Bidirectional LSTM network structure to improve the experimental results.

Acknowledgement

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A Novel Diagnosis Method of Depression Based on EEG and Convolutional Neural Network

Zhuozheng Wang[1], Zhuo Ma[2] Zhefeng An, and Fubiao Huang

[1] Faculty of Information Technology,Beijing University of Technology,Beijing 100124,China,
wangzhuozheng@bjut.edu.cn
[2] Advising Center for Student Development,Beijing University of Technology,Beijing 100124,China,
[3] Department of Occupational Therapy,China Rehabilitation Research Center, China

Abstract. Depression as a common mental illness, has become the second largest killer of human beings. However a significant number of patients are not even aware they have depression. Therefore, combined with deep learning method, a novel diagnosis method of depression based on Electroencephalography (EEG) signals is proposed in this paper, which adopts two-dimensional Convolutional Neural Network (2D-CNN) to build a binary classification model. Firstly, the EEG signals are converted into RGB three-channel color brain maps as the input of 2D-CNN. Secondly, 2D-CNN is applied to automatically extract EEG features and classify them. Moreover, the effectiveness and reliability of the proposed algorithm are assessed on the depression dataset. In addition, the proposed method is compared with Support Vector Machine(SVM) classifier and Long and Short Term Memory(LSTM) network. The experimental results show that the proposed 2D-CNN algorithm has the best performance, and the accuracy can reach up to 92%. This method provide a novel approach for the diagnosis of depression.

Keywords: Electroencephalography(EEG) signals, Depression, Two-Dimensional Convolutional Neural Network(2D-CNN)

1 Introduction

1.1 Background

Depression is a common mental illness with high recurrence rate, high disability rate and high suicide rate [1]. According to the statistics of the World Health Organization (WHO) [2], nearly 350 million people suffer from depression around the world, and it is estimated that more than 95 million people in China are suffering from depression. However, the public awareness of depression is far lower than that of other mental illnesses, and many people with depression don't even know they are sick. Experts say the diagnosis rate of depression is less than 20% at present, which often leads to patients being undiagnosed. If the patients with depression are not treated in time, they are likely to develop into refractory diseases, which can lead to self-harm or even suicide in severe cases. It is reported that the incidence of depression (and suicide) has begun to appear at younger ages (college students, even primary and middle school students) [3]. Therefore, the science popularization, prevention and treatment of depression need to be paid more attention. Currently, the most widely used method for diagnosing depression is based on the Baker Depression Scale [4] or patient self-reported information and the physician's clinical experience. However, the accuracy of diagnosis may be affected by many factors, such as the proficiency of the physician, the degree of cooperation of the patient and so on. So, there is an urgent need to find an objective and effective method to identify depression.

Electroencephalography (EEG) is the overall response of the electrophysiological activities of human brain nerve cells in the cerebral cortex or scalp surface [5], which comprehensively reflects the functional state of the brain and contains a large number of physiology and disease information. Therefore, EEG can be used as a potential biomarker for the diagnosis and treatment of some diseases, such as depression. In addition, EEG data has the characteristics of high temporal resolution, low cost, easy to access and use, so EEG has become the first choice in the field of brain research [6]. Reference [7] have shown that different frequency ranges and spatial distributions of EEG are related to different functional states of the brain. So it is possible to use EEG signals to diagnose and identify patients with depression. EEG signals are usually divided into 5 bands, as shown in the Table 1.

Table 1. Different Frequency Bands of EEG Signals and Corresponding Body States

Brain wave type	Frequency range	State of the human body
Delta(δ)	0.5-4 Hz	Deep sleep with no dreams
Theta(θ)	4-8 Hz	Emotional stress, especially disappointment or frustration
Alpha(α)	8-13 Hz	Relaxed, calm, eyes closed but awake
Beta(β)	13-30 Hz	Concentration, excitement, anxiety
Gamma(γ)	30-100 Hz(usually at 40Hz)	Raise awareness and meditate

1.2 Related Works

In recent years, with the development of computer technology, the processing technology of complex EEG data has achieved rapid development. A number of researchers have combined EEG signals with traditional feature extraction algorithms and machine learning [8] to distinguish between depressed patients and normal subjects. Reference [9] proposed a spectral spatial EEG feature extractor named kernel feature filter and library co-space model, which was used to extract EEG features from patients with depression and normal controls. Support Vector Machine(SVM) was used for classification, and the accuracy is about 80%. Reference [10] selected Alpha, Alpha1, Alpha2, Beta, Delta and Theta asymmetry as features, adopted multi-cluster feature selection (MCFS) for feature selection and used machine learning method to classify the features. The result showed that the combination of Alpha2 and Theta asymmetry had the highest classification accuracy of 88.33% in SVM. Reference [11] in order to solve the problem of misdiagnosis between patients with depression and schizophrenia, the features of resting state EEG signal of patients with depression and schizophrenia were extracted respectively, including: (1) information entropy, sample entropy and approximate entropy (2) statistical attributes (3) relative power spectral density of each rhythm. Then, using these features to form eigenvectors, combined with SVM and Naive Bayes classifier, the classification of schizophrenia and depression patients was studied. The results showed that classification model composed of SVM and eigenvectors of each rhythm rPSD had a good effect on the classification of patients with schizophrenia and depression. Reference [12] proposed a multimodal model, which used the feature level fusion technology to integrate the EEG data of different EEG patterns to establish a depression recognition model. The accuracy of three machine learning classifiers was compared, among which the KNN classification accuracy was the highest, reaching 86.98%. In addition to machine learning, deep learning[13] has also been used in the classification of EEG signals in recent years. In order to improve the accuracy of emotion recognition of EEG signals, reference [14] applied ConvNet to emotion recognition, The classification accuracy of valence and arousal were 81.406% and 73.36%, respectively. Reference [15] put forward an emotion recognition method based on Convolutional Neural Network (CNN) and Long and Short Term Memory(LSTM) network, and conduct emotion recognition experiments on emotion dataset of EEG signals. The average classification accuracy reached 88.15%.

1.3 Our Works

Due to poor performance and generalization ability, these traditional machine learning methods have difficulties in expressing complex functions, and it takes a lot of time to extract effective features. Compared with traditional machine learning, Convolutional Neural Network (CNN) doesn't need to carry out feature extraction before training and testing data and can still guarantee classification accuracy with simplified steps. In recent years, CNN, which is widely used in the field of image and video, has been gradually applied to the processing of EEG signals. EEG signals contain time, frequency and space information, while traditional machine learning only considers time or frequency information. This paper takes the spatial location information of EEG signals into account, so 2D-CNN which can extract spatial features is chosen as the classification model. Then compared with SVM, LSTM and 1D-CNN, the proposed 2D-CNN algorithm has the highest accuracy, reaching 92%.

The structure of the rest of the paper can be summarized as follows: In the section 2, the data used in this study, several commonly used EEG features for classification and how to extract features from 2D-CNN are briefly introduced. The section 3 proposes a depression recognition algorithm based on CNN. The network structure of 2D-CNN is briefly introduced, and a 2D-CNN model for diagnosis of depression is established. In the section 4, how to transform EEG data into a color brain map and how to partition the dataset are introduced. In addition, the proposed method is verified by the depression dataset, and compared with other methods. Finally, the section 5 provides the conclusions and prospects for the future.

2 Data Analysis

2.1 Data Source

The data source of this paper are provided by the psychiatric department in 3A-grade hospital in China. The experimental data were collected from 16 electrodes (FP1, FP2, F3, F4, F7, F8, T3, T4, C3, C4, T5, T6, P3, P4, O1, O2) at the frequency of 100 Hz. The subjects are devided into 16 patients with depression and 16 healthy people, and there is no significant difference in gender or age between the two groups. Then they are asked to sit in a quiet room at resting state with their eyes closed and awake. This process took 2 to 4 minutes. In order to meet the sample size requirements of deep learning, the signal is clipped into a segment of 100 sample points (1 second). In addition, there is 50% overlap rate between adjacent segments, as shown in Fig.1. So there are 15,053 segments of 32 subjects in total.

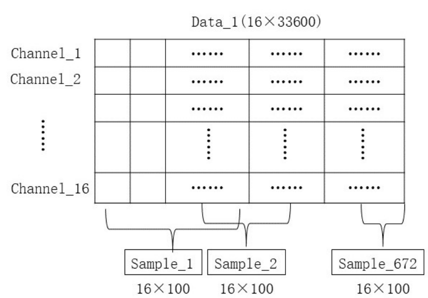


Fig. 1. 16 Channels EEG Data of One Subject.

2.2 Data Preprocessing

The EEG signals should be preprocessed before feature extraction. Firstly, the EEG signals are filtered by bandpass, and the bandpass of the filter is set to 0.5-80Hz to remove interference such as high-frequency noise, low-frequency drift and EMG. Then the notch filter is carried out to filter out the 50Hz power-line interference. Finally, the data is divided into 1 second time segments to improve the speed of feature extraction and increase the amount of data.

2.3 Feature Extraction

At present, there are many methods for feature extraction and analysis of EEG signals, including time domain analysis, frequency domain analysis and time-frequency analysis [16]. Pearson Correlation Coefficient(PCC) [17] is widely used to measure the degree of correlation between two variables. It has no requirement on the range of values between different variables, and the correlation measures the trend. The PCC between two variables is calculated as follows:

$$\rho_X, Y = \frac{cov(X,Y)}{\sigma_X \sigma_Y} = \frac{E[(X-\mu_X)(Y-\mu_Y)]}{\sigma_X \sigma_Y} \tag{1}$$

Power Spectral Density (PSD) [18], which defines how the power of a signal or time series is distributed with frequency, is a measure of the mean square value of a random variable. The PSD of the EEG signals is the Fourier Transform of its autocorrelation function y(i). The autocorrelation function is as follows:

$$y(i) = \frac{1}{N} \sum_{t=0}^{N-1-i} x(t)x(t+i) \tag{2}$$

where i=0,1,$\cdots$,N-1. So the PSD is as follows:

$$P(\omega_k) = \sum_{t=-(N-1)}^{N-1} y(t)e^{i\omega_k t} \tag{3}$$

where k=-(N-1),-(N-2),$\cdots$,0,1,$\cdots$,N-1.

When using SVM or LSTM to classify the above features, manual feature extraction is required in advance, while Convolutional Neural Network(CNN) can automatically extract features. The convolutional layer in the CNN is responsible for feature extraction. The eigenvalue can be obtained through the convolutional kernel and image convolution. In addition to the eigenvalue itself, the feature map of the convolution output also contains relative position information. The convolution process is shown in the Fig.2. Each convolution kernel can extract specific features, and different convolution kernels can extract different features. This is all done automatically by the CNN.

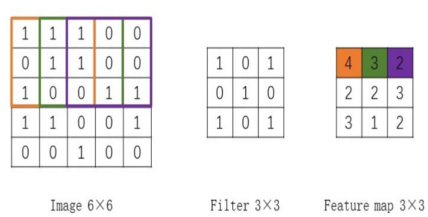


Fig. 2. The Convolution Process.

3 Model Building

3.1 Traditional Method

Support Vector Machine (SVM) [19], which is essentially a binary classifier, has been widely used in the field of feature classification. It maps the samples from the input space to the higher dimensional eigenspace by selecting the appropriate inner product function, and then solves a quadratic programming problem with linear constraints to obtain the global optimal solution. This method effectively avoids the dimensional disaster, ensures the convergence speed, and doesn't have the local minimum problem. In this paper, the polynomial kernel function is selected as the kernel function of SVM, and the parameter gamma is set to 'auto'. Long and Short Term Memory(LSTM) [20] network is a special RNN proposed by Hockritel and Schmidhuber, which can learn long-term dependence and solve the problems of gradient disappear and gradient explosion in long-sequence training. There are three gates of input, forget, and output in the memory cells that are designed to preserve the previous information, update the cell state, and control the flow information. Although SVM and LSTM can classify EEG signals, they both need to extract features from the data first.They only consider the temporal and spectral feature of EEG signals, but do not consider the spatial feature and location information.

3.2 Convolutional Neural Network

Convolutional Neural Network (CNN) was originally proposed by LeCun [21] as a typical feedforward neural network for image processing. CNN as a deep learning model, has the following advantages:(1) Features can automatically be extracted from the input data directly without constructing a set of features for classification, (2) The weights can be shared to avoid the overfitting, (3)The sparse connection of CNN can reduce the number of training parameters. The whole CNN contains three different types of layers, which are Convolution Layer, Pooling Layer and Fully Connected Layer.

- Convolution Layer consists of a number of hidden units. Each hidden unit is a matrix, which can convolve the input data. Each hidden unit convolves to produce a feature map.
- Pooling Layer is used for the subsampling of data to reduce the data dimension after the output of the convolutional layer, which can effectively reduce the amount of calculation and prevent overfitting.
- Full Connection Layer can correlate all the previously extracted features and map them to the output space.

In this study, 2D-CNN is selected, in which the Max Pooling is used for the Pooling Layer. The structure of each layer and the size and number of filters are shown in the Fig.3. Rectified Linear Unit (ReLU) [22] is selected as the activation function of the hidden layer. Compared with other activation functions such as Sigmoid and *tanh*, ReLU has the following advantages: (1) For linear functions,

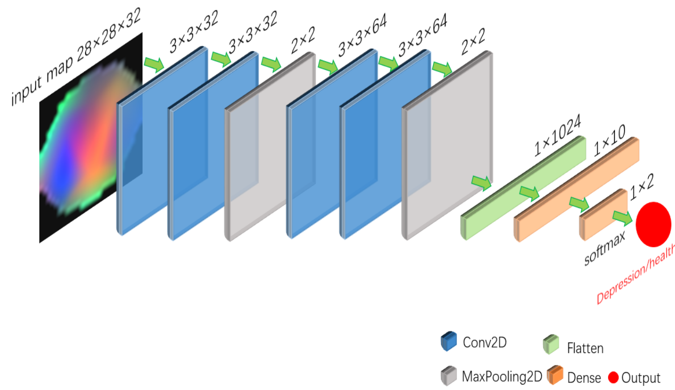


Fig. 3. The Proposed 2D-CNN Structure.

ReLU has a stronger ability of expression, (2) For the nonlinear function, the gradient of ReLU in the non-negative range is constant, so there is no problem of gradient disappear, so that the convergence rate of the model is kept in a stable state. The ReLU expression is shown as below:

$$f(x) = \begin{cases} x, x>0 \\ 0, x \leq 0 \end{cases} \tag{4}$$

Moreover, in order to solve the overfitting, this paper introduced the Dropout layer [23]. During the training of the actual network model, Dropout sets some neurons of hidden layer to 0, and then these neurons become ineffective during the forward propagation. In the Dense layer, softmax is selected as the classifier to classify the output of CNN. The softmax expression is as follows:

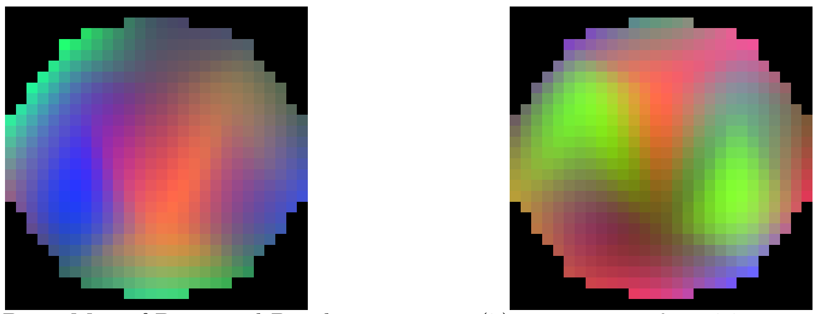
$$S(x) = \frac{1}{1 + e^{-x}} \tag{5}$$

4 Experimental Process and Results

4.1 Converting EEG Signals into Images

In previous studies, EEG classification was mainly based on extracting some features of EEG frequency domain and then classification with traditional classifiers. Because the input of 2D-CNN is image, this paper transforms EEG data into image. On the basis of frequency domain, spatial information is also considered in this study and the EEG signals are finally input to 2D-CNN in the form of images. The position of the electrode on the electrode cap reflects the spatial information of the EEG signals. In this paper, Azimuth Equidistant Projection

(AEP) [24] is used to project the position of the electrodes in three-dimensional space onto a two-dimensional plane. The width and height of the image represent the spatial distribution of cortical activity. Research [25] shows that there are significant differences between patients with depression and normal people in the θ(4-8Hz), α(8-13Hz) and β(13-30Hz) bands. Therefore, we extract the θ, α and β bands of EEG signals respectively. Repeat the process for θ, α and β bands to generate three topographic maps, which are combined to form an image with three (color) channels, as shown in the Fig.4



(a) Brain Map of Depressed People (b) Brain Map of Healthy People

Fig. 4. RGB Three-channel Color Brain Map.

4.2 Training

Firstly, all samples and labels are randomly shuffled to ensure uniform distribution of samples. Then, the first 80% is selected as the training set, the last 20% as the test set, and 10% of the training set as the validation set. After several tests, the parameters used in depression diagnosis is shown in Table.2. In addition, Adam is selectd as the optimizer, and Categorical Crossentropy is chosen as the loss function.

Table 2. Parameters Used in the Diagnosis Model of Depression

Description	Value
the number of filters in convolution layer	32/64
the convolution kernel size in convolution layer	3*3
the pooling size in maxpooling layer	2*2
dropout	0.25
batch size	100
epoch	100

4.3 Evaluation Criteria

The index to evaluate classification effect is generally accuracy, which is defined as the proportion of the correct classified samples of a given sample to the total sample. However, this indicator performed poorly when the positive and negative samples are unbalanced. Therefore, in this study, multiple evaluation indicators are used to comprehensively reflect the performance of the model, including accuracy, precision, recall and F1-score, which are calculated using the following equations:

$$Accuracy = \frac{|TP| + |TN|}{|TP| + |FP| + |TN| + |FN|} \tag{6}$$

$$Precision = \frac{|TP|}{|TP| + |FP|} \tag{7}$$

$$Recall = \frac{|TP|}{|TP| + |FN|} \tag{8}$$

$$F1 - score = 2 * \frac{Precision * Recall}{Precision + Recall} \tag{9}$$

Where TP, FP, TN and FN represent true positive, false positive, true negative and false negative respectively. True positives represent the number of people who predicted depression and actually are depressed, false positives represent the number of healthy samples predicted to be depressed, true negatives represent the number of samples predicted to be healthy and actually healthy, and false negatives represent the number of samples predicted to be healthy but actually depressed. Meanwhile, the loss function Categorical Crossentropy is used in 2D-CNN to measure the performance of the model. The equation of the loss function is as follows:

$$Loss = -\sum_{i=1}^{N} Y_i \cdot log\hat{y}_i \tag{10}$$

The accuracy and loss curves of the 2D-CNN model on training set and validation set are shown in the Fig.5

Confusion matrix is an effective visualization tool for the performance of classification methods. Each row in the confusion matrix represents the truth, while each column represents the predicted label [26]. The confusion matrix records the test classification results, and this study conducts tests on 1,300 samples, as shown in the Fig.6.

In order to evaluate the effectiveness of the proposed method, comparative experiments were conducted on the same dataset, and the results are shown in Table 3 and Table 4, including the classification results of Pearson Correlation Coefficient, and Power Spectral Density on SVM, LSTM and 1D-CNN. The experimental results show that the accuracy of the proposed 2D-CNN is significantly higher than other methods, and the loss is the lowest.

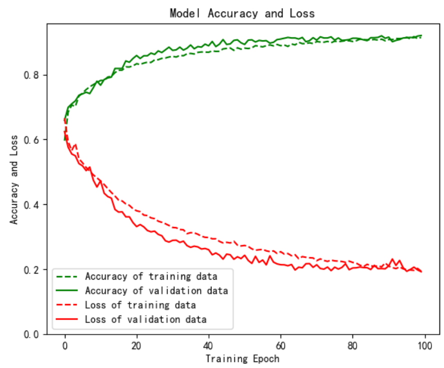


Fig. 5. Accuracy and Loss of 2D-CNN.

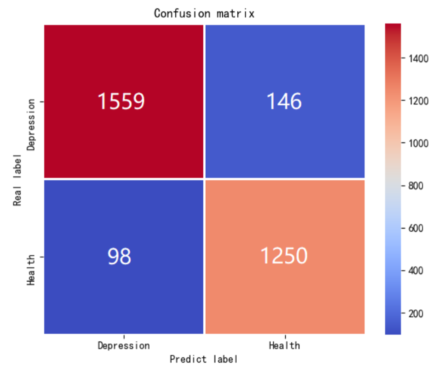


Fig. 6. Confusion Matrix of 2D-CNN.

5 Conclusion and Future Work

In order to improve the performance of depression diagnosis, a approach based on 2D-CNN is proposed in this paper. Experimental results show that the performance of this method is better than SVM, LSTM and 1D-CNN and the accuracy can reach 92% and the loss is only 0.18. Therefore, this paper provides an effective method for the diagnosis and recognition of depression. The results show that the combination of frequency domain information and spatial information can improve the classification effect. The depression diagnosis approach based on deep learning also has many difficulties to overcome. Firstly, there is no systematic deep learning tuning theory knowledge. The tuning of model parameters needs to be based on experience. Secondly, depression diagnosis requires the system to be able to identify the depression in a timely and fast manner, but the training of deep learning model is time consuming. Therefore, in the future work, we will optimize the deep neural network to improve the classification accuracy and reduce the training time. Moreover, the degree of depression can also be classified in more detail, such as normal, mild, moderate, severe, etc. that will be adpoted to the multiple classifications scenarios.

Table 3. The Evaluation Criteria of the Proposed Method and Other Methods

Method	Feature	Accurary%	Precision	Recall	F1-score	Support
SVM	PCC	0.8871	0.88	0.88	0.88	3053
	PSD	0.9057	0.91	0.91	0.91	3053
LSTM	PCC	0.8970	0.90	0.90	0.90	3053
	PSD	0.8786	0.88	0.88	0.88	3053
1D-CNN	PCC	0.87	0.87	0.87	0.87	3053
	PSD	0.88	0.88	0.88	0.88	3053
2D-CNN	Feature map	**0.92**	**0.92**	**0.92**	**0.92**	3053

Table 4. The Accuracy and Loss of LSTM, 1D-CNN and 2D-CNN

Neural Network	Accuracy	Loss
LSTM	0.8970	0.259
1D-CNN	0.88	0.31
2D-CNN	**0.92**	**0.18**

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Implementation of Traffic Sign Recognition System on Raspberry Pi

Chuan-Feng Chiu, Zheng-Qing Liu, Xian-Yi Wu, Hong-Jun Yan, Qi-Xuan Xu and Yun-Kai Lin

Department of Information Management
Minghsin University of Science and Technology, Taiwan
cfchiu@must.edu.tw

Abstract. In this paper we intent to design and develop an intelligent traffic sign recognition system on Raspberry Pi. In the real situation, we could find the fact that drivers are often drive the car tiredly and cause dangerous situation. In order to avoid the dangerous accidents, automatic drive applications are appeared to assist drivers. However, the automatic driving car does not recognize the traffic sign correctly in real-time and depend on non-real time traffic sign information so that the dangerous accidents are appeared. So, in this paper we will implement a system that have recognition mechanism based on deep learning to distinguish the traffic signs. With the developing application, we would not depend on the map updating frequently to know the traffic sign situation. This mechanism also helps drivers to have secure driving behavior. On the other hand, we also design a prototype of automatic car based on Raspberry pi development board to evaluate our proposed method.

Keywords: Self-drive car, traffic sign detection, traffic sign recognize, deep learning.

1 Introduction

Because of the rapid development of hardware and computation speed, the action or the behavior of the daily life which need more human power had changed. For example, in order to reduce the cost of human power in the traditional manufacturing industries, the automatic manufacturing machine would be used to lower manufacturing cost. On the other hand, such kind of changing could reduce the error by human beings also. In recent year, AI is gained more attention. In the application of AI, autonomous driving is one of popular application. Autonomous driving is an enhancing driving behavior, the autonomous car could drive on the road without human control. Autonomous car uses a lot of sensors including GPS, camera LiDAR etc. to detect environment situation to have safety driving experiences. The idea of autonomous car is inspired from 1920. Until 1980, the prototyping of autonomous car is appeared. CMU propose the Navlab[1] and ALV[2] project in 1984 and proposed the first prototyping of autonomous car NavLab1 which had 20 mile/hour maximum speed. In 2014, Telsa proposed the Model S electric car with semi-automatic driving functionality. Many car manufactures also start to develop the autonomous car including Ford, Waymo, Intel, Volkswagen etc..

Although many companies start to develop autonomous car and have demonstration, the current status focus on the safety and correctly driving alone the road lane. However, the actual situation on the road is very different so that current development of autonomous still have a lot of challenges. Therefore, in our opinion an autonomous driving assistance is more practical for drivers. So, in this paper we focus on the traffic sign recognition application. Now most traffic sign symbol is embedded in the map and the map should be updated frequently. The real-time traffic sign would be reflected on time. Therefore, we intent to implement a real-time traffic recognition system that could monitoring the real-time traffic sign on the road and reducing the wrong appearance of traffic sign on the map. In our implementation we would design a car prototype to validate the traffic sign recognition system also.

The paper is organized as following. In section 2, we would have brief review of related works. In section 3 we would reveal the detail of our implementation. Finally, we have conclusion in section 4.

2 Related Works

Autonomous car could use different sensors and technology to detect the situation of the road that including GPS, camera, inertial sensors, LiDAR, distance measurement etc.. Using these technology or combined technology, autonomous car could reduce the traffic accidents and have better driving performance including path planning etc.. On the other hand, vehicles could communicate with each other by Vehicle-to-Vehicle net to have additional information for driving. These technologies could improve the development of the autonomous car. In the following we focus on the computer vision or image processing technology which is related with our implementation directly. Road lane detection is the first noticed issue. By the computer vision technology, autonomous car could detect the edge and situation of the road and could drive on the road safety and steady to avoid the tiredly driving causing dangerous situation[3,4]. But the real situation of the road is un-predicable, such kind of autonomous driving does not use in real environment and still in experimental situation. In the rapid development of deep learning technology on computer vision, many researchers start to use the deep learning technology to detect the road lane[5,6,7,8]. In these approach, CNN[8] is the most popular model. In CNN model, sliding window is applied to scan the whole image and feed the scanned result to convolution layer, pooling layer and fully connected layer to have correct object detection result. However, CNN have high computation cost and would not process in real-time easily so that it could not apply to autonomous car development directly. In order to resolve the computation cost problem, R-CNN[9] is proposed to reduce the computation cost to have better performance by selecting the most important area in the image to avoid scanning whole image comparing with traditional CNN model. Fast R-CNN[10] is proposed to have more improvement on performance comparing with R-CNN and CNN model by pass scanning the overlapping area in the image. Fast R-CNN use nearest neighbor interpolation method to compute the object position in the image. However, this method could have position offset to get error object position which result in lower accuracy. So Mask R-CNN[11] is proposed to resolve the problem of Fast R-CNN in advance by using bilinear interpolation method. Fast R-CNN and Mask R-CNN are the two-stage object detection model. In order to have improved performance in advance, the one-stage model is proposed and YOLO[12, 13, 14, 15] is the famous technology. YOLO could reduce the computation cost by reduce the count of image scanning. So, the better performance is achieved comparing with the above approach. [16][17] use the YOLO to detect the objects on the road like human and cars etc.. In our implementation, we would use the YOLO as the traffic sign detection mechanism to have better performance on the Raspberry Pi platform.

3 The Proposed System

In this section we describe the detail of the implementation of traffic sign recognition system which is implementing on Raspberry Pi platform. The overall design has two major parts including prototype of hardware and the corresponding software module. We describe the design of the proposed prototype of hardware in the following first. We use the Raspberry Pi 4 as the implementation platform. The implementing hardware include L298N motor driver, cameras and ultrasonic sensor. The Raspberry Pi 4 is the main computation and control kernel to coordinate the sensors and component action. On the other hand, the traffic sign detection and recognition are also processing by Raspberry Pi 4. The motor driver would control the actions of go forward, backward, stop and turn left or right. The camera would capture the traffic sign to deliver to the Raspberry Pi computation kernel to perform traffic sign detection and recognition. The above components are integrating as a testing prototyping car showed in Fig. 1. Fig. 2 shows the layout design of the proposed implementation.

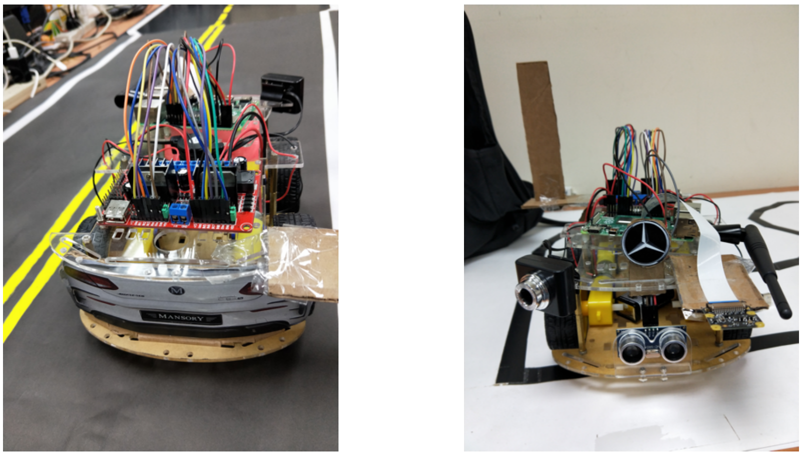

Fig. 1. The Back-End and Front-End of the Implementation Prototyping

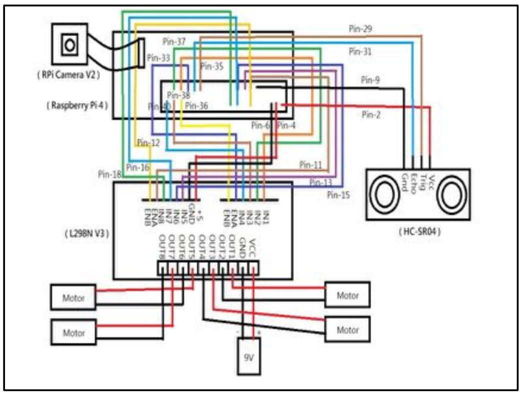

Fig. 2. The Implementing Hardware Layout of Traffic Sign enabled Car

In order to achieve the implementation of the traffic sign detection and recognition on Raspberry Pi, we proposed the design of the software architecture first. Fig. 3 shows the proposed design. We implement the software architecture based on the Raspbian operating system which is based on linux kernel. In order to control and monitor the behavior of camera, motor driver and ultrasonic sensors, we design a common sensor abstract processing layer to unify the message passing between the proposed application and sensors. In the Sensor Abstract Processing Layer, we would encode each different sensor with different channel. Based on such kind of design, we could unify the processing for developing Control and Monitoring modules. In the future, we could use the unify design to integrate with more different equipments related with cars. In our implementation, Control and Monitoring would capture the images from camera sensor and feed to Traffic Sign Detection and Recognition module. On the other hand, the Control and Monitoring would communicate with motor drivers to trigger the motion of the car and ultrasonic to detect obstacle.

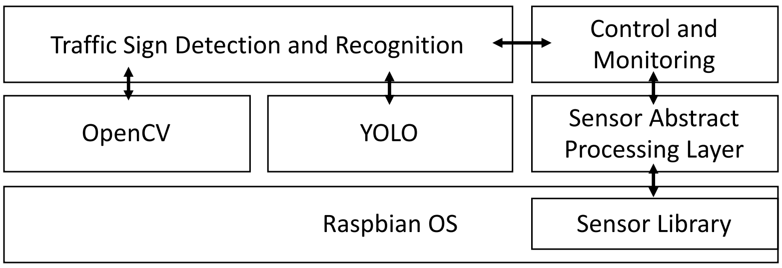

Fig. 3. The Implementation Software Architecture

The Traffic Sign Detection and Recognition module is implemented based on OpenCV and YOLO libraries. We use YOLO which is an object detection with high performance to detect and extract traffic sign from the images captured by camera. After extracting the traffic sign in a bounding box, we use Haar Feature-based Cascade Classifier[18, 19] to recognize the traffic sign. Fig. 4 shows our traffic sign detection and recognition implementation. In order to make the detection and recognition correctly, we collect positive and negative samples to training the traffic sign detection and recognition. In order to have higher accuracy, we also extended the sample by different capturing image angles and different environment situation like light factors. Fig. 5 shows the part of our training positive and negative samples.

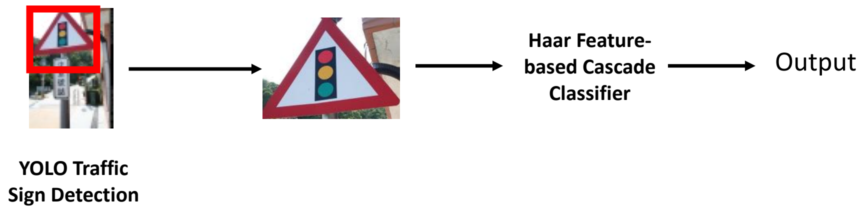

Fig. 4. The Implementation Flowchart of Traffic Sign Detection and Recognition

Fig. 5. The Part of Training Positive and Negative Samples

In the following some experimental results are showed. Fig. 6(a) and Fig. 6(b) shows the experimental recognition result of different traffic sign. The implementation car could recognize correctly. Fig. 6(c) shows the detection of the traffic light with red light and the implementation car could stop in front of the motorcycle waiting zone and stop line. Fig. 6(d) shows the experimental result of the weak light situation and the implementation could recognize successfully.

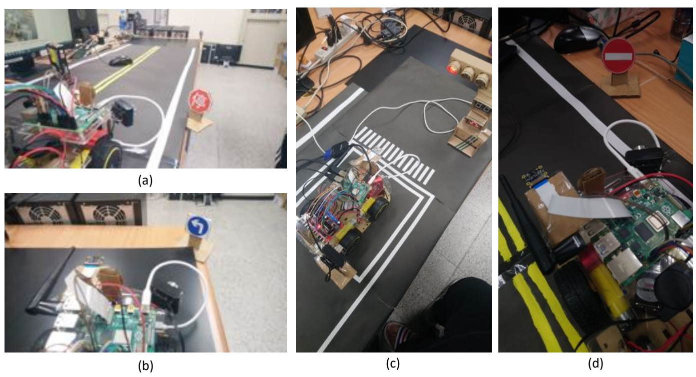

Fig. 6. Implementation Experimental Result

4 Conclusion

In this paper we implement a real-time traffic sign detection and recognition system on the Raspberry Pi platform. The implementation could avoid the error or non-state-of-art appearance of traffic sign on the map. We use Raspberry Pi as the platform and embed sensors to develop a prototype of car which has the traffic sign recognition assistance functional. For the implementation, we use data argument technology to have more training dataset to have better recognition performance. For the final result of the implementation, we validate the proposed implementation also and the implemented prototype of car could recognize the traffic sign correctly. In the future, we would apply the super resolution technology to traffic sign detection which achieve more long traffic sign detection distance and we would put the functionality to HUD system to act as a real driving assistant system.

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An enhanced adaptive neighbourhood adjustment strategy on MOEA/D for EEG signal decomposition-based big data optimization

Meng Xu[1], Yuanfang Chen[2],Dan Wang[1,✉], and Jiaming Chen[1]

[1] Faculty of Information Technology, Beijing University of Technology,Beijing,China
xumeng@emails.bjut.edu.cn,wangdan@bjut.edu.cn&billchen@emails.bjut.edu.cn,
[2] Beijing Institute of Mechanical Equipment, Beijing, China.
chenyuanfang2015@163.com

Abstract. Multi-objective evolutionary algorithms (MOEAs) have shown good performance in many complex mathematics benchmarks and real applications problems. However, MOEAs still have some challenges in the big data optimization problem with thousands of variables. In previous studies, an adaptive neighbourhood adjustment strategy on MOEA/D had a good optimization performance in CEC2009 competition test instances, in which variables had high dimensions. In this paper, an enhanced adaptive neighbourhood adjustment strategy on MOEA/D, called MOEA/D-EANA, has been proposed for 2015 EEG signal decomposition-based big data optimization. It combines fitness-rate-rank based multi-armed bandit operators(FRRMAB) selection strategies with the advantages of adaptive neighbourhood adjustment strategies. These operators enhance the diversity of solutions in our previous algorithm. A set of big data optimization problems, including six single objective problems and six multi-objective problems, are tested in the experiments. Computational results show that our proposed algorithm achieves promising performance on all test problems.

Keywords: Multi-objective evolutionary algorithms, big data optimization, adaptive neighbourhood adjustment

1 Introduction

Big data optimization problems are a large challenge in the real world, particularly in the massive and complex data set [1, 2]. This problem consists of hundreds of thousands of decision variables, various mathematical properties of the objective functions and require considerable computational time. Big data optimization problems are a hot topic for multiple domains such as health care, financial, logistics, and many others.

The characteristics of big data bring challenges to some computational problems. Abbas et al. have recently published one of the big data optimization problems in artifacts removal from electroencephalographic (EEG), introduced in Big Data Com-petition 2015[3, 4]. The natural EEG signal is desired to be decomposed into two different parts using algorithms. The first part of the source signal and the latter part corresponds to the artifacts or noise. So researchers proposed many multi-objective optimization approaches to model this decomposition and presented two metrics to quantify the amount of EEG information lost during the cleaning process [5–8].

The Multi-objective based on decomposition (MOEA/D) transforms a MOP into a set of single-objective optimization subproblems and optimizes them simultaneously. Using each subproblem neighbourhood to the subproblem to optimize itself makes it possible to solve MOPs faster than other multi-objective algorithms [9]. An adaptive neighbourhood adjustment strategy of MOEA/D (MOEA/D-ANA) is proposed [10]. It can be considered a local search approach, which had better performance on convergence while not considerate enough about the diversity of solutions. Our proposed algorithm combined composite operators selection with adaptive neighbourhood adjustment strategy and balanced the performance on convergence and diversity. This algorithm we called MOEA/D-EANA. It will help to improve the performance of big data optimization problems.

This paper is organized as follows. In sect.2, the related work of our previous work is shown. In sect.3, the MOEA/D-EANA is described in detail in Sect. 3. In sect.4, the problem of big-data optimization is introduced. In sect.5, the results on six datasets are reported. In sect.6 summarizes the work in this paper.

2 Related Work

MOEA/D is a classical algorithm adapted to solve application problems such as medical care, logic, task scheduling, etc. This algorithm uses the neighbourhood of each subproblem, helps each subproblem faster find the solutions of MOP. In the previous work, the neighbourhood size had proved to affect the performance of MOEA/D, and its variants [9, 10]. The large neighbourhood size helps improve the performance of exploration. On the contrary, the small neighbourhood size im-proves the exploitation[11]. In original MOEA/D, each weight vector corresponds to each subproblem(individual). Individual density could be obtained through the European distance of weight vector. For a subproblem, the neighbourhood size is fixed. In the evolution process, the number of neighbours around each individual will not be fixed. When a subproblem obtained good solutions, it means the more individual evolve in their directions, the density of this individual is dense, and vice versa. This fixed neighbourhood size did not fit the evolution process. So we proposed the adaptive neighbourhood adjustment strategy. So the adaptive neighbourhood size could help enhance the performance of MOEA/D, the details of this algorithm could be found in [10].

This strategy is introduced in Algorithm 1, where id is the diversity of individual, and T is neighbourhood size. If $id = 1$, this means that a subproblem corresponds to an individual, the neighbourhood size is not changed.If id is small, we think that the density of individual is sparse, so these individual needs enlarge the neighbourhood size. If id is too large, the density of individuals is dense, so it reduces the neighbourhood size.

Algorithm 1 The strategy of adaptive neighbourhood size adjustment

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Input:
the current point of each subproblem x^i,i=1,2,...N;
the weight vectors λ;
initialize $id^i = 0, i = 1, 2, ..., N$;
Output:
the neighbourhood size T;

Compute the max value of objectives by the $z^{nad} = \max\limits_{1 \le j \le m, 1 \le i \le N} \{f_j(x^i)\}$;
Compute the min value of objectives by the $z^{min} = \min\limits_{1 \le j \le m, 1 \le i \le N} \{f_j(x^i)\}$;
for each $i \in [1, N]$ **do**
  for each $j \in [1, N]$ **do**
    Compute the vertical distance from the solution and weight vector by equation (1). Before obtaining the value of vertical distance, the objectives need normalization.;

$$D(x, \lambda_i) = \left\| \overline{f}(x) - \frac{\lambda^T f(x) \lambda}{\lambda^T \lambda} \lambda \right\|, where \overline{f}(x) = \frac{f(x) - z^{\min}}{z^{\min} - z^{nad}}; \tag{1}$$

  end for
  Get the number of individuals in a subproblem around:
  $k = min \quad D(x, \lambda_i)$,
  $id^k + +$
  if $id^i < 1$ **then**
    select a large neighbourhood size, $T^i = T^i + N^*$;
  else $\{id^i > 1\}$
    select a small neighbourhood size, $T^i = T^i - N^*$;
  else
    $T^i = T^i$
  end if
end for
return T;

---

3 The Description of MOEA/D-EANA

The advantage of the adaptive neighbourhood adjustment strategy is that it is a problem specific by changing the neighbourhood size for each subproblem's performance at different times. However, in big data optimization, too many variables can lead to aggregation of solutions, so the composite selection operators is used to improve the diversity of the previous algorithm.

The composite operator selection strategy could lead to more diverse solutions compared to the single genetic strategy. MOEA/D-EANA selected three candidate operators : DE/rand/1, DE/rand/2 [13, 14, 20] and CMX (Center of Mass Crossover) [15]. DE/rand/1 is the most traditional operator, DE/rand/2, increasing population diversity. CMX operator can search the places where the DE difference operator cannot explore and increase population diversity. In the evolutionary process, each subproblem is selected based on the probability of successful selection in the previous times to choose the operator operation to be used this time. This strategy selected different operators for different subproblems is beneficial to the evolution of the whole population. The details of the three operators expression in Table 1 .

Table 1. Computational results achieved by MOEA/D-EANA, MOEA/D-ANA, and the baseline algorithm for single objective optimization problems.

Operator	**Formula Expression**
DE/rand/1	$v_{i,g} = x_{r_1,g} + F \times (x_{r_2,g} - x_{r_3,g})$
DE/rand/2	$v_{i,g} = x_{r_1,g} + F \times (x_{r_2,g} - x_{r_3,g}) + F \times (x_{r_4,g} - x_{r_5,g})$
CMX	$o = \frac{1}{3}\sum_{i=1}^{3} x_{i,g}$, $v_{i,g} = 2o - x_{r_1,g}$

where $F = 0.5$, $X_{r_1,g}$, $X_{r_2,g}$, $X_{r_3,g}$, $X_{r_4,g}$, and $X_{r_5,g}$ are different solutions randomly selected from neighbourhood, $V_{i,g}$ is the solution of offspring.

In this paper, the fitness-rate-rank based multi-armed bandit operators selection strategy (FRRMAB) is used to select a good operator in each iterations. [12]. In the FRRAMB, the fitness improvement rate saved in a sliding window similar to the queue implementation. It designs a matrix where the first row is used to store the operator numbers used in the previous generations, such as $op_1, op_2 and op_3$, and the second row is used to record the fitness improvement rate (FIR) of the offspring generated by each operator,and the FIR can be used with the following mathematics:

$$FIR = \frac{pf_i - cf_i}{pf_i} \tag{2}$$

where pf_i is thefitness of the parent and cf_i is the fitness of the offspring. The number of each operator and FIR entered into the matrix in pairs.

In the initialization of the algorithm, this matrix is set to be empty. In the evolution process, the number operators and fitness improvement rate (FIR) are entered in this matrix, as shown in the Figure 1. When the matrix is filled, the first column of data will be lost, and the data of the whole matrix will move forward one unit, and the last column will be added with new data.The reason for discarding the first column is that it has the least impact on the operator number in the recent generation. Then the operator number corresponding to FIR is

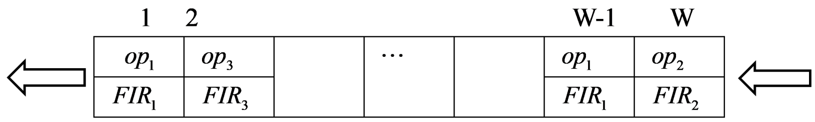


Fig. 1. The matrix of operators and FIR

counted and evaluated by the fitness reputation ratio(FRR), the mathematical expression of FRR is as follows:

$$reward_i = \sum_{i=1}^{W} FIR_i \quad i = 1, 2, 3 \tag{3}$$

$$FRR_i = reward_i / \sum\nolimits_{j=1}^{n} reward_j \tag{4}$$

Therefore, the operation selection to be selected next time can be expressed by the following formula:

$$op_i = \underset{i=\{1,2,3\}}{\arg\max} \left[FRR_i + C \times \sqrt{\frac{2 \times \ln \sum_{j=1}^{3} n_j}{n_i}} \right] \tag{5}$$

where the C is the expansion factor. The basic scheme of MOEA/D-EANA is descripted as Algorithm 2

Algorithm 2 The scheme of MOEA/D-EANA

Initialize:
the weight vector λ^i;
the solution x^i;
the ideal point $z_j{}^*, z_i = \min\left\{f_i(x^1), \ldots, f_i(x^N)\right\}$;
initialize neighborhood size: $T = (T^1, T^2, \cdots, T^n)$;
Evolution:
1: **for** each $i \in [1, N]$ **do**
2: To produce new offspring y from one of three operators by the equation 5
3: Update the reference point z_i
4: Evaluation the fitness and update FIR_i in the sliding windows.
5: Using Algorithm 1 to select neighbourhood size from the neighbourhood mating pool for each subproblems i .
6: **end for**
7: Stopping criterion: if the stopping criteria is satis-fied, the stop and output the Pareto set and Pareto fitness, otherwise, go to step 1
8: **return** PF and PS;

---

4 Big Optimization Problems

The background of CEC 2015 Competition is about the processing of electroencephalographic (EEG) signals[16, 17]. There are three different datasets (D4, D12, and D19) in the competition, which are based on different time series. The length of each time series is 256. If the dataset has 2 time series, the corresponding problem will have 512 variables to be optimized. The number of time series used in the competition are 4, 12, and 19, and the corresponding optimization problems have 1024, 3072, and 4864 variables, respectively. For the three datasets, a noise component is added to obtain three new datasets called D4N, D12N, and D19N, respectively. Thus, there are six single objective optimization problems and six MOPs. In this paper, we try to use the proposed MOEA/D-EANA to solve these problems.

The ICA [18, 19] model of this problem can be shown below. It assumed that the X is a large matrix, its dimension is $N * M$, N presents the number of time series, and M is the length of each time series. In this competition, each time series M is of length 256, and the number of times series N are 4,12 and 19. S has the same dimension with N. A is a small dimension $N * N$ as a transformation matrix.

$$X = A \times S \tag{6}$$

This problem aims to decompose S into two matrixes with the same dimension: S_1 and S_2,which have the same dimensionality.Then we can get $S = S_1 + S_2$ and $X = A \times S_1 + A \times S_2$, It assumes that C is the Person correlation coefficient between X and

$$C_{i,j} = \frac{\mathrm{covar}(X, A \times S_1)}{\sigma(X) \times \sigma(A \times S_1)} \tag{7}$$

where $cov(.)$ is the corviance matrix, and σ is the standard deviation. so this model abstracted as bi-objective function.

$$\min\ f_1 = \frac{1}{N^2 - N} \sum_{i,j \neq i} C_{i,j}^2 + \frac{1}{N} \sum_{i} (1 - C_{i,i})^2 \tag{8}$$

$$\min\ f_2 = \frac{1}{M \times N} \sum_{i,j} (S_{i,j} - S_{1i,j}) \tag{9}$$

The first objective function is to generate C to maximize the diagonal elements of C, while minimizing non-diagonal elements to zeros. The second objective function is used to minimize the distance of S and S_1. Each element of S_1 varies from -8 to 8. In addition, the number of variables is 1024, 3072 and 4864.

5 Experiment and Results

In this section, we experimented with verifying our proposed algorithm. These experiments are executed on a PC desktop with a 2.3GHz CPU and I5 processor. No server platform has been performed.

5.1 The parameters of big data optimization problems

For big data optimization problems, the datasets had six different EEG records with several records contain noise, the white noise level of 0.1, which namely D4, D4N, D12, D12N, D19, D19N. We compared MOEA/D-EANA with MOEA/D-ANA and NSGA-II(baseline). The parameter setting as follows:
• The population size N is 50;
• Each algorithm will run 10 times independently;
• Stopping condition: all algorithms function evaluation is 100000;
• The ideal points are $\mathrm{z}^* = [1.01, 22.34]$;
• F and CR are 0.5;
• $T = 0.1 \times N$ and $N^* = 0.02 \times N$;
• The window sliding $W = 20$.

5.2 The performance metrics

The score function is the metric of big optimization problems, five solutions be sampled uniformly from the obtained Pareto set, including the two extreme solutions. The score function calculated based on the 2015 Big Data Optimization Competition, the score metric value is larger, the better performance of the S_1 close to S, the score of can be expressed by the following formula:

$$score = \begin{cases} bfv_{bl} - bfv & if\ bfv < bfv_{bl} \\ -1000(bfv_{bl} - bfv) & otherwise \end{cases} \tag{10}$$

where bfv and bfv_{bl} are the best fitness value obtained by MOEA/D-EANA with the baseline algorithm.

5.3 The results of single objective and multi-objective objective

Table 2 lists the computational results achieved by MOEA/D-EANA, MOEA/D-ANA, and the baseline algorithm (NSGA-II) for single optimization problems, and mean value is the average best function value. The proposed MOEA/D-EANA achieves much better performance from the results than MOEA/D-ANA and NSGA-II on all test sets. MOEA/D-ANA performs better than NSGA-II.

For multi-objective optimization, five points are selected from the obtained Pareto front, the proposed algorithm compared to the baseline algorithm (NSGA-II), if the solution achieved by our method has better performance than the baseline algorithm, the score is the mean distance.If the compared solution dominates our solution, a large negative constant value (-1000) is multiplied by the distance. The score value is equal to the value of distance. Therefore, a higher score means that the algorithm is better than the baseline algorithm.

The scores of MOEA/D-EANA and MOEA/D-ANA based on the baseline algorithm(NSGA-II) is shown in Table 3, the MOEA/D-EANA achieve better performance than MOEA/D-ANA and NSGA-II. The $''N''$ which containing noise is lower than not containing noise EEG signal, it means that as the noise

Table 2. Computational results achieved by MOEA/D-EANA, MOEA/D-ANA, and the baseline algorithm for single objective optimization problems.

Problem	MOEA/D-EANA mean	MOEA/D-ANA mean	Baseline(NSGA-II) mean
D4	**6.16E-02**	9.88E-01	1.87
D4N	**5.92E-02**	8.71E-01	1.74
D12	**1.93E-03**	8.46E-02	2.93
D12N	**1.82E-03**	7.23E-02	2.82
D19	**2.54E-03**	1.45E-03	3.19
D19N	**2.62E-03**	1.24E-03	3.17

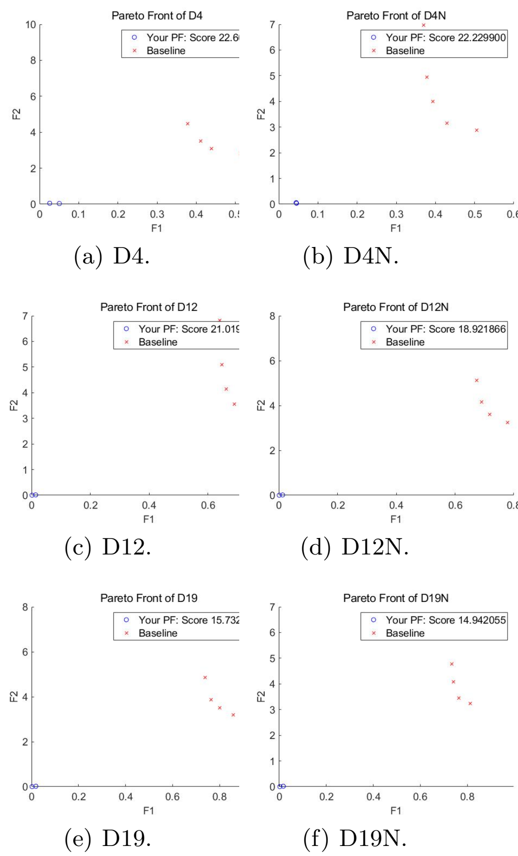
can affect the algorithm's performance, the score gets lower. As the number of variables increases, the lower the score, which means that the algorithm becomes increasingly difficult to solve the problem[21]. Figure 2 compares five solutions selected from the Pareto set of MOEA/D-EANA and the baseline algorithm. It can be seen that MOEA/D-EANA achieves a better score value than the baseline.

Table 3. Scores obtained by MOEA/D-EANA and MOEA/D-ANA for multi-objective optimization problems..

Problem	MOEA/D-EANA	MOEA/D-ANA
D4	**2.26E+01**	2.25E+01
D4N	**2.22E+01**	2.18E+01
D12	**2.10E+01**	2.07E+01
D12N	**1.89E+01**	1.75E+01
D19	**1.57E+01**	1.50E+01
D19N	**1.49E+01**	1.20E+01

6 Conclusion

In this paper, the MOEA/D-EANA of the framework was proposed for optimizing the big data 2015 benchmark problems with both single and multi-objective problems, which ensembles the adaptive neighbourhood size adjustment and composite operator selection. In the experiments, six EEG datasets from the big data optimization problems are used to validate the performance of MOEA/D-EANA. The experimental results show that MOEA/D-EANA had better performance than the baseline algorithm and MOEA/D-ANA. For future work, the technology of dimension reduction are used in MOEA/D-EANA. It will could reduce the number of variables and computational time in big data optimization problem.



(a) D4. (b) D4N.

(c) D12. (d) D12N.

(e) D19. (f) D19N.

Fig. 2. The comparison score of five point from the Pareto set of MOEA/D-EANA and the baseline algorithm (NSGA-II).

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An Analysis of the Research Situation of China’s National Security—Based on the Perspective of Social Network Analysis*

WU ZhengJi[1*[0000-0001-9803-6412]] **Yang LiangBin**[2[0000-0001-7214-9750]]

1*.(1999-) Male, Undergraduate Research direction is computer technology, **corresponding author.**

*E-mail:wuzhengji25@126.com

2.(1976-) Male, PhD, professor. The research direction is social network analysis and information visualization.

Abstract: [Objective / Meaning] As a new discipline, national security has developed rapidly in China in recent years. It is more intuitive and clearer to use social networks to conduct research situation analysis. [Methods]The main methods of this study include: keyword analysis, bi-cluster thematic analysis, citation curve analysis, author role research, research institution role research. [Procedures]This article is based on the keywords of “National Security | National Security Concept” in the CNKI database from 1997 to 2016, using SCI, CSSCI, Peking University core journals and other databases as the journal source, using the network analysis software Ucinet, Gephi professional functions and the drawing software Origin8 conducts research and analysis on keywords, authors, research institutions, and the number of citation documents, draws network maps, citation curves, and explores the development trend of China's national security studies. [Results / Conclusions] Although China's national security studies are an emerging discipline, preliminary construction has been completed. From the traditional level of national security studies to "network security", "data security", and "ideology" Security "and other soft power security transitions. It is precisely because of the numerous branches and rapid updates of the discipline of international security that the relationships between scholars involved in research are not as close as in other disciplines. However, the number of institutions participating in the research is very large. Among them, Peking University, the Chinese Academy of Sciences, and the Institute of International Relations are the main institutions.

Key words: Social Network, National Security, Citation curve, Visualization, Origin8, Ucinet

CLC Number:

0 Introduction

National security is the basic interest of a country. It is an objective state in which a country is free from danger, that is, an objective state in which the country has no external threats or violations and no internal chaos or illness. Contemporary national security includes basic content in 12 areas: political security, homeland security, military security, economic security, cultural security, social security, technological security, cyber security, ecological security, resource security, nuclear security, overseas interest security [1].

In recent years, China’s national security situation has become increasingly complex. Whether in the virtual world or in the real world, there are uncertainties and challenges everywhere from the

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personal safety of the people to the national sovereignty. Therefore, it becomes more and more important to scientifically understand national security issues and study national security as a theory which has practical significance. On April 9, 2018, the Ministry of Education issued the "Implementation Opinions on Strengthening the National Safety Education in Large, Middle and Primary Schools", requiring that national safety education be generally carried out from elementary schools, middle schools to universities, and at the same time set up national security first-level disciplines in universities to conduct national safe education[2].Meanwhile social network analysis theory has made great progress in community structure investigation, statistical significance test, visualization, and exploration of cultural background in social networks[3].

Based on the importance of China’s national security science and its adaptability to social network analysis, this article attempts to analyze the development of China’s national security science from a macro perspective and analyze its situation with the help of social network analysis theory in order to provide useful reference for the development of China's national security science.

1 Current situation

1) National Security

China first proposed the concept of "national security" in the government work report of the First Conference of the Sixth People's Congress in June 1983 and treated it as an emerging discipline in 1990s. However, due to the hard work of scholars, our country's national security science has developed rapidly, and it has completed changed from "traditional binary" to "non-traditional endless", from Marxism's "One-Dominant" to "Multiple", from "Ideological Conflict" to "Multiple Drivers Inside and Outside", and from "flat" to "three-dimensional"[4]。In 2002, our country proposed a new security concept with a systematic core of "mutual trust, mutual benefit, equality, and collaboration"，and the main changes compared with the tradition are: 1) Considering both internal and external aspects, emphasizing that the country’s core values, political order, and survival methods are not infringed. 2) Emphasizing the diversity of security levels which global security, regional security and people's security are all considered. 3) Emphasizing the expansion of the security field. Economic security, information security, environmental security and social security are included in the security category [5][6][7]。

The "Excerpts from Xi Jinping's Discussion on Overall Security Concept" not only made a profound analysis of China's national security science, but also made a very clear interpretation of the focus of future research. The overall national security of our country is a huge complex, and the insecurity factors it faces are comprehensive, including many factors at home and abroad. Our country's overall security should have Chinese characteristics, with cultural security as a breakthrough, build an overall security system with top-level design [8][9]。

1.2 Social network analysis

With the advent of the information age, social network analysis technology has received much attention from academic circles at home and abroad. At present, the hot spots in the international academic community can be roughly divided into three parts [10]： 1) Research on the structural characteristics of social networks 2) Research on group interaction in social networks 3) Research on information dissemination in social networks.

China also attaches great importance to the research of social networks. In terms of structural analysis, in 2008, Cheng Xueqi and other researchers from the Institute of Computing Technology of the Chinese Academy of Sciences analyzed the characteristics of the community structure and improved the discovery method of network hierarchical overlapping communities [11] . In terms of group characteristics, Yang Shanlin and others from Hefei University of Technology divided decision-making behaviors into three categories based on the herd and proposed a cellular automaton-based evolutionary model for group decision-making herd behaviors in 2009[12]. In terms of information dissemination, in 2000 years, Xing Xiusan from Beijing Institute of Technology proposed the theory of non-equilibrium statistical information with the information (entropy) evolution equation that expresses the law of information evolution as the core, deduced the nonlinear evolution equation of Shannon information (entropy), introduced Statistical physical information and derived its nonlinear evolution equation [13]. At the same time, in 2014, Fang Binxing and others published the book "Analysis of Online Social Networks", combining the above three aspects to systematically elaborate the basic theory, key methods and technologies in the analysis of online social networks[14].

2 Data sources and research methods

2.1 Data sources

The literature comes from articles in the CNKI database. The search method used in this study was based on the keyword "national security" or "national security" and selected the 250 most cited papers in Chinese literature, and after screening, a total of 247 documents were used as experimental materials. These documents include keywords, author names and institutions, citation author names and institutions, and the number of citations for each document from the date of publication to 2019 and other attributes for visual analysis.

2.2 Research methods

Social networks, that is, the structure of social relations, can reflect the social relations between actors. In recent years, they have been widely used to study citation relations. In this paper, we used the related social networks analysis indicators such as centrality, cohesion subgroups, and related concepts of citation curves. Meanwhile, we used gCluto to perform bi-clustering and visualization of high-frequency keywords, and professional function drawing software Origin8 to fit the number of cited documents. Citation curve analysis, statistical product and service solution software SPSS performs corresponding analysis on highly cited literature topics and citation curve types, and network analysis tool Ucinet and visualization tool NetDraw was used to analyze the acquired literature。

gCluto is the graphical clustering toolkit, which is the front end of Cluto data clustering. The advantages are: 1. Make Cluto cluster in a user-friendly graphical way. 2. Provides several methods for the visualization of interactive clustering results such as: visualization matrix, visualization hills, etc.

Origin8 is a popular professional function drawing software produced by OriginLab. It is recognized as a fast, flexible and easy-to-learn engineering drawing software. Origin8 has two main functions: data analysis and drawing.

Gephi is an open source free cross-platform complex network analysis software based on JVM, which is mainly used for various networks and complex systems, interactive visualization and detection of dynamic and hierarchical open-source tools. Its advantages are: 1. Simple operation and easy to use. 2. Diversified functions and beautiful visual graphics.

The Ucinet software is written by a group of network analysts at the University of California, Irvine. The network analysis integration software includes NetDraw for 1D and 2D analysis data analysis and the 3D display analysis software Mage that is under development and application.

3 Keyword analysis

As the author's refining of an entire article, keywords can often clearly and intuitively express the theme that the entire article wants to elaborate. Therefore, keyword extraction and analysis play a great role in understanding the theme of the article. At the same time, keyword analysis of a certain number of documents also helps us to grasp the discipline development trends。

3.1 High frequency keyword network

In order to study the development trends of China's national security and the internal links between the keywords involved, this study divided 247 articles into two parts according to publication time: 1995-2007 and 2007-2019 to perform the bi-cluster keyword analysis Keyword analysis. For these two parts, define keywords that appear more than or equal to 2 as high-frequency keywords and pair the high-frequency keywords in pairs to obtain a co-occurrence matrix. Use Netdraw to draw a keyword co-occurrence network map。

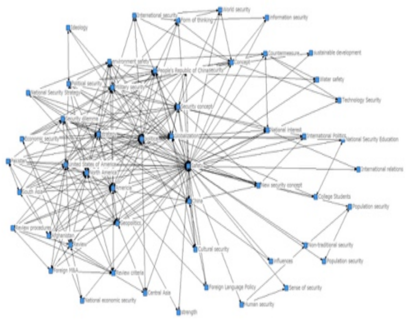


Figure1

Figure2

Figure1 1995-2007 high frequency keyword co-occurrence network map

Figure2 2008-2019 high frequency keyword co-occurrence network map

It can be seen from the graph that the focus of China's national security development has shifted in these two time periods. Excepted the keywords “national security” and “national security concept” used in the search in this article, the keywords at the core of 1995-2007 are “politics”, “military security”, “environmental security”, “globalization”, etc. This shows that the focus of China’s national security studies at this time is more inclined to some national basic security aspects, which is also consistent with the achievements made by our country at that time.

The key words in the network center from 2008 to 2019 are “cyber security”, “United States”, “climate change” and so on. This fully shows that with the rapid development of the times, in a modern, networked, and diversified world, a country needs to focus on the issues that related to the national security.

3.2 Bi-cluster research topics

Bi-cluster analysis is a method to discover the potential local patterns by clustering the rows and columns of the matrix at the same time. This method was created due to the need for large amounts of biological gene data for analysis. Compared with traditional clustering methods, bi-clustering can extract the information of rows and columns and discover their potential connections, which is especially effective for sparse and high-dimensional matrices. In this study, after deleting the keyword “national security” used in the search, the co-occurrence matrix was reconstructed and imported into gCLUTO software for bi clustering. The clustering method is repeated dichotomy, the number of clusters is 10, the optimization function is I2, and the similarity coefficient is the cosine function. After clustering and drawing a visual mountain chart, the number of clusters with obvious differences was found to be 5 types, so relocate the number of clusters to 5 and reclassify, combined with the similarity index of results given by gCLUTO software, it was found that most of the ISim values Greater than 0.5, indicating that the clustering effect is well-behaved, and the similarity is high in various groups.

Table1 Bi-cluster result similarity index

Clusters	Size	ISim	ISdev	ESim	ESdev

From 1995 to 2007					
0	4	0.943	0.008	0.354	0.050
1	6	0.713	0.087	0.369	0.016
2	10	0.696	0.092	0.387	0.052
3	10	0.650	0.048	0.421	0.043
4	23	0.492	0.055	0.387	0.068
From 2008 to 2019					
0	4	0.959	0.011	0.006	0.004
1	3	0.758	0.095	-0.000	0.000
2	9	0.617	0.078	0.018	0.010
3	4	0.447	0.042	0.041	0.049
4	19	0.022	0.036	-0.000	0.000

The clustering results in the visualized mountain peak diagram in Figure 3 are represented by mountain peaks. The steeper the mountain peaks, the stronger the similarity of the data within the class. At the same time, the peak is composed of 5 colors of red, yellow, green, blue, and light blue. The closer to red, the lower the standard deviation of data similarity within the class, and the closer to blue, the closer the standard deviation of data similarity to class High, when the color tends to be more monotonous, it means that the similarity between the data within the class is greater. The color blocks in the visualization matrix in FIG. 3 represent the frequency of the original keywords. The larger the value, the darker the color. At the same time, the matrix also rearranges the rows of the matrix, arranging the keywords belonging to the same cluster together. Figure 3 lists the high-frequency keyword bi-cluster visualization matrix and mountain charts for the period 1995-2007.

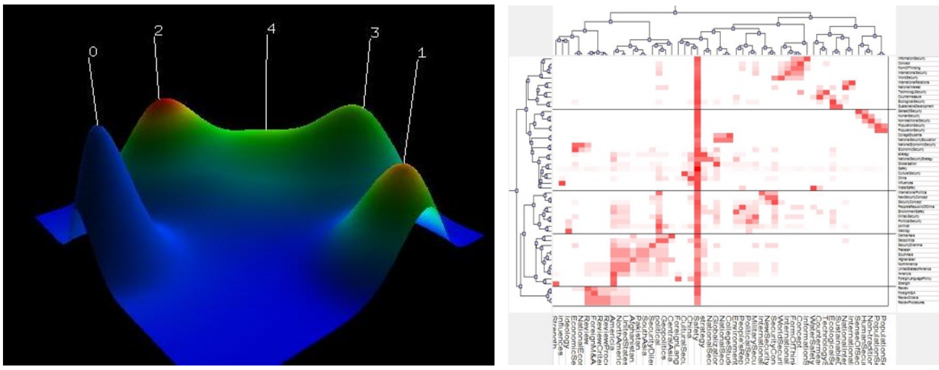


Figure3 High-frequency keyword bi-clustering visualization matrix and mountain peak plots from 1995 to 2007

Combining the above figures, the highly cited literature related to national security can be summarized into the following topics:

1) From 1995 to 2007

Theme 0： Foreign mergers and acquisitions safety and review standards. The words “foreign capital mergers and acquisitions” and “review standards and procedures” have appeared in the keywords many times. This shows that China attached great importance to the security of finance and foreign investment.

Theme 1： The concept of China's national security and the thinking form of international security. The emergence of these words shows that at the time, China not only focused on the development of basic theoretical knowledge of its national security science, but also remember to look abroad, always paying attention to the trend of international security. This also reflects the characteristics of the development of national security as an emerging discipline in my country.

Theme 2：Security issues between China and the United States. As the two largest economies in the world, they never forget the relationship with each other.

Theme 3：Political security. Reflects the importance of political security for the initial construction of China's national security studies.

Theme 4：Ecological security and sustainable development. The emergence of this theme shows that at that time, China recognized the importance of environmental and ecological security issues. A good ecological environment has a very important influence on national security.。

2) From 2008 to 2019

Theme 0：Foreign mergers and acquisitions and finsa. In the period of 2008-2019, national security issues such as foreign mergers and acquisitions appeared again, indicating that our national security science attaches great importance to the direction of international financial security.

Theme 1：Language planning and national language skills. The link between language and national security has gradually attracted the attention of scholars in recent years. National language ability is the language ability that a country has to deal with domestic and foreign affairs. Language education is an important factor for ensuring safety and plays a very important role in promoting mutual understanding. It is precisely because of its importance and China's current lack of national language proficiency (such as the small number of foreign languages and the lack of high-level foreign language talents) that this branch of national security has received widespread attention in recent years.

Theme 2：Cyber Security. The rapid development of the Internet in recent years has made the Internet the main battlefield for people to socialize. It is precisely because the role of the network in people's lives is very important that the branch of network security has received extensive attention from scholars in the field of national security in the past 10 years.

Theme 3：Data Sovereignty. Now that we are in a highly informationize world, data becomes more and more important. The maintenance of data sovereignty can not only affect the maintenance of China's domestic security, but also help China gain a foothold in the international arena.

Theme 4：Ideological security. The traditional concept of national security mainly refers to the military and political security of the country, while ideological security includes many fields such as economy, information, ecology, culture, science and technology. The proposal of ideological security means that China has completed the construction of the initial traditional national security concept, and pay more attention to the impact of "ideology" and "cultural soft power" on national security。

3.3 Citation curve analysis of highly cited literature

Each document has its own life curve. Since the date of publication, its content has been sought after in line with the academic upsurge of the time to its gradual aging and lost its use value. It is precisely because the literature has such characteristics that scholars have proposed measurement indicators such as half-life and Price index to study the process of document aging from different perspectives in order to hope to dig out its underlying laws and explore document topics and documents relationship between cited quantity and citation life.

1） Citation curve distribution

This study refers to Qu Wenjian's summary of the modern classification of citation curves [15], divided the curves as 6 categories: classical citation curve, multi-peak citation curve, exponential growth citation curve, exponential decline citation curve, waveform citation curve and sleeping beauty citation curve.

According to the classification characteristics of the citation curve and with the help of manual classification of topics and the fit function of Origin8 software for the number of literature citations per year, the top 50 citations are classified and summarized in Table 2.

Table2 Cross-tabulation of citation curves and research topics for highly cited documents

	CLASSICAL	MULTI-PEAK	CURVE	SLEEPING BEAUTY	EXPONETIAL GROWTH	EXPONETIAL DECLINE	SUM
				1995-2007			
THEME 0	4	1	0	0	0	0	5
THEME 1	2	9	2	2	0	0	15
THEME 2	0	1	0	0	0	0	1
THEME 3	2	9	0	0	0	0	11
THEME 4	0	0	0	0	0	0	0
SUM	8	20	2	2	0	0	32
AVERAGE ANNUAL CITATION	75.94	97.96	29.97	34.5	0	0	—
				2008-2019			
THEME 0	0	6	0	0	0	0	6
THEME 1	2	2	0	0	0	0	4
THEME 2	2	1	0	0	0	0	3
THEME 3	0	0	0	0	1	0	1
THEME 4	4	0	0	0	0	0	4
SUM	8	9	0	0	1	0	18
AVERAGE ANNUAL CITATION	100.8	55.62	0	0	46.25	0	—

Looking at the distribution of citation curves in these two periods, the following points can be summarized：

1) Most of the highly cited documents of national security science have a life cycle

No matter which period you are in, you can find that the articles with life characteristics such as the classic citation curves and the multi-peak citation curves have a great high proportion among the whole articles, for example, in the 1995-2007 period, there are 32 articles in total and 28 articles have a life cycle.

2) 1995-2007 period

The documents that match the multi-peak citation curve account for the most, up to 62.5%, indicating that during 1995-2007, highly cited documents of national security sciences often have multiple peaks, which delayed the decline cycle and extended the document life cycle. At the same time, the frequency of citations for the 1995-2007 period is very high. Among them, the citations that match the multi-peak citation curve type have reached an average of 97.96 citations per year, which means these articles would be cited almost every three days. Thus, these literatures are huge for the construction of China's national security studies and the help for future generations.

3) 2008-2019 period

The number of documents that match the classic citation curve type and the compound multi-citation citation curve type in the 2008-2019 period are close, but the average annual citation curve of the compound classic citation curve type is up to 100.8 times, indicating that the past 10 years China's national security research shows a prosperous scene, and the subject of the research is also very popular. At the same time, drawing on the average annual citation frequency of the documents with multi-peak citation curve types from 1995 to 2007, I think we can look forward to the citation frequency of the documents with multi-peak citation curve types from 2008 to 2019 in the next few years.

4 Author knowledge role recognition research

By conducting research on author knowledge role recognition, it can help us understand the development of national security in China, the academic exchanges between authors, and the role of authors in their disciplines.

The research object of this study is the citation relationship between the authors of the top 50 cited articles. Since there are more than one author in some literatures, there are a total of 75 authors. Table 3 is the first 5th author's ranking.

Table3 the top 5 ranking of the authors from top 50 articles

Ranking	Author
1	Liu Jiayi
2	Chen Guojie
3	Zeng Changxin, Shen Weishou
4	Guo Zhongwei
5	Zheng Hangsheng, Hong Dayong

4.1 Analysis of community graph

After determining the list of authors, then retrieve all the author's literature resources and citation documents in the field of national security from the CNKI database, so as to obtain the amount of documents cited by the author in the field and the amount of cited documents, thus we can use Gephi to establish the author's citation network diagram (Figure 6).

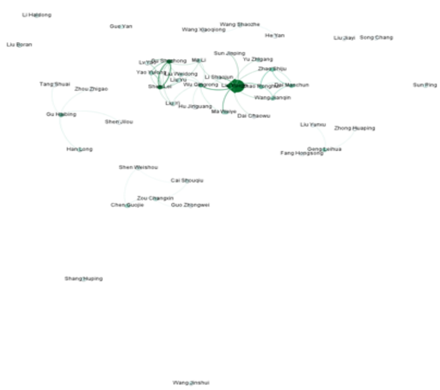


Figure 6 Author citation network diagram

In this network, nodes represent each author, the darker the color, the more active the author. It can be seen from the figure that the relationship between these 75 authors is not very tight (density is only

0.0137). By investigating the areas that the authors are involved in and good at, they can be roughly divided into national legal and political security fields with Liu Yuejin and Zhao Ronghui as the core, and national economic security with Gu Haibing, Liu Jiayi, Wang Shaozhe, Shen Lei, Gu Shuzhong as the core Field, as well as the national ecological environment security field with Geng Leihua and Chen Guojie as the core. This phenomenon not only reflects the large number of branches in the field of national security science in China, but also indicating the differences between the branches are large, showing a phenomenon of diversification. On the other hand, it shows that the mature branches in the field of national security science in China today include political security, economic security and ecological security.

4.2 Centrality analysis

1) Degree centrality

In a network, if a point is directly connected to many other points, then we think that this point is in a more central position in the network where it is located. In this study, due to the use of directed graphs, it is necessary to distinguish between the concept of point-in and point-out. Point-in-degree represents the situation where the author's literature is cited by others, that is, the frequency of the author's citation, the greater the value, the more the author plays a role of “knowledge source” in the network. Conversely, the point-out degree represents the frequency with which authors cite other people’s documents. The larger the value, the more the author is in the role of a “knowledge sink” in the network.

This study used Ucinet to analyze the author's degree centrality and summarized the top 5 authors with the in-degree and out-degree (Table 4). It can be seen that Zhao Ronghui, Ma Weiye, Li Shaojun and Wang Shaozhe have a higher in-degree but lower out-degree, which belong to the role of high-quality article creators in this network. Wu Qingrong, Zhao Shiju and Dai Manchun are highly out-degree, and they play a more role in absorbing the high-quality opinions of others in the network. And Shen Lei, Gu Shuzhong and Liu Yuejin have a both high in-degree and out-degree, which means that not only can they publish excellent articles, but also be good at absorbing the views of others, which is the core of the entire network.

Table4 Ranking of top 5 authors in in-degree and out-degree

Author	In-Degree	Author	Out-Degree
Liu Yuejin	7	Shen Lei	11
Zhao Ronghui	6	Gu Shuzhong	11
Gu Shuzhong	4	Liu Yuejin	10
Ma Weiye	4	Wu Qingrong	10
Li Shaojun	4	Zhao Shiju	6

2) betweenness centrality

Betweenness centrality is another major indicator for centrality analysis. If the number of shortest paths at any two points is greater, the centrality will be greater. In actual analysis, betweenness centrality often represents the degree to which a person controls resource. The larger the value, the more the person is in a core position and controls the spread of knowledge.

With the help of Ucinet's analysis function, we analyze the centrality of each author and list the top 5 authors in Table 5. As mentioned earlier, due to the low network density of this reference relationship, the value of betweenness centrality is not very large. However, we found that Liu Yuejin and Zhao Ronghui ranked high, and judged that they should belong to the core position of the branch they are good at.

Table5 Ranking of top 5 authors in betweenness centrality

Author	Betweenness centrality
Liu Yuejin	27.500
Zhao Ronghui	7.500
Wang jianqin	3.000
Gu Haibing	3.000
Shen Lei	2.500

3) Closeness centrality

Closeness centrality is opposite to the first two indicators above. It measures that a node is not limited to the capabilities of other nodes in the network. In actual analysis, the higher the ranking, the more the node has the ability to acquire knowledge, that is, it is in a core position.

The author's mutual citation graph is directed graph, so it is necessary to distinguish between its internal closeness centrality and external closeness centrality. Table6 lists the ranking of its top 5 authors.

Table6 Ranking of top 5 authors in closeness centrality

Author	Internal Closeness Centrality	Author	External Closeness Centrality
Ma Weiye	1.469	Wu Qingrong	1.586
Li Shaojun	1.469	Zhao Shiju	1.491
Dai Chaowu	1.468	Dai Manchun	1.490
Sun Jinping	1.468	Gu Shuzhong	1.471
Liu Yuejin	1.449	Shen Lei	1.471

Since the density of the whole graph is low, only 0.0137, the overall values of the centrality present a lower level. However, it can also be seen that “Li Shaojun”, “Dai Chaowu” and some others ranked high, indicating that they are relatively independent and not controlled by other authors. This is also consistent with the in-degree and out-degree tables analyzed above.

4.3 Cohesive subgroup analysis

When the relationship between certain actors in the network is relatively close, forming a sub-structure, this small group is called a cohesion sub-group. Here we conduct an analysis of the cohesive subgroup, thereby trying to have a preliminary understanding of the state of the substructure within the citation network.

With the help of Ucinet's CONCOR iterative algorithm function, the network nodes are partitioned to obtain the number of subgroups that appear in the overall citation network, and the subgroup visualization graph (Figure 7) is obtained. Depend on the density matrix (Table 8) and the scale density matrix (Table 9), I draw a simplified diagram.

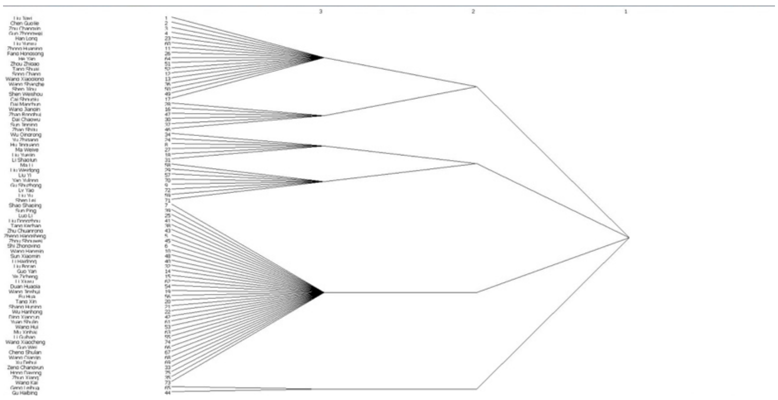


Figure7 Subgroup visualization

Express the above chart as a table

Table7 Author classification chart

Subgroup A：Liu Jiayi、Chen Guojie、Zou Changxin、Shen Weishou、Guo Zhongwei ...
Subgroup B：Wang Jianqin、Wu Qingrong、Dai Manchun、Zhao Ronghui ...
Subgroup C：Hu Jingguang、Ma li、Gu Shuzhong、Liu Yi、Liu Weidong ...
Subgroup D：Dai Chaowu、Liu Yuejin、Sun Jinping、Ma Weiye ...
Subgroup E： Sun Ping、Liu Dongzhou、Luo Li、Zhu Chuanrong、Zheng Hangsheng ...

It can be seen from the classification that the entire group is divided into 5 subgroups. Combined with the division of knowledge roles and the fields and point analysis of each author's expertise, the following subgroups can be defined as follows.

Although the members of subgroup A have a certain amount of out and in degrees, but the other members that each member contacts are very fixed. Combining the areas, they are good at, we can find that the members of subgroup A are more active in the fields they involve while low activity in other branches of national security.

The out degrees of the members of subgroup B are often greater than their in degree, that is, they often cited other schoolers' articles rather than be cited, which means that they are good at absorbing multi-faceted and multi-domain knowledge, and plays the role of "knowledge sink" in the network.

Although the members of subgroups C and D are involved in different branch areas, their in-degree is often greater than their point-out degree, that is, their articles always be cited by other person and they belong to the role of "knowledge source". Meanwhile, these members also communicate very closely with members in fields they do not involve, indicating that they are in a relatively important position in the citation network.

The members of subgroup E have both low in-degree and low out-degrees, indicating they are in the boundary of the network.

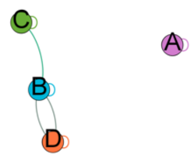
While using the CONCOR program to group, we get the density matrix between each subgroup. In order to grasp the relationship between each subgroup, I normalized the density matrix by getting the value of the subgroup density less than the overall density to 0, and the value greater than 1 to 1. According to the above rules, get the following matrix.

Table8 Normalized density matrix between subgroups

A	B	C	D	E

A	1.000	0.000	0.000	0.000	0.000
B	0.000	1.000	0.000	1.000	0.000
C	0.000	1.000	1.000	0.000	0.000
D	0.000	1.000	0.000	1.000	0.000
E	0.000	0.000	0.000	0.000	0.000

With the help of Gephi's drawing function, the simplified image matrix is as follows.



Graph8 Simplified image matrix between subgroups

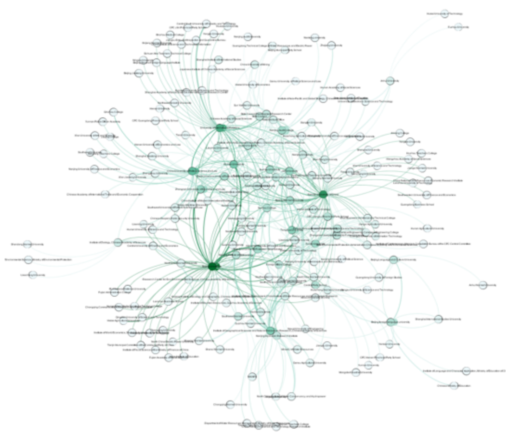
It can be seen from the chart that subgroup B not only plays the role of "knowledge sink" among these 75 authors, but also acts as a bridge, connecting subgroup D and subgroup C, making these two parts' authors can exchange their knowledge to each other. The authors of subgroup A only maintain resource exchanges under the same discipline branch, while the authors of subgroup E neither communicate with other subgroups nor communicate within subgroups, so they are not shown in the figure.

5 Analysis of national security research institutions

Through perform the social network analysis on research institutions, it can help us to understand what the main institutions of national security research in China are, the role they played and the relationship between them. This can help us to be targeted in the construction of the institutions which involved national security discipline in the future.

5.1 Community graph analysis

Similar to the network diagram of the author's cross-citation relationship described above, this study selected author institutions, citation institutions and cited institutions involved in the top 50 cited documents. Figure 9 is the network diagram of the relationship between institutions.



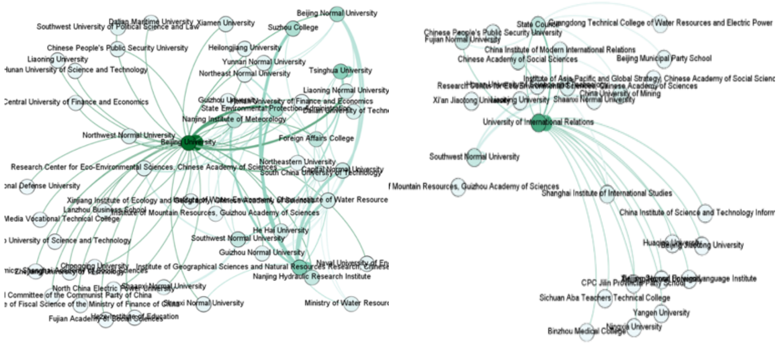


Figure9 Network diagram of relationship between institutions (The two pictures below are enlarged versions of the dark parts in the picture above)

For the research of institutions, we still use the drawing function of Gephi, where nodes represent the names of institutions participating in national security research, and edges represent the citation relations between institutions. The darker the node, the greater the degree of node, and the more active it is. With reference to Figure 9, we can see that there are many research institutes related to national security in China. Among them, Peking University, Renmin University of China, The University of International Relations, China University of Political Science and Law, etc. These institutions are the backbone of China's national security research and the leader in this discipline.

5.2 Centrality analysis

1) Degree centrality

Put the acquired data into Ucinet for degree centrality analysis and integrate the top 5 institutions with in-degree and out-degrees into Table 9. It can be seen from the table that institutions such as "Renmin University of China", "China University of Political Science and Law" and etc. have higher in-degree and lower out-degree, indicating that they have played a role of knowledge source in the construction and provided many high-quality resources for China's national security studies. The out-degree of "Jilin University", "Nanjing Audit Institute", and "Zhongnan University of Economics and Law" are significantly greater than their in-degree, indicating that they are more active in the flow of knowledge and are actively learning the innovative ideas of other institutions. The "Peking University" and "University of International Relations" are not only having a high in-degree, but also have a high out-degree, indicating that they are not only made outstanding contributions to the construction of China's national security, but also maintained the habit of absorbing high-quality views from the outside world which are the core force for the development of this discipline.

Table9 Ranking of Top 5 Institutions in in-degrees and out-degrees

Institution	In-Degree	Institution	Out-Degree
Renmin University of China	45	Peking University	30
Peking University	39	Jilin University	20
University of International Relations	31	Nanjing Audit University	16
Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences	28	State Environmental Protection Administration	14
China University of Political Science and Law	26	University of International Relations	12

2) **Betweenness centrality**

Put the obtained data into Ucinet for intermediate centrality analysis and integrate the top 5 institutions into Table 10. It can be seen from the figure that "Peking University", "The University of International Relations", "Renmin University of China", "China University of Political Science and Law" are ranked high, indicating that they have played a very important role in knowledge dissemination and exchange, and these institutions' in-degree is often greater than theirs out-degree, indicating that they play a role in controlling other nodes in the relationship network.

The betweenness centrality of the network has a potential of 16.02%, and the value is low, indicating that the betweenness centrality of the institutions is relatively low in terms of the entire network. That is, in national security research, most institutions do not need other institutions as intermediaries to obtain information.

Table10 Ranking of top 5 institutions in betweenness centrality

Author	Betweenness Centrality
Peking University	5896.308
University of International Relations	2794.206
Renmin University of China	2765.697
China University of Political Science and Law	2130.063
Suzhou University	2001.177

3) **Closeness centrality**

Closeness centrality represents the ability of a node to be free from control by others. Import the acquired data into Ucinet for closeness centrality analysis and put the top 5 institutions in the Table 11.

Table11 Ranking of top 5 institutions in closeness centrality

Author	in-closeness centrality	Author	out-closeness centrality
Institute of Zoology, Chinese Academy of Sciences	2.055	Jilin University	1.003
Anhui University	2.055	Northwest University	0.973
Nanjing Institute of International Relations	1.992	Dalian University of Technology	0.973
National Audit Office	1.977	South China University of Technology	0.972
China Institute of Modern International Relations	1.947	Harbin Institute of Technology	0.972

Due to the low density of this network relationship graph, the overall centrality value is not very high, but it can also be seen that the top rankings are "Institute of Zoology", "Chinese Academy of Sciences", "Anhui University", "Nanjing Institute of International Relations", etc., which also corresponds to the characteristic that the point out degree is basically 0 and the point out degree value is higher.

6 Conclusion and prospect

Although national security science has only been established for less than 30 years as an emerging discipline, due to the strong support of the country, the active participation of many scientific research institutions and the importance and complexity of its discipline, this discipline has achieved great success in China. Since 1999 the University of International Relations first pioneered the National Security Science which has achieved a series of achievements in the construction of disciplines and the "National Security Science Foundation" has been listed as a ministerial-level textbook for funding.

After that, many scientific research institutions have blossomed and formed a national research group with “Peking University”, “The University of International Relations” and “Chinese Academy of Sciences” as the core。During this period, a large number of scholars and professors who have made unremitting efforts for the vigorous development of this discipline have emerged, such as “Liu Yuejin” professor from “The University of International Relations” and “Zhao Ronghui” professor from “Shanghai International Studies University”. It is precisely because of the hard work of these institutions and scholars that China’s national security research and construction can have a rapid development in less than 20 years and complete the transformation from such as “resource security”, “military security”, “political security” and other traditional security to such as “language ability”, “network security”, “data security”, “ideological security” and other national soft power security transition. However, from the beginning of the establishment of national security to the present 30 years, the theme of "America" has been enthusiastically discussed by scholars. At the same time, combined with the phenomenon that the literature type of multi-peak citation curve in the period of 2008-2019 has been cited less frequently, which because the literature has a long life cycle and has not reached its peak, I think that in the next 10 years, the research theme of China’s national security would be concentrated in “security issues between China and the United States” and China’s soft power security construction such as “Network security”. Here, I sincerely hope that our national security studies can continue to flourish in the future construction and continue to prosper!

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Hiding of Personal Information Areas through a Dynamic Selection Strategy

Sang-Hong Lee[1[0000-0001-7543-9788]] and Seok-Woo Jang[2[0000-0001-5580-4098]]

[1,2] Anyang University, Anyang 14028, Republic of Korea
shleedosa@anyang.ac.kr, swjang7285@gmail.com

Abstract. Video content with exposed personal information is freely distributed to the general public through the Internet without user approval, which is a problem. In this paper, we propose a method of detecting areas representing personal information from continuous color images through an artificial neural network and hiding the detected target area appropriately for the surrounding environment. The proposed method first applies a color model and deep learning to robustly detect a target area representing personal information exposed from an image. The detected area is then tracked quickly based on position prediction and simultaneously blocked. In this paper, the hiding of the target object is performed by adaptively selecting one of the mosaic processing, image blurring, and virtual object insertion techniques in consideration of surrounding conditions. Experimental results show that the proposed method accurately extracts the personal information area, efficiently tracks the extracted area, and dynamically selects the hiding technique. The method proposed in this paper is expected to be useful in related fields such as object detection, big data analysis, and biometric recognition.

Keywords: Image content, Adaptive selection, Object hiding.

1 Introduction

Due to the advent of digital cameras with excellent performance and high quality, the development of large-capacity storage devices that are inexpensive and very fast, and information delivery trends from text data-oriented to video data-oriented, a large amount of high-quality color video content is rapidly spreading [1]. These video contents are usefully used for big data analysis in a variety of practical applications, such as IoT-based building monitoring, artificial intelligence-based traffic control, human computer integration-based video security, and computer vision-based object tracking [2].

However, video content including personal information such as a person's face, a specific part of an exposed body, and a resident registration number is also a problem because it is freely distributed through the Internet without any restrictions. In particular, the psychological pain of those who learn that their personal information has been exposed to a large number of unspecified people will be very significant, and the exposed personal information may be abused for purposes such as sending spam text messages and spam e-mails.

Therefore, research is needed to effectively protect the exposure of unwanted personal information to the outside world by automatically hiding only the target areas where personal information is exposed from the images being entered into the system through image blurring effects, block-based mosaic processing, and virtual object insertion [3].

Existing studies of detecting target areas from received video content and hiding detected target areas can be found in relevant literature. However, the existing hiding methods are still low in completeness, and contain various restrictions on the surrounding environment and circumstances. In particular, a technique for presenting multiple hiding methods and adaptively selecting the surrounding contextual hiding method among these methods, has not yet been proposed in the field of image security.

Therefore, in this paper, a target area containing personal information, such as a human face, in the input image is robustly detected using a deep learning technique, and mosaic processing, image blurring, and virtual object insertion are performed while efficiently tracking the detected target area. We present a new approach to hiding by dynamically selecting the most suitable method among the techniques. Fig. 1 shows the overall flow chart of the personal information hiding algorithm through the dynamic selection strategy proposed in this paper.

Therefore, in this paper, we present a novel approach to robustly detect target areas containing personal information, such as human faces, in received images, and dynamically select the most suitable method among mosaic processing, image blurring, and virtual object insertion techniques while efficiently tracking the detected target areas. Fig.1 shows the overall flowchart of the privacy domain-hiding algorithm through the dynamic selection strategy proposed in this paper.

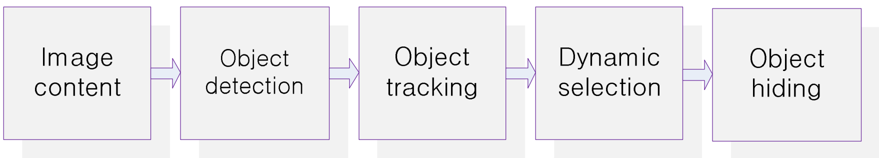

Fig. 1. Overall flowchart of the suggested method.

As shown in Fig. 1, the method proposed in this paper first accurately detects a target area containing personal information from color images continuously input using a deep learning technique. Then, the detected area is quickly tracked by applying a position prediction algorithm. Finally, the target area being tracked is dynamically blocked by adaptively selecting a suitable method from among mosaic processing, image blurring, and virtual object insertion techniques in consideration of the surrounding environment.

2 Object Detection and Tracking

In this paper, the human face area is set as the target area representing the exposed personal information. In the proposed method, the RGB color space of the input image is first converted into the YC_bC_r color space [4]. An elliptical skin color distribution model adaptive to the input image, defined as in Equation (1), is then generated through learning, and only skin color pixels are extracted by applying the generated model to the image.

$$\frac{(x-ec_x)^2}{a^2}+\frac{(y-ec_y)^2}{b^2}=1 \tag{1}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \cos\theta(C_b^{'}-C_x)+\sin\theta(C_r^{'}-c_y) \\ -\sin\theta(C_b^{'}-C_x)+\cos\theta(C_r^{'}-c_y) \end{bmatrix}$$

Subsequently, in the algorithm proposed in this paper, a deep learning technique [5] is applied to accurately detect only the face area from the skin color area acquired in the previous step. In the deep learning structure used in the proposed system, the image pyramid is created in six steps. When finally detecting the target area, the final result is derived by summing the detection results of each step of the pyramid.

In the deep learning model, max-margin object detection (MMOD) optimizes all sub-windows without performing sub-sampling. In other words, the target region is detected by applying the window scoring function F(x, y) to all sub-windows [6]. In Equation (2), ϕ denotes a feature vector obtained from the moving window position r of the image x. w is a weight vector that performs learning to reduce false positives. By applying Equation (2), a result corresponding to the detection score can be obtained. Finally, the location of the target area is finally extracted by summing the areas with the highest score in the hierarchical pyramid image.

$$y^{*}=\arg\max_{y\in Y}F(x,y)=\arg\max_{y\in Y}\sum_{r\in y}< w,\phi(x,r)> \tag{2}$$

In this paper, the target region detected using deep learning is quickly tracked by applying the Kernelized Correlation Filters (KCF) technique [7]. In general, KCF is based on the idea of a typical correlation filter, and it is known that it produces good performance by significantly improving the computational speed using a kernel technique and a circulant matrix.

$$\alpha = F^{-1}\left(\frac{F(y)}{F(k(x_1,x_2,\sigma))+\lambda}\right) \tag{3}$$

$$k(x_1,x_2,\sigma)=\exp\left(-\frac{1}{\sigma^2}\left(\|x_1\|^2+\|x_2\|^2\right)-2F^{-1}\left(F(x_1)\oplus F^{*}(x_2)\right)\right)$$

In this study, when a face area containing personal information is detected in a color image that is continuously input, the target area is learned for stable tracking by using the corresponding image and the location of the detected personal information area. Learning in this study is carried out as Equation (3). In Equation (3), x denotes the current frame, which is a training image, and y denotes the target area to be tracked. λ represents a parameter to prevent overfitting. α means the model of the target area to be tracked. k denotes the kernel matrix. In the approach presented in this study, the target area is continuously tracked from the next input color image using the model α of the target area obtained by learning.

3 Dynamic Hiding Strategy

In this paper, using a deep learning algorithm, the target area including the initially detected personal information is continuously tracked through KCL while adaptively hiding at the same time. In other words, the best method suitable for target area hiding is selected from among the three hiding methods, namely mosaic processing, image blurring, and virtual object insertion, in consideration of user preference and surrounding environment. Then, the exposed personal information area can be effectively protected by blocking the target area with the selected hiding technique.

In the mosaic-based hiding technique, a grid-shaped mosaic [8] is created, and then the generated mosaic is naturally overlapped on the target area detected in the previous step, so that the area including personal information is not exposed to the outside. The proposed method first obtains the minimum enclosing rectangle (MER) of the extracted target area to cover the target area with a mosaic. Then, the corresponding region of the image contained within the obtained MER is divided into blocks with the same horizontal and vertical sizes in equal units, and then each block is filled with color values generated by the mosaic processing technique.

The image blur-based hiding technique covers the exposed personal information area by applying a two dimensional Gaussian function [9] to an image. Image blurring is performed through convolution. Blurring using a Gaussian function used in the proposed system is one of the representative hiding techniques. In general, if blurring using a Gaussian function is applied to the target area where personal information is exposed, it is possible to obtain a hiding result with a relatively small sense of heterogeneity with the area located around the target area.

The virtual object-based hiding blocks the exposed personal information area more intimately by overlapping the character object on the detected target area. However, most of the existing methods of inserting virtual objects are very inefficient because they have to manually position the virtual object at a desired point in the image and manually adjust the virtual object several times according to the size and shape of the area to cover the virtual object. Therefore, in this paper, the location and size of the designated virtual object can be automatically adjusted according to the detected target area.

In the proposed method, image blurring, mosaic processing, and virtual object insertion techniques are dynamically selected in consideration of user preferences and surrounding conditions. In this paper, first, when a user selects one of the three hiding techniques, the target area is hided with the selected technique. If the user's preference values for the three hiding techniques are similar, a hiding technique is adaptively selected by reflecting the surrounding environment in which the image was captured. To this end, in this study, the complexity metric of the surrounding environment as shown in Equation (4) is calculated using the weighted sum of distance features and lighting features.

$$\Omega(\alpha, \beta; t) = \alpha \times \left(1 - \left| \frac{F_{illum}(t)}{\left\| F_{illum}(t) \right\|} - \frac{1}{2} \right| \times 2 \right) + \beta \times \left(1 - \left| F_{distance}(t) - \frac{1}{2} \right| \times 2 \right) \quad (4)$$

$$F_{illum}(t) = \frac{1}{256 \times P \times Q} \times \sum_{i=0}^{P-1} \sum_{j=0}^{Q-1} Y(i, j)$$

$$F_{distance}(t) = \frac{1}{P \times Q} \times \left\{ MER_W \times MER_H \right\}$$

4 Experimental Results

The computer used for the experiment consists of an Intel Core(TM) i7-6700 3.4Ghz CPU, 16GB main memory, 256GB SSD, and a Galaxy Geforce GTX 1080 Ti graphics card equipped with NVIDIA's GPU GP104. On the personal computer used, Microsoft's Windows 10 operating system was installed. In addition, Microsoft's Visual Studio version 2017 was used as the integrated development environment of the introduced method, and the proposed algorithm was developed using the OpenCV computer vision library and Dlib C++ library. In this paper, various types of images including the exposed personal information area were collected and used to evaluate the performance of the proposed hiding algorithm. Most of these image data were captured in a natural environment with no specific constraints.

$$M_{accuracy} = \frac{TARGET_{hiding}}{TARGET_{total}} \times 100\,(\%) \quad (5)$$

In this paper, the performance of the proposed target area hiding method was quantitatively evaluated in terms of accuracy. In this study, the same metric as Equation (5), defined as the ratio of the number of target regions accurately detected and blocked in the input color image and the number of target regions contained in the entire image data, was used. $\text{TARGET}_{\text{hiding}}$ in Equation (5) represents the number of target regions that are correctly hided using the proposed algorithm. In addition, $\text{TARGET}_{\text{total}}$ means the total number of target areas representing personal information belonging to the image data to be tested. The quantitative measure used in this study is defined as a percentage.

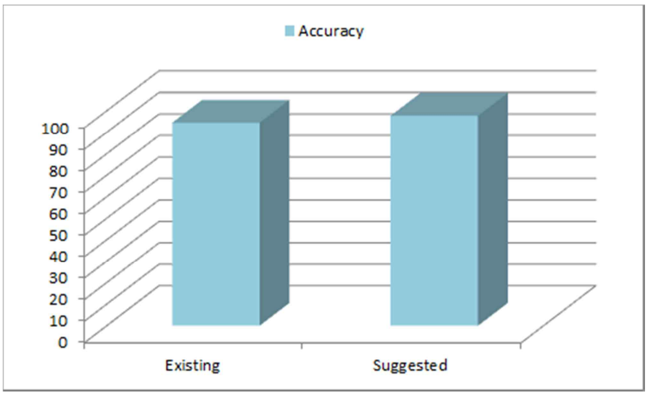

Fig. 2. Performance comparison.

Fig. 2 presents a graph of the performance measurement results of the target area hiding method in terms of accuracy. As can be seen in Fig. 2, the algorithm using the dynamic selection strategy proposed in this paper blocks the target area including personal information more effectively than the existing method.

5 Conclusion

In this paper, we propose an algorithm that robustly detects the target area containing personal information excluding the background part from various color images, and then effectively protects the detected target object area by a blocking method suitable for the surrounding situation. In the method, the target object area containing personal information is robustly segmented based on the color of the human skin. Then, a morphology operation is applied to the selected skin pixel image to remove noise, and labeling is performed to extract individual skin regions. Then, only the human face region is robustly detected using a deep learning-based object detection algorithm from the extracted skin region. Then, by effectively covering the detected face area by selecting a blocking method suitable for the surrounding situation, it is possible to protect the personal information from being exposed to the outside.

In the future, we plan to verify the robustness of the system by applying the deep learning-based multi-level object domain blocking method proposed in this paper to many images captured in more diverse environments. In addition, the proposed blocking algorithm will be more stabilized by tuning various parameters used in the proposed system.

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A Study of Online Electronic Voting System based Blockchain

Byeongtae Ahn[0000-0003-3431-9493]

Liberal & Arts College, Anyang University, 22, 37-Beongil, Samdeok-Ro, Manan-Gu, Anyang 430-714, South Korea.
ahnbt@ anyang.ac.kr

Abstract. As the offline paper voting, which has been conducted until recently, continues to be a problem in terms of security and reliability, the interest in online electronic voting with increased safety and convenience is increasing. Several countries around the world are now adopting and activating online electronic voting. However, existing electronic voting has not been officially introduced in most countries due to interdependence and procedural security flaws. If 100% of these interdependencies and security can be trusted, the high-cost paper voting method will gradually decrease. Therefore, in this paper, blockchain technology is applied to compensate for the problem of electronic voting. This system can verify and hold blocks independently using a P2P method without a central authority to prevent falsification with reliability. In addition, by removing temporal and spatial constraints, the voter turnout can be increased and voting is possible directly on smartphones and PCs.

Keywords: Electronic Voting, BlockChain, Ethereum, Smart Contract, Paper Voting.

1 Introduction

Reliability and security issues for voting around the world are increasing every time. Two months prior to the 2016 US presidential election, the fact that voting machines in Arizona and Illinois were hacked from foreign hackers was also publicized. These issues raised doubts about the integrity of the voting results and raised the need to improve the electronic voting system [1].

Compared to existing paper voting, e-voting is not only capable of real-time counting, but also has fewer errors, so Estonia introduced and implemented e-voting since 2005. However, due to the nature of interdependence in electronic voting, even if an error occurs at one point in the system, it is difficult to accurately identify the point of occurrence of the error because they are mutually affected because different parts of the system depend on each other [2]. In addition, the problems of ensuring reliability and preventing forgery, which are the limitations of the existing online and offline voting systems, are constantly increasing. Therefore, in this paper, we designed a blockchain-based electronic voting system that can reduce the cost of offline voting and prevent fraudulent elections. This system was made to run in an Ethereum-based distributed computing network environment and enabled on the web or d-App.

In Chapter 2 of this paper, related research is introduced, and in Chapter 3, a blockchain-based electronic voting system is designed. And Chapter 4 presents conclusions and future tasks.

2 Related Studies

Electronic voting is currently being implemented in several countries, and in particular, Estonia is the first country to apply the voting system on a national scale using the Internet. The structure of the existing Internet-based electronic voting I-voting system uses E2E encryption to vote, but Estonia's electronic voting system utilizes blind signature technology [3,4]. Estonia's electronic voting system uses nationally issued ID cards and the keys they hold to vote. For voting, Estonian voters can use a card reader and client software to access the website for electronic voting and create a legally valid signature. During the voting process, two RSA key pairs were generated, one for authentication and one for digital signing.

FollowMyVote is a blockchain-based electronic voting system that is implemented online and uses blockchain to prove to voters and watchers that the vote has not disappeared. The FollowMyVote system adopts a way to obtain voting rights by downloading applications and authenticating their identities. The system uses two key pairs using elliptic-curve encryption to maintain voter anonymity. One is for identification, and the other is used for voting [5,6].

Zhao and Chan proposed a bitcoin lottery-based system [7]. This system is a new approach that eliminates the need for a central authority to decrypt the vote after the election period and does not need to encrypt the vote.It uses a random number value to hide the relationship between the voting action and the voter. The authenticity of the vote was determined by proving that it was 0[8]. Later, Takabatake proposed a voting system using similar proof of knowledge [9].

Most recently, Bistarelli et al. proposed an electronic voting protocol using Bitcoin, and this system divided the election organization into two subjects, one performing the authentication function and the other the token distribution function to grant voting rights. Through this, the privacy of voters was protected in the voting process, but it was difficult to monitor the behaviors of two separate entities organized in the protocol and had limitations in expanding the voting scale [10].

Blockchain eliminates the central bank system that is applied to existing banks, and decentralizes the data stored in the central ledger to store data on the users' computers in the chain. We have built a peer-to-peer (P2P) system that can trade with. The reason why experts call the blockchain a very secure technology that cannot be forged or altered is the hash value. Before transmission occurs, a unique hash value is generated in the block, which has the previous hash value and the current hash value in the block head, so if someone tries to forge / modulate the data value of a specific block for malicious purposes The hash value of the block is changed. This is a very safe technique because it is determined that the hash values of all blocks in the blockchain, which are generally composed of hundreds of thousands or more, cannot be changed because the previous hash values of the blocks connected to the front and back must also be changed.

Blockchain is a structure that allows all users who participate in the blockchain to access not only my data, but all users' data by storing all data on the user's computer, rather than storing user data on a central server. Blockchain uses a hash function to build a very secure data storage method where data cannot be forged or tampered with. The inside of the block of the blockchain used by Bitcoin is shown in Fig. 1

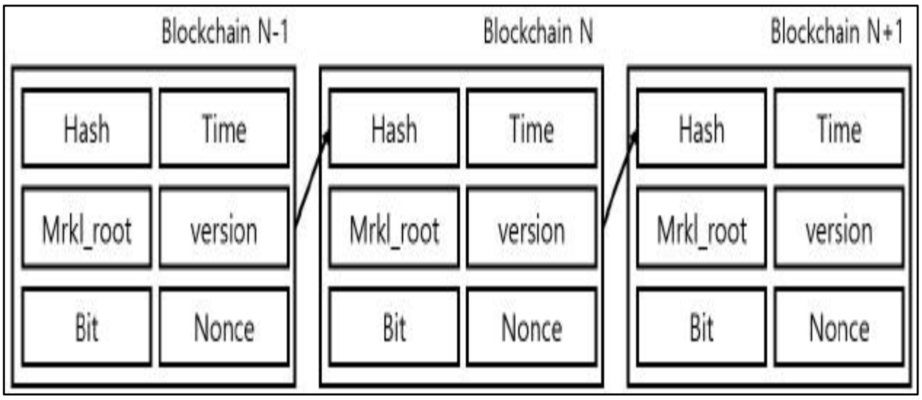

Fig. 1. Blockchain connected by a hash function

Inside the block, the previous hash value is stored, and you can see it as if it were chained. If a malicious user attempts to forge / modify the data of a specific block, the currently stored hash value is changed, and accordingly, hash values connected to front and back must also be changed. It is impossible to change the hash value of all blocks in the existing blockchain. Although it is a decentralized system, users can use it without worrying about data forgery or forgery.

3 Design of Electronic Voting System

In this paper, we designed an electronic voting system based on Ethereum using blockchain technology. This system is an electronic voting method that prevents illegal elections and allows safe and convenient voting online. This method solved the high-cost problem of paper voting, which is an existing offline method, and solved the security problem for electronic voting in an online method. In addition, it increased the convenience of voters who are inconvenient or difficult to vote, and is an electronic voting method specialized in Korea. Fig. 2 shows the flow chart of this system.

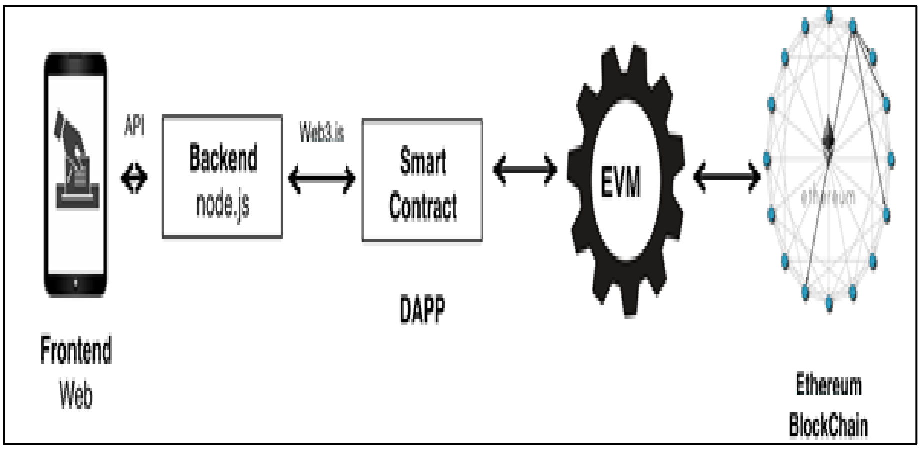

Fig. 2. Data Flow Architecture of System

The user can vote on a smartphone or PC, and the results of the vote are stored on a server and transmitted to a smart contract. These smart contracts are generated as byte codes through the Ethereum virtual machine and stored as blocks in the Ethereum main net. Voting results are provided in smart contracts through a solidity language that supports Turing completeness. This method improves reliability by ensuring the anonymity and convenience of voting as well as providing complete defense against malicious attacks. This system is designed as a web-based interface to increase accessibility, and because it is modular, it is easy to integrate with other tools including authentication tools.

Fig. 3 shows the overall configuration of the system.

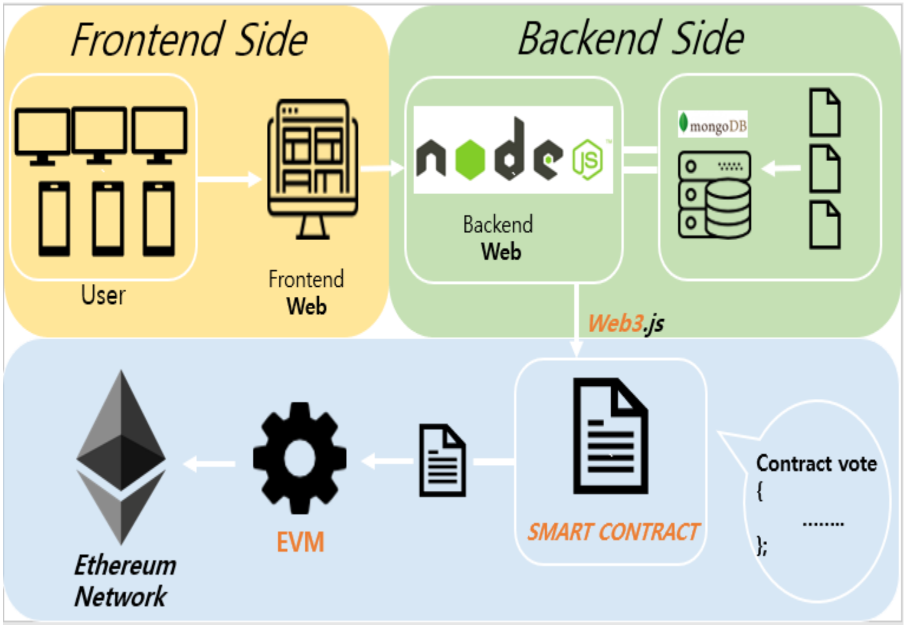

Fig. 3. Structure of Electronic Vote System

The user accesses a website using a smart phone and a computer and uses an electronic voting system. At this time, the identity may be verified through the personal information stored in the block for identification, and the electronic voting may be accessed. When using the electronic voting system, a node.Js server capable of asynchronous processing was used to eliminate the overload that could cause many problems. In addition, for fast data update and storage, memory DB mongoDB is used to improve compatibility with the server. The web and the server were made to access the smart contract using Web3.js, and the normally signed voting information was distributed and stored in the Ethereum blockchain. At this time, the smart contract is generated as a byte code through the Ethereum virtual machine and stored in a block.

The design of this system increases the efficiency of voting management tasks such as shortening voting and counting time, preventing invalid votes, etc. In particular, it has the advantage of improving turnout and low budget.

4 Conclusion and Future Works

In this paper, we designed an electronic voting system based on Ethereum using blockchain technology. The system can be used not only for large-scale public elections, but also for voting in small groups, and it has improved the reliability of electronic voting. In addition, the cost of voting was reduced and the turnout was improved.

In this paper, we proposed an Ethereum-based electronic voting system using blockchain and smart contracts and tokens to solve the interdependence and system integrity problems of the existing electronic voting system. And, compared to the existing bitcoin system, it was easy to implement functions such as access control. As a future task, we will implement a practical system based on this design.

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Study of Effective Intelligent Campus using Zigbee based on Sensor Network

Byeongtae Ahn[0000-0003-3431-9493]

Liberal & Arts College, Anyang University, 22, 37-Beongil, Samdeok-Ro, Manan-Gu, Anyang 430-714, South Korea.
ahnbt@ anyang.ac.kr

Abstract. Universities that have been pursuing informatization with the development of high-speed networks and IoT (Internet of Things) are expanding the informatization area by introducing online academic administration systems, mobile campuses, and electronic libraries as part of the recent intelligent campus construction. As key technologies in this ubiquitous rank, the Ubiquitous Sensor Network (USN) along with radio frequency identification (RFID) and zigbee are emerging. In this paper, we propose an integrated management system model for the establishment of a intelligent campus, such as a digital library system and a smart card system capable of providing various services using zigbee, which is currently prominent. The integrated management system can provide a higher quality education environment through transparent and efficient administrative management and one-stop service provision, away from the labor-intensive system of educational institutions, and users can provide personalized and knowledgeable intelligent education services that meet their needs and environments.

Keywords: Intelligent campus, Sensor, IoT, Zigbee, Network

1 Introduction

Recently, due to the rapid development of information and communication technology, network infrastructure has been widely distributed, and as various advanced digital equipments are becoming more common in everyday life, the ubiquitous era based on this is coming. Various attempts are made to incorporate the new paradigm into education, and there are factors that can evolve educational methods or efficiently support all activities related to education. Already, many advanced countries are trying to build a intelligent campus that applies ubiquitous computing technology to university campuses with this in mind. The aforementioned intelligent campus refers to a campus that supports convenient and safe activities of campus members with ubiquitous computing technology using small computer technology and wired/wireless network technology. Currently, intelligent campus-related research is actively underway, and technology is being developed accordingly[1].

In this paper, according to this trend, we propose a intelligent campus design suitable for junior colleges using zigbee wireless communication technology. Chapter 2 of this paper examines the research overview of intelligent campus and wireless communication technology for building intelligent campuses, and Chapter 3 examines the current status of intelligent campuses at home and abroad. And in Chapter 4, Intelligent campus’s service is designed considering the characteristics of junior colleges, and Chapter 5 presents conclusions and future tasks.

2 Research overview of Intelligent Campus

A intelligent campus refers to a campus in which the user who uses it for the movement of knowledge and information, which is the center of the campus environment, is intelligently moved without conscious awareness of nearby devices. The intelligent campus is based on the latest computing technology and network infrastructure currently available, and for this, it is necessary to construct a network infrastructure to realize ubiquitous computing services. In this paper, we introduce major technologies for network infrastructure construction for the sensor network environment, which is the center of constructing such a intelligent campus[2].

	2.4 GHz	868 MHz	915 MHz
Data Rate	250 Kbps	20 Kbps	40 Kbps
Channel	11~26channel	1 channel	10 channel
DSSS	32-chipPN codes	15-chip PN codes	
Chip Modulation	O-QPSK	BPSK	
Symbol Rate	62.5 Ksym/s	20 Ksym/s	40 Ksym/s
Chip Rate	2.0 Mchips/s	300 Kchips/s	600 Kchips/s
Sensitivity	-85 dBm	-92 dBm	
RF Linearity	-10 dBm (IIP3), -4 dBm (Output P1dB)		
Transmit Power	0 dBm (1mW)		
Adjacent Channel Rejection	0 dB		
Alternating Channel Rejection	30 dB		

Fig. 1. Compare of zigbee standard & stack

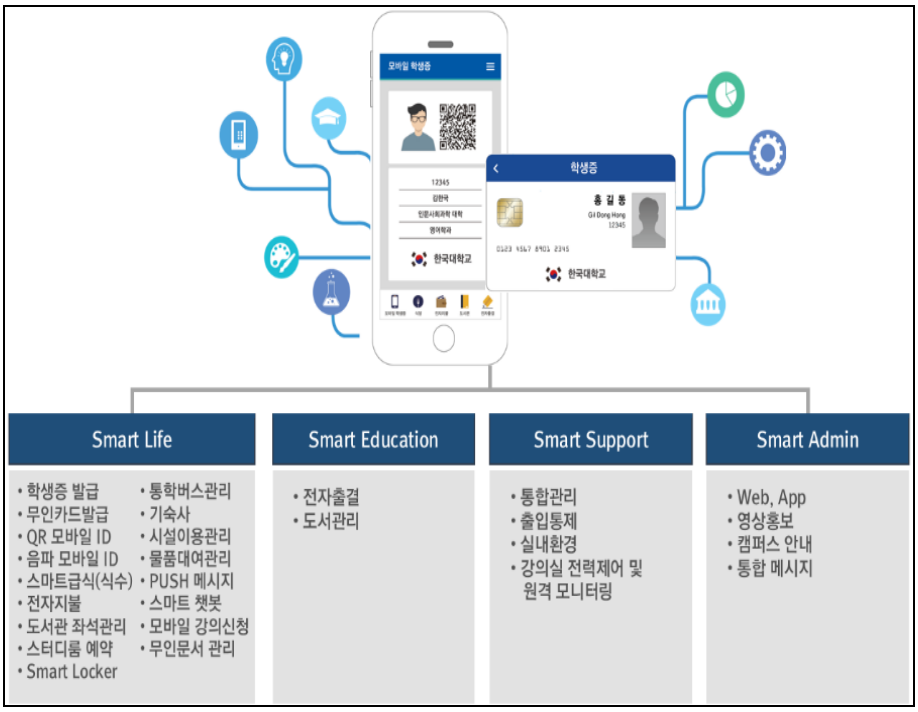
The following Fig. 1 compares the standard and main stacks of zigbee technology. The u-sensor network (USN) technology is a network configured to wirelessly collect information collected from various sensors.It is wireless by identifying temperature, acceleration, location information, pressure, fingerprint, and gas obtained from the sensor. It is a network environment for real-time information transmission through the network. In this paper, zigbee wireless communication technology is applied to intelligent campus construction to support remote control, location-based service and real-time information sharing[3].

3 Design

3.1 Internal Intelligent Campus

The intelligent campus needs four core technologies. Terminal technology, network technology, platform technology, and service technology. Each field continues to develop along with the development of u-learning in universities, of which the sensor network field is the most active.

Looking at the development of intelligent campuses in Korea, in 1999, Sookmyung Women's University has built a “u-bi Sookmyung service” using mobile computing. The u-bi Sookmyung service supported electronic attendance, 2D barcodes and wireless network environments using mobile student IDs. Afterwards, the utopia research team at Yonsei University built a intelligent campus through mobile wireless network access such as color code-based u-profile, u-messaging, and u-campus tourguide services[4]. And based on Konkuk University's X Internet, which began in 2004, a comprehensive information system was implemented that applied the J2EE&EJB platform and CBD architecture development methodology, and Kyunghee University implemented the u-class by introducing the world's first “two-way lecture system”. In addition, Ewha Womans University is in the completion stage of ECC (Ewha Campus Center). After signing a memorandum of understanding (MOU) with SK Telecom on the construction of a intelligent campus, the USN system using u-library, laptop rental and information devices, and other parking systems, safety systems, and interactive lecture systems were expanded and implemented. The direction of u-campus in domestic universities is developing into platform development through intelligent mobile, multifunctional phone, sub-notebook PC, wearable PC, and information service through USN. However, these intelligent campuses are large universities and are not suitable for vocational colleges. Therefore, in this paper, intelligent campus is designed in consideration of the characteristics of junior colleges[5].



Figu.2. Yonsei University Intelligent campus

Fig. 2 shows the structure of the entire intelligent campus of Yonsei University. In addition to general functions, Yonsei University's intelligent campus provides various services such as electronic document-based administrative services[6].

3.2 International Intelligent Campus

Research and development of ubiquitous computing environment is making a lot of progress in foreign companies and related fields as well. In Japan, Tokushima University has developed a system (tango) that recognizes information of objects by attaching RFID tags to each object, and implemented a manner education system (JAPELAS) based on infrared data communication IrDA (Infrared Data Association) [7].

The University of Hannover (Germany) implemented a so-called “laptop university project” using notebook computers, mobiles and other information devices. The Georgia Institute of Technology (USA), called Georgia Tech, is promoting an e-class project called'classroom 2000'. e-Class implements a software infrastructure system environment that automatically saves and re-searches lecture contents using wireless LAN through an intelligent electronic board (Live Board) [8].

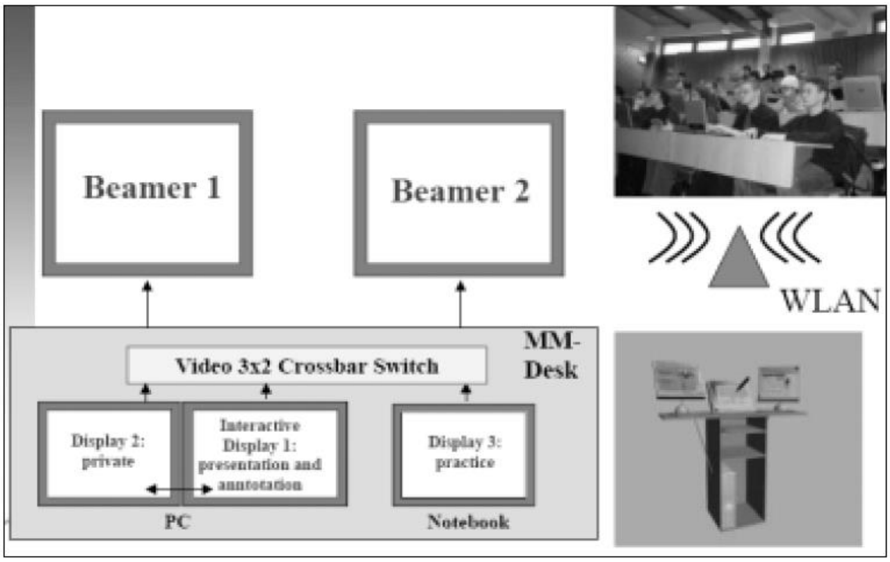


Fig. 3. Structure of Hannover University

Fig. 3 shows the system structure diagram of Hannover University, which has a well-established intelligent campus among overseas universities.

4 Intelligent campus Service Concept

4.1 Base design for realization of intelligent campus zigbee network

The universities that built each intelligent campus implemented an efficient ubiquitous environment through information transmission and retrieval through various network infrastructures. In this paper, we construct a intelligent campus using zigbee wireless communication suitable for low-cost, low-power, and low-speed sensor network environments considering the characteristics of junior colleges[9].

The design of this paper processes information by attaching and embedding a zigbee sensor module to an object or place necessary to implement a zigbee-based network to recognize the object and sense the surrounding environment of the installed place and transmit the data to the wireless network. do. For efficient sensing of the module, zigbee RF transceiver is installed by selecting a suitable location considering the communication efficiency according to the location of the building and the location of indoor/outdoor building structures and equipment, and the OS is the OS for sensor network node suitable for large-scale network implementation. Suggest TinyOS. In order to speed up the sensor device response according to network initialization and to efficiently drive the zigbee stack, a kernel based on the Round Robin method is used rather than the Event Driven method. The chip is low-power, low-cost, supports 128-bit AES encryption method, uses JN5121 developed by Jennic, suitable for intelligent campus construction, and supports networking using CDMA network using CDMA module. Also, we propose efficient support by using korwin's KW-ZP-DUA1-JN3 for controlling the surrounding zigbee device through application programs such as PC or PDA[10].

4.2 Concept of intelligent campus using zigbee network

Figure 4 is the overall system design of the intelligent campus using zigbee network.

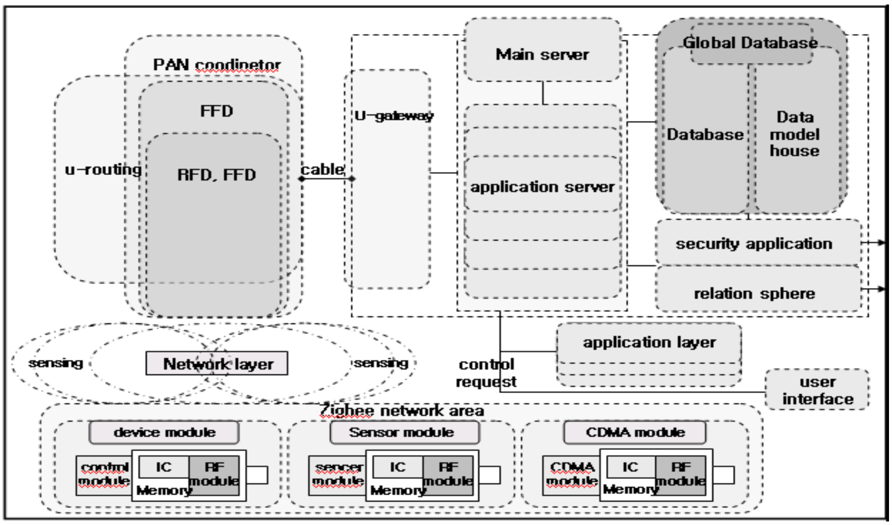


Fig. 4. Entire system of intelligent campus using zigbee

Intelligent campus service based on USN infrastructure provides intelligent information service based on sensor network using zigbee chip in consideration of the characteristics of junior colleges[11].

Intelligent libraries, remote controls, and electronic bulletin boards provide authentication through user identification and information access using zigbee networking using electronic student IDs and zigbee modules attached to mobiles. In addition, through the sensing of the AP through the zigbee module, the electronic attendance function and the location search service of people and public facilities are supported, and a safe and efficient educational environment through environmental monitoring is provided through continuous environmental monitoring through an interface with a built-in S/W tool. Provided through appropriate control of the server. In addition, it provides a wireless network service that is complemented by zigbee's 128-bit AES for the security vulnerability of the wireless network in u-campus construction[12].

It recognizes the biometric information of students, professors, and faculty accumulated in real time from the sensing point, stores the activity amount in the database, and provides a health management service through the stored information. By transmitting continuous biometric information such as electrocardiogram and blood sugar to the server through mobile and electronic student ID with zigbee module attached and embedded by an individual, the transmitted information is stored and charted health records are provided through the user interface. In addition, hospital-like health checkup tables can be provided from the server through the model house, and efficient health care services are provided to members by adding health abnormal warnings or regular checkup dates to the notification function[13].

The electronic library currently manages books by bar code recognition and manages the entry and exit, and has disadvantages such as non-contact or low recognition rate, and inability to track the location of books in real time. However, the zigbee network built using the zigbee module can search for major book locations using a real-time sensing system, and book reservations, specific pages, and downloads of relevant files using mobile. In the case of relatively large files, information can be provided using e-mail or personal web folder, and SMS text is provided for the completion of file transfer and additional book information[14].

Remote control services are provided for public equipment and major equipment in the school that are permitted to be used through the approval of the use of the server. Using the PC and mobile to which the control module is connected, it requests approval from the server through the zigbee network, and provides a remote control interface through the user interface when the server's approval is completed. The remote control service provides a level of control so that there is no disadvantage in the provision of convenience to the members, and supports the convenient activities of the members through the efficient remote control service[15].

The real-time electronic bulletin board using the zigbee network is used as a space for useful information such as message transmission through the network between students and faculty and student notifications on the electronic board, advertisements, and publicity anywhere in the school, and free transmission of frequently used document files and picture files. To support an efficient communication space.

In addition, through personal authentication through the member's mobile module and electronic student ID module, and access to the server and database using the zigbee network, a service that can be paid anywhere in the school is supported[16].

5 Conclusion and Future Works

In this paper, the sensor network environment of the intelligent campus was designed in consideration of the characteristics of junior colleges using zigbee wireless communication suitable for the construction of the USN environment. The intelligent campus service through the zigbee network provides a campus support system suitable for the introduction of a intelligent campus and efficient services in related fields. In addition, by comparing and analyzing the wireless network-based technology between universities that built a intelligent campus, it was shown that the intelligent campus construction of a sensor network environment using zigbee is the most suitable communication technology for the intelligent campus of a junior college. The future task obtained by writing this paper is: First, a study on the efficient coexistence of other wireless communication technologies in a intelligent campus environment that requires a variety of services. Second, it is necessary to find a plan for additional cost reduction in service implementation and application. Third, it is a complementary problem according to the network configuration of members. There is a 128-bit AES encryption process provided by the 802.15.4 standard, but a software complementary system must be implemented to supplement additional information

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Implementation of Smart English Education using IoT based on Blockchain

Byeongtae Ahn[0000-0003-3431-9493]

Liberal & Arts College, Anyang University, 22, 37-Beongil, Samdeok-Ro, Manan-Gu, Anyang 430-714, South Korea.
ahnbt@ anyang.ac.kr

Abstract. As supply and spread of Smart phones has emerged recently, a personalized Learning system with needed education resources obtained has been provided consistently in real time at anytime and anywhere. Previous e-Learning system based on PC (Personal Computer) and web service is extending to the Smart Learning System which is based on movable u-Devices (Smart phones, tablet-PCs, laptops, etc.) and mobile applications. This paper suggests the appliance of moving, flash, document-based, and tool-based contents on Smart Learning System, which previously was provided at web-based environment. For this purpose, we provided an English-learning content to the students based on previously developed approach of English learning, in real time by gathering location information of students in the campus. we enabled them to study English through customized system based on their ability..

Keywords: Smart Learning, IOT, u-Learning, GCM, Smart Campus

1 Introduction

A rapid development of IT technology has brought revolutionary changes throughout many parts of our society. Influenced by explosive spread and constant improvement of Smart devices, the paradigm of education is also greatly changing. As Smart Learning has risen as a new educational paradigm of the 21st century, it is also strongly demanded by the field of college education. This demand is not a blind acceptance of new technology but an efficient tool of education in the age of Smart Learning[1]. Therefore active seeking of a way to apply the latest technology on education is advisable, promptly satisfying the needs of the times. Thus, for improvement of in-campus English learning ability, this paper suggests the Smart Learning System using Internet of Thing (IoT)[2].

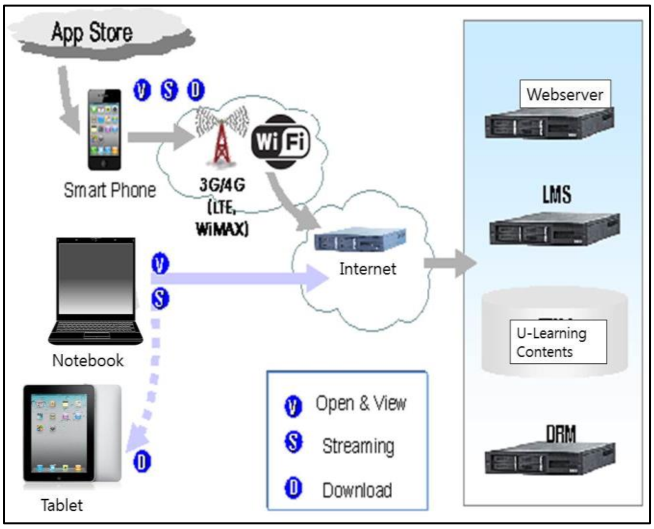

Fig. 1. Structure of Smart Learning System Platform

Fig. 1 is the structure of Smart Learning System based on the web. It was designed regarding the production and usage of various contents in web-based environment of various platforms that also operates for requests of comparative High resource. On smart phones, you can study in real time through data streaming and concurrently download related resources. We developed a smart phone application for such facility, and adopted Internet of Things so that by gathering the in-time location information of the user, the user can be provided a brief English-learning quiz during the way to and from school. This facility can also be applied for laptop and tablet-PC, but we focused on the smart phone for its convenience of mobility and portability. Smart Learning is an education environment in which the learning can be approached in autonomous and proactive way through various devices, and the user can communicate or cooperate interactively with other users[3].

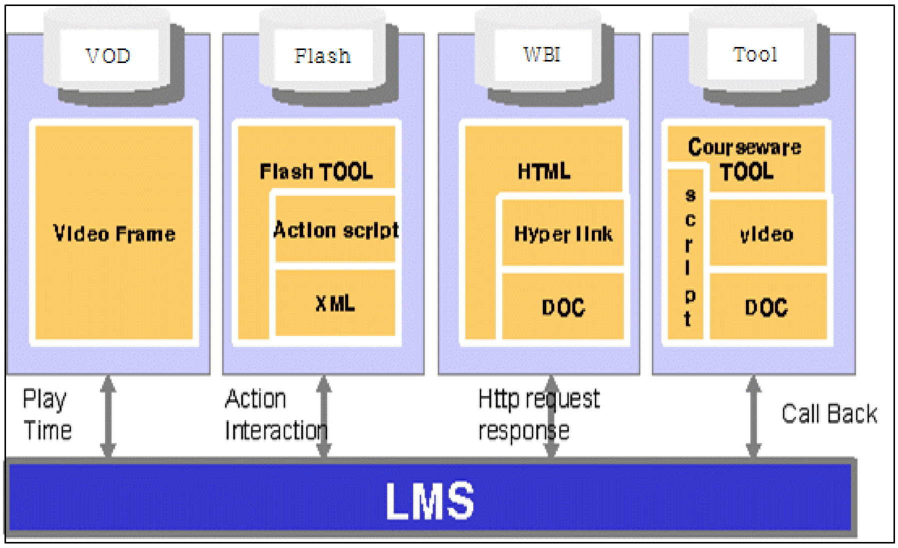

Fig. 2. Architecture of LMS Interactive

Fig. 2 shows internal structures of various contents and synchronous types between LMS (Learning Management System) and the contents. Through LMS, the contents served by the server are transformed to be independent from platform and then provided to each user. A suitable environment construction for the platform of user is interlocked enabling a continuous learning of the user[4].

Smart Learning System using Internet of Things gathers location information of students within a 200m radius from the school campus[5]. Then in real time, it provides a sentence (or a question) for English learning through smart phone and grades the answer submitted in a certain limited time. Also, by gathering school timetable of the students through the school affairs supporting system, it provides resources for English learning of speaking and listening so that the users would write and submit a proper sentence about the resources. The second chapter of this paper will introduce related studies, the third chapter will introduce the design of Smart Learning System, and the fourth chapter will propose the conclusion and future tasks.

2 Related Studies

2.1 Internet of Things

Extension of smart devices, smart phones in particular, has brought out a hyper connectivity in which network communication is enabled at any time and at any place continuously. The core components of this hyper connectivity environment are the intelligent communication systems between objects including M2M (machine to machine), IoT (Internet of Things), and IoE (Internet of Everything)[6].

Advent of this hyper connected society, started from people-oriented communication, has extended to the linkages of human-object and object-object. Development of Internet of Things has changed people's lives, radically bringing innovation in various industries of medicine, transportation, manufacturing, and distribution: it is accomplishing the ultimate Smart Life.

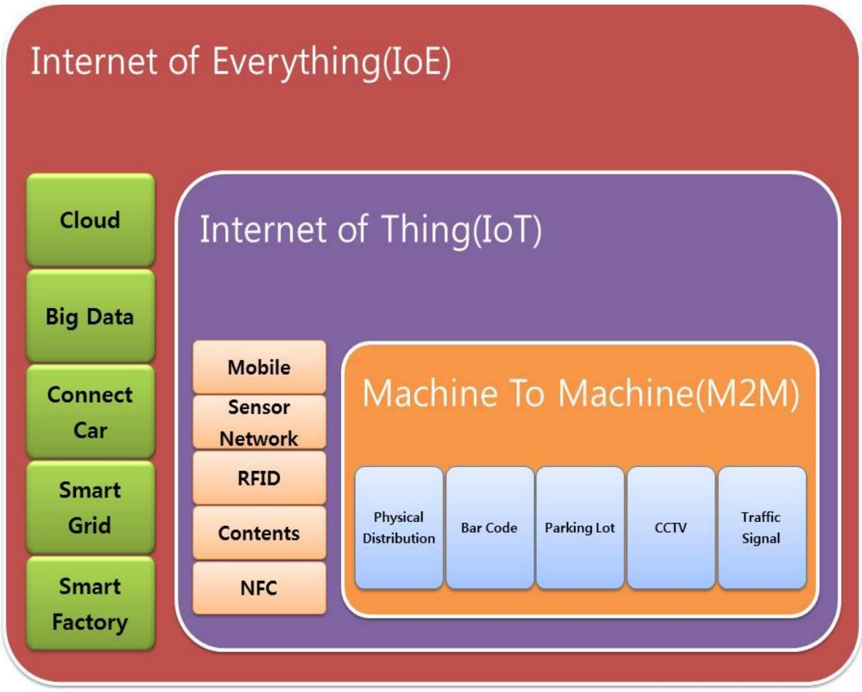

Fig. 3. Structure of M2M, IoT, IoE based on Hyper Connected Environment

Fig. 3 shows a diagram of M2M(Machine to Machine), IoT(Internet of Things), and IoE(Internet of Everything) which are the components of hyper connected environment. The hyper connective technology provides several types of links between devices using various network technologies (RFID, NFC, WIFI, Bluetooth, Zigbee, GPS, 4G, or LTE-A). Through these links it creates new ideas of services integrated with other industries. Especially a new paradigm of educational information based on ICT such like Smart Learning is emerging. Also recently, its time, space, learning contents, and approaches are keeping extending through the Smart Learning based on wire-wireless network and multi-device platform[7].

Internet of Things is an intellectual environment based on ICT(Internet Communication Technology) which connects all the objects within wire-wireless network and intercommunicate information of user to object, or object to object. Gartner, an American market survey agency, has chosen Internet of Things as the most popular and advanced field of technology. Internet of Things is broadly segmented into three areas:

device (user device and sensor), network (wire and wireless), and service interface (platform and application). The area of device transfer a data collected and extracted from certain object to the other object by embedded communication function. The area of network is a wire-wireless gate which transmits and receives the data sent from user to object, or object to object. The area of service interface deals with the data to create information, control devices, and administrate devices.

2.2 Domestic and Foreign case of Smart Learning

A domestic introduction of Smart Learning started as 'Smart Education Strategies' was established in 2011 for deduction of private education deduction, improvement of in-class education, and overall enhancement of education satisfaction. The government focused on laying the groundwork for smart education through infrastructure construction and digital textbook development but failed to bring noticeable achievement. They succeeded to develop the digital textbook but could not introduce them to the spot of education, for there was no proper content nor learning model suitable for smart learning and stable communication infrastructure was not secured. Therefore for a successful settlement of smart learning, an establishment of new policy regarding present of public education, characteristics of smart learning, and its users is suggested. On the other hand, there is a case which such system developed by a company is being used[8].

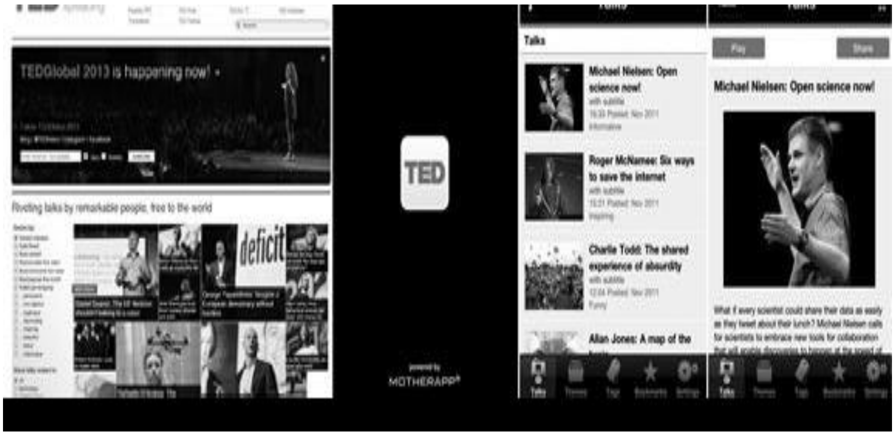

Fig. 4. TED Learning Service in Web/Mobile Environment

Fig. 4 shows the interface of TED learning service in web/mobile environment. TED is an informative conference hosted by an American non-profit foundation that provides qualified lectures of celebrities from each fields. Its video media is free to use in web and mobile environment, and also provides translation service for users so that they can share 'ideas worth spreading' globally.

3 Implementation of the system

The Smart Learning System using Internet of Things supports real-time English learning for the students through smart phone application during their way to school or absence of class. The student would learn English following customized level or the level chosen by the user[9].

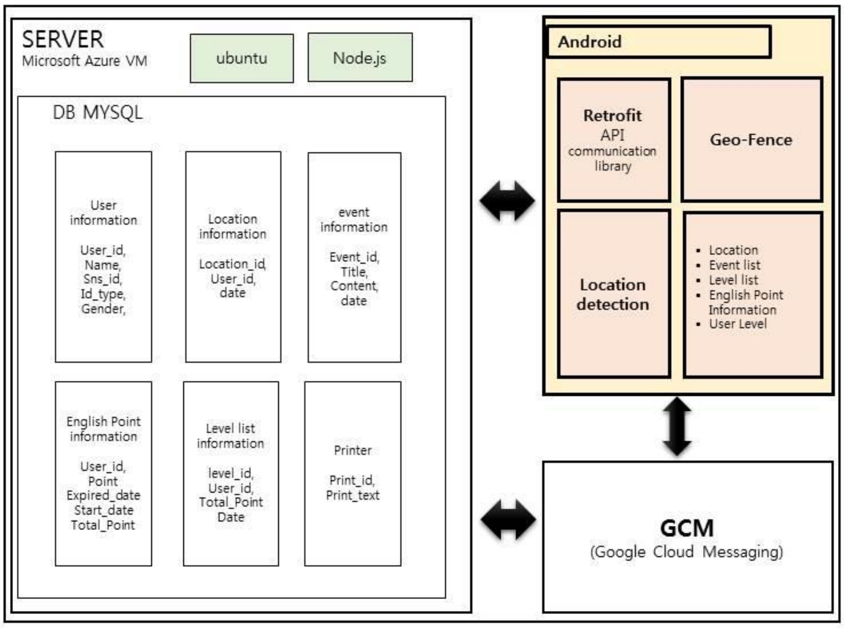

Fig. 5. Structure of Smart Learning System

Fig. 5 is a structure of Smart Learning System in which the user can access the English learning system based on server. MySql DB is used as a database, composed with 6 tables. Mobile access of the user can be recognized by gathering location information within a 200m radius from the school campus by Geo-Fence based on Android. The recognized data is transferred to the user in real time through the server. In this user-based Android environment, the user can work through various vocabulary practices, sentence quizzes, and real-time speech service. These various user information is transferred to the server in real time through Google Cloud Message (GCM). The data sent is saved and cumulated as a score for each user, and base on this data, the system serves English tests of customized level[10].

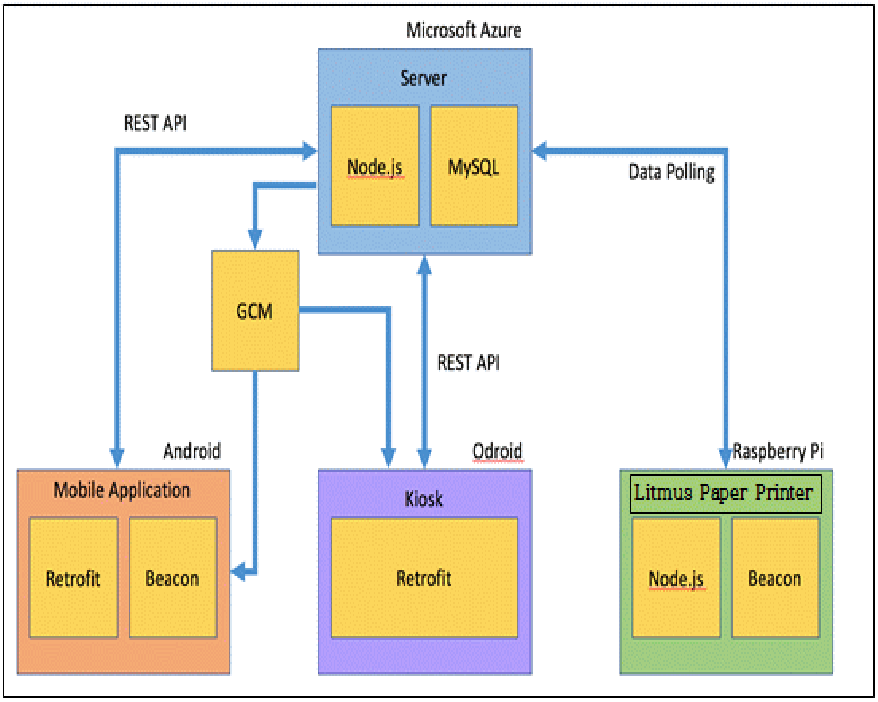

Fig. 6. Flow Chart of Smart Learning Data

Fig. 6 shows the flow chart of Smart Learning System for efficient English learning. Through the server, with the location recognized by GCM, the system send tasks to the user in real time and the data sent is transferred to the server by the user through the application. If the user is in the campus, the answer for the task can also be sent to the server through kiosk. During the lecture, its mid-term test, final test, and quizzes can be sent to the server in real time. According to all these data collected by the server, the system distinguishes user-customized level of learning through big data analysis.

Basic prototype of Smart Learning System is broadly classified into three types. First type is a LMS prototype based on geofencing. LMS(Learning Management System) is a system that manages overall academic affairs through network. It shows progress, score, and attendance of the user. As a solution of offline attendance management system, various ways including ID card, NFC, and QR code tagging have been suggested. However an offline system inevitably includes inconvenience in process from the viewpoint of UX, such like time loss for attendance checking and cheated attendance. To solve such problem of previous LMS, geofencing- a technology that collect information of user access in certain designated area, which is a compound word of 'grographic' and 'fencing'- is used. Once a range of area is designated by GPS, access of user in the area is turned into data by convenient simple registration using smart phone. A Smart Learning System based on geofencing Internet of Things collects the attendance data automatically through link between personal device and LMS.

Second type is a N-screen LCMS prototype based on beacon. LCMS(Learning Contents Management System) manages various learning contents that are used for communication of those online-offline learning through network. Education is composed of tutor, tutee, and learning contents. The contents have developed by being translated into digital data, applying ICT, but its method of transmission is still remaining as unilateral transfer, which is quite classic. Extension of transmission method using beacon-based N-screen is a connected learning system in which interaction between tutor and tutee is strongly linked. Third type is a cooperative learning prototype based on social network. Through Smart Learning based on social network, the user not only simply studies the informative contents provided but also reproduces and provides new contents to the others. This academic cooperation and sharing of collective intelligence are enabled by the technique of ICT, which let the users to become productive consumers, and so the system involves a property of 'prosuming'. Through the sharing of various learning contents, the user can reinforce self-directed learning capability, information necessity sorting capability, active reception, and creative appliance capability. Also, using the supporting infrastructure, multi-communication, expansion of contents, and constant approach can be guaranteed through real-time interactive network.

In this paper, we designed the Smart Learning System prototype using only the strengths of geofencing-based and beacon-based prototypes.

4 Conclusion and Future Works

we designed a system that presents English sentence (question) and speech to the students who access near the school campus within a 200m radius, in real time by collecting location information of the students. Then we designed an intellectual system that classifies level of the users with the information collected by the server, the answers submitted by the students in limited time. For further studies, if a mobile application cannot provide the answer information due to network error, constructing a real-time information serving system through kiosk in campus can be considered.

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Implementation for Smart Contract Visualization based on BlockChain

Byeongtae Ahn[0000-0003-3431-9493]

Liberal & Arts College, Anyang University, 22, 37-Beongil, Samdeok-Ro, Manan-Gu, Anyang 430-714, South Korea.
ahnbt@ anyang.ac.kr

Abstract. In recent years, blockchain, which is the base technology of the 4th industrial revolution, is rapidly emerging as an alternative to the centralized data management method. An application platform for providing blockchain networks and services to both the general public and the underprivileged (elderly people, farmers, people with disabilities) is essential. In particular, the socially vulnerable (defective families, grandparents, boy and girl heads, multicultural families, settlers, recipients of basic life) need clear guidelines for complex and high-level contracts in reality. Therefore, in this study, we designed a smart contract visualization application platform to improve user convenience. This system provides an easy-to-use interface for socially vulnerable and underprivileged, and presented guidelines for signing complex and high-level contracts. In addition, we designed a mobile UI/UX for smart contracts and enabled automatic creation of Ricardian contracts.

Keywords: First Keyword, Second Keyword, Third Keyword.

1 Introduction

Recently, with the rapid development of blockchain technology, attempts to provide new distributed services by fusion with existing technologies are increasing. To provide these services, various DAPPs are being developed using smart contracts, and DAPPs registered on the Ethereum platform for smart contracts to operate are gradually increasing to 2000 types [1]. In addition, the application fields of DAPP are applied to various fields such as manufacturing, distribution, medical, cloud computing, and public services.

Blockchain is rapidly emerging as an alternative to the centralized data management method of the existing server-client structure. Blockchain is a distributed, independent, and open common ledger management technology that distributes ledgers that record transaction information on a peer-to-peer network rather than a central server of a specific institution, and records and manages them jointly [2]. The existing ledger management method, which stores transaction information in central data and manages it on a central server, is difficult to follow up when hacked, resulting in high cost due to security work. In addition, since the existing ledger management method manages the ledger centrally, there is an arbitration cost to be paid to the central manager, and the blockchain can be used as an efficient alternative to solve the above-mentioned problems [3]. Blockchain not only reduces the central management cost, but also makes it difficult to falsify/modulate the book record than the centralized data management method because the copy of the transaction book is distributed to all network members [4].

Therefore, in this study, we designed a smart contract visualization application platform to improve user convenience. The application platform provides guidelines for signing complex and high-level contracts, and provides an easily usable interface for the socially disadvantaged and marginalized. In addition, bills, receipts, specifications, and P2P e-commerce were supported [5].

2 Related Research

In Section 2, we will look at the structure of smart contracts, Ricardian contracts, and Ethereum, as well as blockchain-related studies to develop blockchain-based systems.

2.1 BlockChain

Blockchain is a decentralized database in which information entered into the ledger is verified by blockchain parties using public key encryption technology. The operation of the blockchain depends on the type of blockchain, but the blockchain itself functions as a record of information [6]. In other words, the blockchain technology is an ordered list in which blocks containing transaction information are connected to the immediately preceding block, and the blockchain network creates new blocks to reflect changes between them every period, and each block It is connected to the previous block in time to form the shape of the chain [7]. Blockchain distributes and manages blocks by distributing them across multiple nodes on the network, and distributed blocks contain transaction information.Blockchain, which is a set of blocks, is a huge distributed ledger that includes all transaction information. It can be said [8]. A technology called blockchain is a combination of three technologies.

● Peer-to-peer networking: A computer communication method that can communicate without relying on one central management agency, such as a BitTorrent network, which has the advantage of not having a single point of failure in structure [9].

● Asymmetric cryptography: A computer can send an encrypted message to a specific recipient, so that everyone can verify the authenticity of the sender, but only the intended recipient can read the message. Bitcoin and Ethereum use an asymmetric password to create a set of credentials for the account, so that only the owner of the token can send the token [10].

● Cryptographic hashing: A secure way to quickly compare large datasets and verify that data has not been altered by generating a unique small fingerprint for all data. Bitcoin and Ethereum's Merkle tree, a data structure, is used to record the ordered order of transactions, which are hashed by fingerprints that serve as the basis for comparisons on computers on the network and quickly synchronized. It is possible [11].

2.2 Smart Contract

Smart contract is a typical application case where blockchain technology is realized. In other words, if the contracting party participating in the blockchain network writes the contract contents in code and writes it on the blockchain, the blockchain technology automatically executes the contract by referring to the contract information recorded on the blockchain when the contract conditions are met [12]. In this case, the blockchain technology allows the programmed contract to be continuously executed without stopping, and also allows the asset owner's digital assets to be directly transferred without external involvement. Blockchain technically performs the function of recording transaction information, but does not itself support smart contracts [13]. However, the blockchain technology automatically recognizes the smart contract, a decentralized application, and creates a contract address for this, and if the person who wants to trade sends the necessary conditions to execute the contract to the contract address of the smart contract, the smart contract automatically Let it run. Smart contracts are applications that are automatically executed when certain predetermined conditions are met, and to implement smart contracts, a platform is required to operate a blockchain technology that can check, supervise, and execute all transaction information that occurs over the network [14].

3 Smart Contract Application

3.1 Design of Smart contract Visualization

In this paper, the application platform for smart contract visualization was studied. This system designed a framework for creating Ricardian contracts and visualized the mobile UI/UX of smart contracts. Fig. 1 shows a visualization flow chart that makes it easy to check the contents of the contract. The contents of the existing smart contracts are embedded in the block through byte code, and then become a style sheet document through the binding process. Or go through the verification process through the app. It is then automatically converted to HTML or PDF through templates and data bindings for the visualization of the smart contract.

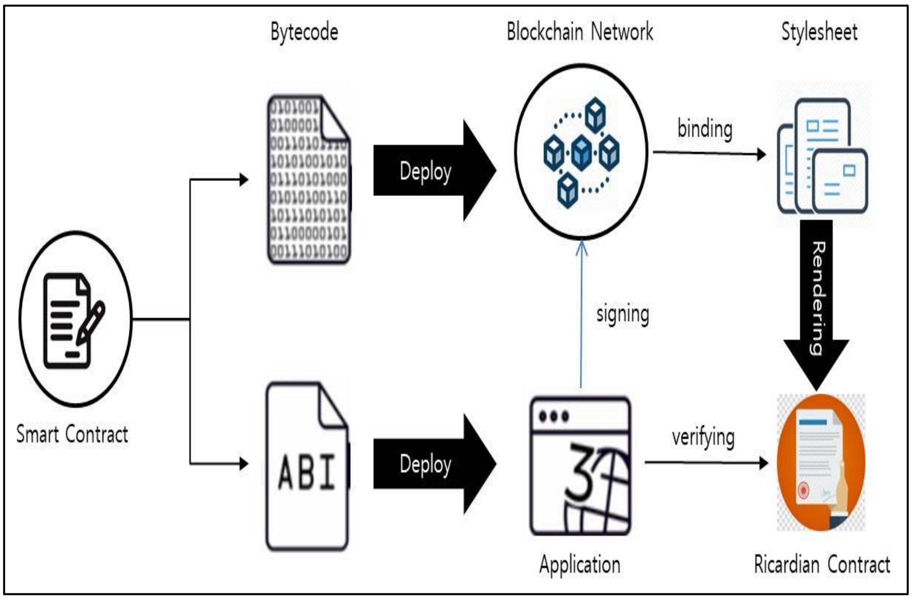

Fig.1. Flowchart of Smart Contract Visualization

Fig. 2 shows the overall system flow diagram. When a script or scenario is written, it goes through the test execution command. If an overload occurs during test execution, a service request is made to the server. If the server solves the overload problem and transmits the test result, it is displayed on the screen through real-time monitoring. And after storing the test results in a database, the test results are analyzed and information is provided.

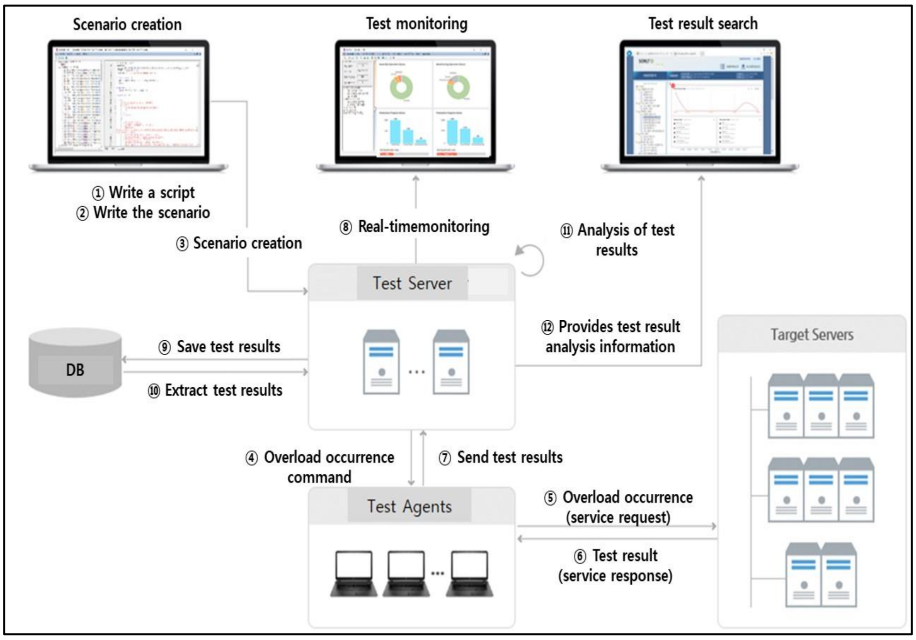

Fig. 2. The Flow chart of whole system

Fig. 3 shows the hierarchical structure of the platform in this system. The red dotted box will be developed in the future, and we have focused on Contract Generator Application, Contract Development Toolkit, Ricardian Contract Management, User Identity Management, Blockchain Engine Interface, and De-centralized Storage. The blockchain engine interface implements the API required to interface with Ethereum or other blockchain engines, and is generally responsible for RPC calls through HTTP and performs encrypted communication through SSL. Distributed storage is a method of dividing and storing information to be stored in a decentralized distributed node and implemented in a content-addressable-network (CAN) method on a P2P network. The contract development tool kit is implemented as a module in the form of a software development kit that communicates with the contract platform and provides common modules for web or mobile web development.

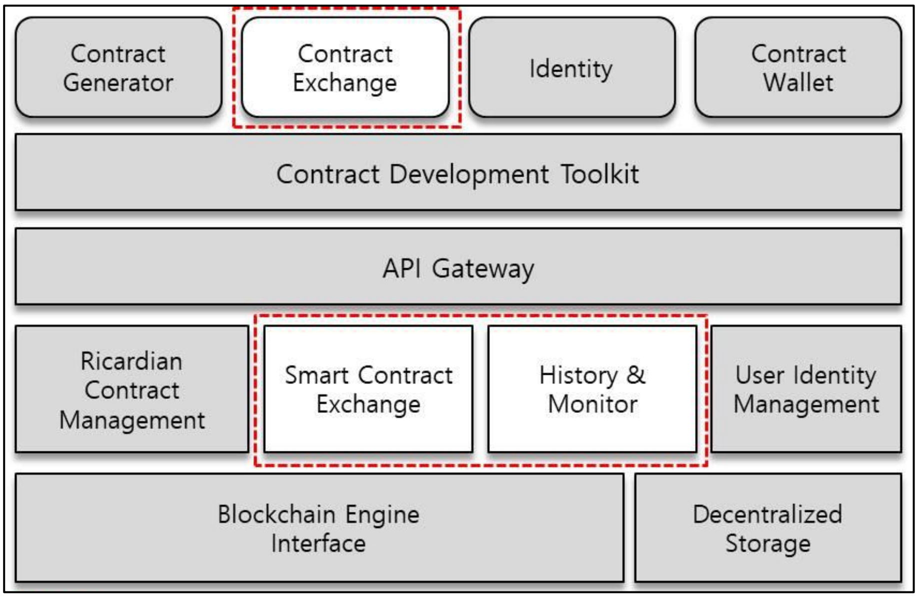

Fig. 3. Structure for System Platform

is a decentralized database in which information entered into the ledger is verified by blockchain parties using public key encryption technology.

3.2 Ricardian Contract Generation

We developed a technology that automatically generates a Ricardian contract based on a smart contract. A Ricardian contract is a digital document that defines conditions and content for two or more parties to act on each other, signed and approved by the parties in human-readable text. In other words, it generally refers to an electronic document having legal effect. The automatic creation of Ricardian contracts based on the contract template is provided in the form of on-chain contracts and off-chain contracts.

An on-chain contract is a contract that can be created and viewed and viewed on the blockchain, and the creator selects the contract template and completes the contract with the sender, recipient, date, title, content, etc. The completed content is a method that is electronically generated and hash value is stored in the blockchain.An off-chain contract is when a contract that is proposed outside the system has been created. First, if there is a physical contract, a hash value is generated after the physical object is scanned and stored in a distributed storage. These hash values are stored in the blockchain's contract meta information. When using an external electronic document without an actual contract, a hash value is generated after storing the original electronic document in a distributed storage. At this time, the issuer, document ID, QR code, etc. are stored in the contract meta information of the blockchain together.

4 Conclusion

In this paper, we designed a web service for web-based smart contract management. This service allows applications to run through mobile-based biometric authentication. On the web-based basis, smart contracts can be created and viewed through DApp. In addition, we designed an application platform that can be used for heterogeneous applications.

In this system, it is possible to support on two or more blockchain platforms, and it is designed to run on minimum ETH and EOS. In order to strengthen the vulnerability of security, it has to be performed through an external institution's verification system and is designed to have a processing speed of at least 300 TPS (Transaction Per Second).

The development of this system can be used for official mail sending service and contract management service. In the official document sending service, it can be used for sending and reading public documents between companies. In addition, confidentiality and integrity are strengthened through the automatic generation technology of Ricardian contracts. Lastly, it provided a user-friendly interface that includes TTS (Test To Speech) and STT (Speech To Text) functions, maximizing the official mail service.

In the contract management service, it is possible to create and view contracts between enterprises or individuals or individuals to individuals. And by applying the visualization module that can easily check the contents of the contract, anyone can easily check the contents of the smart contract. Finally, the elderly and digital technology marginalized groups were also easily accessible.

As a future task, it is necessary to improve the processing speed to 3000TPS or more by strengthening various functions. In addition, there is a risk of loss through electronic storage, so it is necessary to improve functions that enable unsystematic storage. Lastly, it is necessary to simplify the work to minimize costs when preparing a contract.

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The Effect of Korean Companies Business Environment and Halal Certification on Export Performance

Hyuk Jun Choi [0000-0003-4004-8722]

Department of International Logistics, Pyeongtaek University, 111 Yongyi-dong, Pyeongtaek City, Gyeonggi-do, 17869, Republic of Korea
Profchoi@ptu.ac.kr

Abstract. The global halal industry is expected to grow by 8% annually from $2 trillion in 2016 to $3 trillion by 2021 (Thomson Reuters, 2018). The main factor in the global halal market expansion is the increase in Muslim population, which is the main consumer, and the annual growth rate of Muslim population is estimated to be 1.5% over the next 20 years, more than double the growth rate of non-Muslim population of 0.7%. This study analyzed the impact of Korean companies' business environment, strategy, and government support on halal certification acquisition and also analyzed the impact on export performance. And This study analyzed the impact of halal certification on export performance. As a result of the analysis, first, it was analyzed that the corporate environment and government support affected the acquisition of halal certification. Second, halal certification was analyzed to affect export performance. Third, the corporate environment and corporate strategy were analyzed as factors affecting export performance.

Keywords: Halal, Halal Market, Halal Certificate, Export Performance.

1 Introduction

Over the past decade, the term halal has evolved to take on a new meaning. What used to be mostly about food and Islamic financing is now seen as a way of life, sending ripple effects across supply chains and industries. The trend is now stimulating billions of dollars in halal market expansion. In 2017, the global halal economy amounted to $2.1 trillion as the world's roughly 1.8 billion Muslims warm up to halal lifestyle products. Halal food and beverage products make up the largest category, with consumers worldwide spending $1.3 trillion, followed by halal clothing at $270 billion, halal media and entertainment at $209 billion, halal travel at $177 billion, halal pharmaceuticals at $87 billion, and halal cosmetics at $61 billion.
In order to enter the Halal market efficiently, this study aims to analyze the impact of the corporate environment, corporate strategy, and government support system on the understanding and acquisition of Halal certification, and to analyze the impact on the export performance of Halal certified companies.

2 Literature Reviews

The word ‘Halal’ is originated from an Arabic word meaning permitted or allowable (JAKIM). Halal are things or actions that permitted by Shariah Law/Islamic Law and it should be performed to show an obligation towards Islamic faith(Tarmizi et al, 2014). As a defining market parameter, halal is evolving and expanding. Traditionally, halal was seen to refer only to meat and poultry, specifically with reference to the method of slaughter. More recently, this has grown to include non-meat foods such as dairy, baked goods, snacks, confectionery, ready-made meals and other processed food and beverage products(ITC, 2015). Most of the halal-related studies were conducted in the Middle East and Southeast Asia. Min(2015) analyzed the characteristics of the halal markets in Indonesia and Malaysia understanding the halal market as a whole.

Jeong et al(2016) suggest the implications for the domestic halal food industry by analyzing the trade structure and the domestic and international trends of halal food industry growing into a global mega-industry. Jeong et al(2015) reviewed the status of supply, consumption, and import and export in terms of export market development through a literature survey on the Halal market. It also presented its implications and policy alternatives through a survey of experts on halal product exports by Korean companies and prior case studies such as Malaysia, Indonesia, UAE and Japan. In introducing the concept of halal logistics, Rudy Bruil (2010) conducted a perception survey of Muslim consumers in halal meat distribution, focusing on the supply chain of the effective halal market. Tarmizi (2014) presented guidelines and standards for halal logistics based on the fact that halal workers are less interested in performing halal logistics. In addition, 156 employees of Malaysian logistics companies were studied for factors affecting Halal logistics preparation.

Shah(2016) suggested that logistics service providers should be successful in the halal logistics industry, analyze business flows by country, and provide active government support and customer service to non-Muslims as well as Muslims to use halal food. Meanwhile, Lee(2012) considered Islamic law and Malaysia's legal system and halal certification system, and Lee et al(2014) presented the difficulties of standards for halal certification.

Korean companies lack information on the halal market, and halal-related research is also mostly literature research and halal market research. This study seeks to derive export performance factors for Korean companies operating in the halal market.

3 Model and Result

3.1 Model

The following Figure 1 is a model for this study.

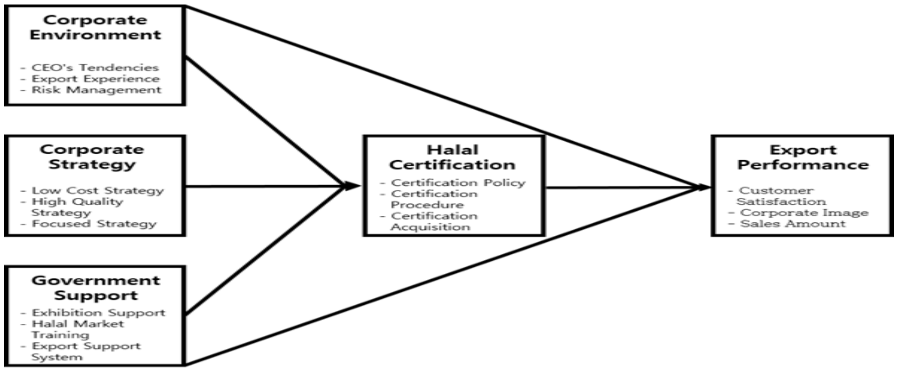

Fig.1. Research model

3.2 Basic Statistics Analysis

3.2.1 Sample Selection and Data Collection

For the analysis of this study, a questionnaire survey was prepared for companies with experience exporting to the halal market. A total of 291sample targets were collected via e-mail, fax and face to face interviews, of which 248 were used for analysis.

3.2.2 Method of Analysis

Statistical processing of surveys collected for this study used SPSS 25.0 and Analysis of Moment Structural (AMOS) 21.0 statistical programs. The specific analysis methods of this study are as follows. First, reliability analysis is conducted to verify the reliability of the questionnaire. Second, we conduct Confirmatory factor analysis to measure the relationship between latent variables as well as between observation variables. In addition, a correlation analysis is conducted to determine the causal relationship of each factor with newly obtained variables through a verifiable factor analysis. Finally, Path Analysis was conducted to derive the performance factors of the halal market of Korean companies for the purpose of this study.

3.3 Results

The general status of the companies to be sampled was conducted with frequency analysis, and the number of employees, industries, export experiences, and export area were analyzed. Demographic characteristic of respondents by survey is as follows.

Table 1. Demographic Characteristic of Respondents

Classification	Detail	Response(No.)	Percentage(%)
Size	under 10 Labors	22	8.87
	11-50	74	29.8
	51-100	86	34.6
	101-300	54	21.7
	Over 301	12	4.83
Industry	Cosmetics	34	13.7
	Food & beverage	115	46.3
	Clothing & fashion	15	6.04
	Agricultural & Fishery	23	9.27
	Tourism	22	8.87
	Medication	21	8.46
	Logistics	18	7.25
Export Experience	under 2	29	11.7
	2-5	45	18.1
	5-8	56	22.5
	8-10	75	30.2
	over 10	43	17.3
Export Country	Saudi Arabia	52	20.9
	UAE	57	22.9
	Indonesia	43	17.3
	Malaysia	62	25.0
	Singapore	34	13.7
Total		248	100.0

The reliability analysis results of the questionnaire are shown in Table 2.

Table 2. Reliability Analysis Results

Theoretical variables	Measurement variables	Cronbach's Alpha
Corporate Environment	CEO's Tendencies	.890
	Export Experience	.889
	Risk Management	.895
Corporate Strategy	Low Cost Strategy	.892
	High Quality Strategy	.888
	Focused Strategy	.888
Government Support	Exhibition Support	.887
	Halal Market Training	.885
	Export Support System	.885
Halal Certification	Certification Policy	.891
	Certification Procedure	.892
	Certification Acquisition	.890
Export Performance	Customer Satisfaction	.888
	Corporate Image	.886
	Sales Amount	.885
	Net Profit	.887
Cronbach's Alpha α	.894	

Criteria for goodness of fit are shown in Table 3.

Table 3. Criteria for Goodness of Fit

χ2	df(χ2/df)	P-V	GFI	AGFI	CFI	RMR	NFI	TLI
7.13	4(1.78)	.000	.987	.906	.993	.008	.980	.960

The following Table 4 shows the results of the correlation analysis.

Table 4. Correlation Analysis Results

Factor	A	B	C	D	E
Corporate Environment (A)	1				
Corporate Strategy(B)	.31**	1			
Government Support(C)	.22**	35**	1		
Halal Certification(D)	.59**	.13	.21**	1	
Export Performance(E)	.27**	.21**	.14	.69**	1

The following Table 5 shows the results of path analysis.

Table 5. Path Analysis Results

Path	COE	E.M	T-V	P-V	Results
Corporate Environment-> Halal Certification	.203	.091	2.080*	.037	Accept
Corporate Strategy-> Halal Certification	.092	.093	.905	.321	Reject
Government Support-> Halal Certification	.201	.098	2.054*	.044	Accept
Halal Certification-> Export Performance	.342	.103	3.300**	.000	Accept
Corporate Environment-> Export Performance	.206	.082	2.095*	.041	Accept
Corporate Strategy-> Export Performance	.211	.078	2.150*	.038	Accept
Government Support-> Export Performance	.056	.081	.532	.427	Reject

* $p<.05$, ** $p<.001$

4 Conclusion

This study analyzed the impact of corporate environment, corporate strategy, and government support on halal certification acquisition and export performance in order to find efficient ways for Korean companies to enter halal as the halal market grows rapidly. It also analyzed the impact of the halal certification system on export performance. This study used the questionnaire method, and the survey was distributed and collected by companies with export experience in the halal market. A total of 302 copies of the survey were distributed and 254 copies were collected, with a total of 248 companies having a valid sample. Specific analysis methods were frequency analysis and path analysis. The analysis results and implications of this study are as follows. First, the corporate environment and government support are affecting halal certification. This shows that export experience and management's inclination to the halal market are very important, and that the government's education on the halal market and the establishment of an export support system are very important. Second, understanding the halal certification system and obtaining halal certification affect export performance. This shows that it is very important to obtain Halal certification and gain the trust of local consumers. Third, the corporate environment and corporate strategy are affecting the export performance of the halal market. It can be seen that risk management is needed for companies' halal markets, and a customized strategy is needed considering the characteristics of the halal market. In particular, if the centralization strategy and excellent quality of the segment market through halal certification are put forward, consumers can gain trust even if it is a high-priced product. .

On the other hand, the limitations of this study first require more systematic and specific research, such as economic conditions, industrial analysis, market analysis, logistics infrastructure, and corporate advancement cases. Second, the halal market is judged to have sufficient market conditions for food companies, pharmaceutical and cosmetics companies, and logistics companies to enter, and research on how to enter the market needs to be conducted in depth.

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A Study on the Utilization Factors and Satisfaction of Cross-Border e-Commerce in Korea

Byeogtae Ahn[1 [0000-0003-3431-9493]] and Hyukjun Choi[2 [0000-0003-4004-8722]]

[1] Faculty of Division of Liberal Arts, Anyang University, 37-22, Samduck Minahn-gu, Anyang-City, Gyeonggi-do, 430-714, Republic of Korea
ahnbt@anyang.ac.kr
[2] Department of International Logistics, Pyeongtaek University, 111 Yongyi-dong, Pyeongtaek-City, Gyeonggi-do, 17869, Republic of Korea
profchoi@ptu.ac.kr

Abstract. In 2020, The global economy was depressed due to COVID-19, and many countries implemented many fiscal policies to prevent the recession. Cross-border e-commerce is a service that refers to the entire process of logistics, funds, and information, and now the function of cross-border e-commerce is gradually expanding, including functions such as purchasing goods, logistics warehouses, customs declaration, loan credit, platforms, and payment. Cross-border e-commerce is growing rapidly, changing the customs of traditional trade. Thus, this study sought to derive important factors that Korean consumers consider when using cross-border e-commerce. The analysis method of this study was AHP and IPA analysis. The AHP analysis showed that among the four main factors, the transaction factor is the most important. In addition, IPA analysis showed that one factor of transaction, two factors of e-commerce system, two factors of logistics, and one factor of payment were the factors of major improvement.

Keywords: E-Commerce, Cross-Border E-Commerce, AHP, IPA.

1 Introduction

The prolonged COVID-19 has caused many changes not only in Korea but also around the world. E-commerce, in particular, has become a key shopping tool due to COVID-19. According to Euromonitor(2020), the global e-commerce volume in 2019 was about $2 trillion, a high annual growth rate of more than 20 percent, and global cross-border E-commerce market is forecast to grow to more than 8% CAGR in 2020-2024. Increasing penetration of mobile computing devices and the adoption of blockchain technology in the logistics market are key factors driving growth in this market(TechNavio, 2019). In 2020, China's cross-border e-commerce trade (export and import) reached 1.69 trillion CNY, up 31.1 percent from a year earlier. Among them, exports rose 40.1% year-on-year to 1.12 trillion CNY, and imports rose 16.5% year-on-year to 570 billion CNY. Meanwhile, Korea's Online direct sales amounted to 5.96 trillion won. It increased 65.4% from 2018 and exceeded 5 trillion won for the first time. In addition, direct online purchases amounted to 3.63 trillion won, up 22.3

percent from a year ago(Statistic Korea, 2019). Amid the global economic crisis, cross-border e-commerce is rapidly growing. Therefore, this study seeks to derive the important factors that Korean consumers consider when using cross-border e-commerce and analyze their satisfaction.

2 Literature Review

E-commerce generally refers to the production, advertising, sale and distribution of products through electronic means. E-commerce can occur within and between three basic participant groups – business, government and individuals. There are four main types of e-commerce, namely, business to business (B2B), business to consumer (B2C), consumer to consumer and business to government. E-commerce can be divided into domestic or cross-border according to whether the buyer and seller are located in the same country or not(ESCAP, 2019).

While the basic definition of e-commerce seems to be simple, it has become increasingly sophisticated for the past two decades in the following ways. First, the variety of e-commerce platforms has increased substantially. Second, a single e-commerce platform may have evolved from a marketplace into an e-commerce ecosystem. Third, technologies such as cloud computing, big data, the Internet of things, artificial intelligence (AI), machine learning and block chain have been adopted by e-commerce platforms which yield new business models. Fourth, the rapid development of e-commerce in many countries in the region has given rise to a large number of e-commerce operators.

CBEC (B2C) can be divided into two modes of operation(CIRS, 2018):

- Bonded Import: stocking in bonded warehouse – orders from consumers – sending products from bonded warehouse.
- Direct Purchase Import: orders from consumers - sending products from overseas.

The scope of cross-border e-commerce includes both international B2B and B2C. The scope of the study is covered by the B2C e-commerce sector. The types of cross-border e-commerce are largely divided into direct overseas purchases and reverse direct purchase. Among them, overseas direct purchase means that consumers directly purchase products they want through Internet sites such as overseas open markets or clothing brand sites. It is called overseas direct purchase. Korea's National Statistical Office defines it as 'online direct overseas purchase (import).

The rapid development of information technology has led to many changes in e-commerce methods, and research related to social network services and cross-border e-commerce is actively conducted.

The development of computer and internet technologies has promoted cross-border ecommerce (Valarezo et al., 2018), and international trade is expected to increase in size through cross-border e-commerce (Terzi, 2011). Thus, various studies have been conducted on cross-border e-commerce. A study by Gomez-Herrera, Martens and

Turlea (2014) predicted that cross-border e-commerce would significantly reduce trade costs, noting that an efficient and flexible international payment system would be important for the promotion of e-commerce.

Yang et.al (2014) produced electronic marketing, electronic customs clearance, and international logistics as factors that affect the form of overseas e-commerce for small and medium-sized businesses in China. Han(2014) proposed a plan to promote the use of online shopping malls in Korea by overseas consumers through an analysis of the current status of online shopping in Korea. Feng et al(2017) suggested that cross-border e-commerce products often require long-distance transport, so logistics-related problems are a priority to overcome and that international cooperation is needed between the parties involved. Kwak(2017) presented strategies for effective overseas direct sales in the Chinese market, Ahn(2017) compared the characteristics of cross-border e-commerce with traditional and e-trade, Hong (2017) conducted an analysis of customs clearance and logistics systems for reverse direct purchase of Korea and e-commerce in China. Kim et al(2020) proposed to develop related export policies and infrastructure, strengthen the cross-border e-commerce platform, establish and promote the role of the government, and improve logistics efficiency. Unlike previous studies, this study analyzes what factors Korean consumers usually consider when using cross-border e-commerce and the difference between important factors and satisfaction.

3 Research Design

3.1 Analytic Hierarchy Process

In this study, AHP techniques are used to analyze the main consideration factors for consumers using cross-border e-commerce. AHP is a decision-making method for capturing expert knowledge and experience(Satty, 1977). In this sense, it is a method for researchers involved in studies to quantitatively address problems by comparing multiple factors and evaluating the priorities of the multiple factors based on their knowledge and experience, showing advantages in deriving relative weights through pairwise comparison (Satty, 1980). AHP is performed through the following analysis process. First, to make a decision about a complex problem, related factors are stratified, which requires a process of creating higher level factors by clustering the variables influencing the decision. Second, a pairwise comparison of decision-making variables is performed, which grants a weight to each variable on a 9-point scale. The relative importance is derived from this pairwise comparison process. Lastly, the consistency in the responses of respondents is verified, which validates the significance of the analysis in general statistical analysis. Thus, AHP can be used to verify consistency through the consistency ratio using the consistency and random indices, typically determining that the consistency of the response is appropriate when the consistency is 0.1 or less.

3.2 Key Factors

In this study, in addition to the activation factors presented in the preceding study, additional improvement factors were considered through interviews with experts responsible for cross-border e-commerce. Experts interviewed eight e-commerce companies, the Korea Customs Service, e-commerce delivery companies, and e-commerce professors to derive the following factors. This study has derived 19 major variables through expert interviews and stratified the variable into four higher-level factors in consideration of the characteristics of the variables. The following Fig 1 shows the main factors for AHP analysis.

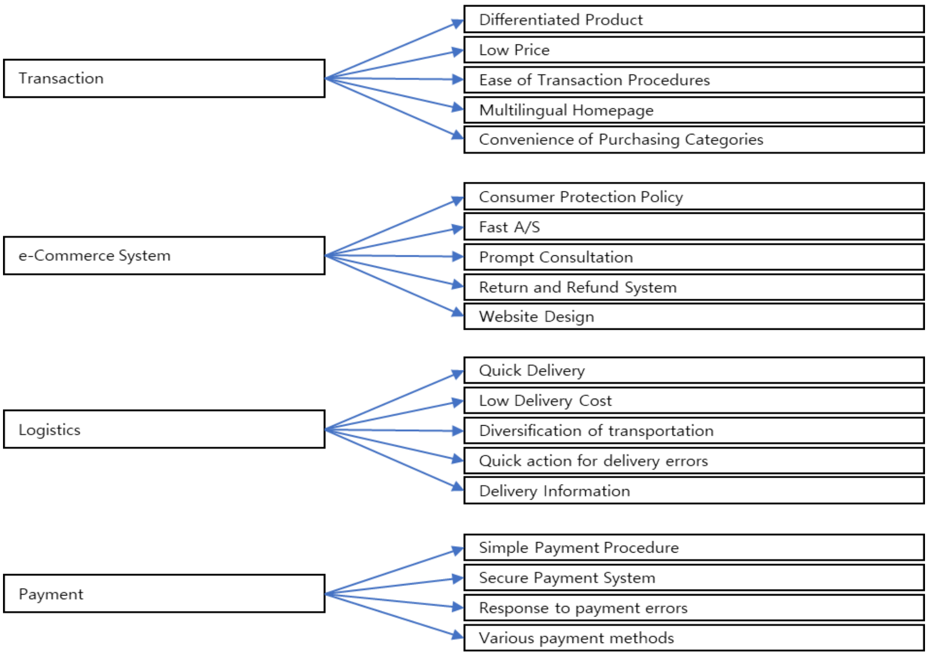

Fig. 1. Hierarchy Structure of Main Factors.

3.3 Sample Selection and Data Collection

This study prepared and distributed questionnaires to Korean consumers who use cross-border e-commerce. A total of 248 copies of the survey were distributed and 142 copies were collected, with 120 valid samples. This survey was conducted through e-mail, fax and messenger which lasted approximately one month from August 2020.

4 The Results of AHP Analysis and IPA

4.1 Basic Statistics Analysis

The study analyzed the general status of consumers using cross-border e-commerce, and the results were Table 1.

Table 1. Demographic Characteristics of Respondents

Classification	Detail	Response(No.)	Percentage(%)
Gender	Male	66	55.0
	Female	54	45.0
Age	20-30	54	45.0.
	31-40	35	29.1
	41-50	19	15.9
	51-60	12	10.0
Occupation	Student	73	60.8
	Office worker	12	10.0
	Manager	5	4.2
	Expert	8	6.7
	Housewife	22	18.3
Purchase item	Clothing and Fashion	47	39.2
	Cosmetics & Beauty	17	14.1
	Home appliances & electronics	28	23.3
	Food & Beverage	9	7.5
	Baby Goods	8	6.7
	Daily Necessities	11	9.2
Total		120	100.0

4.2 The Results of AHP Analysis

The following Figure 2 shows the results of the AHP analysis.

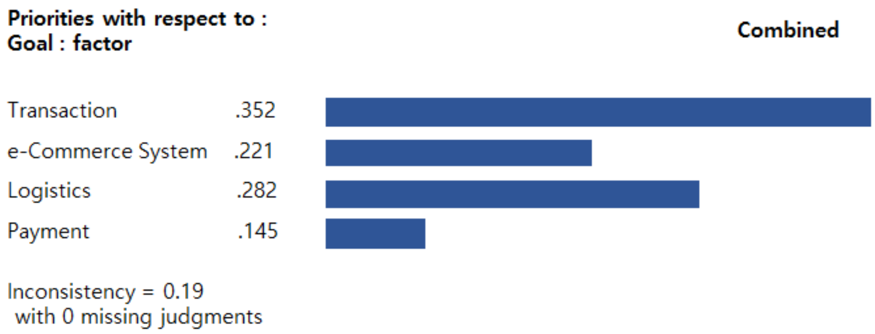

Fig. 2. AHP Analysis Results

4.3 Important Performance Analysis

Importance-Performance Analysis is the first technique used by Martilla & James(1977). This method evaluates the importance before and after use of each attribute to measure the user's satisfaction with the product or service. and it is an evaluation technique that allows comparison and analysis of the relative importance and achievement of each property at the same time. The following Figure 3 shows the results of the IPA matrix analysis.

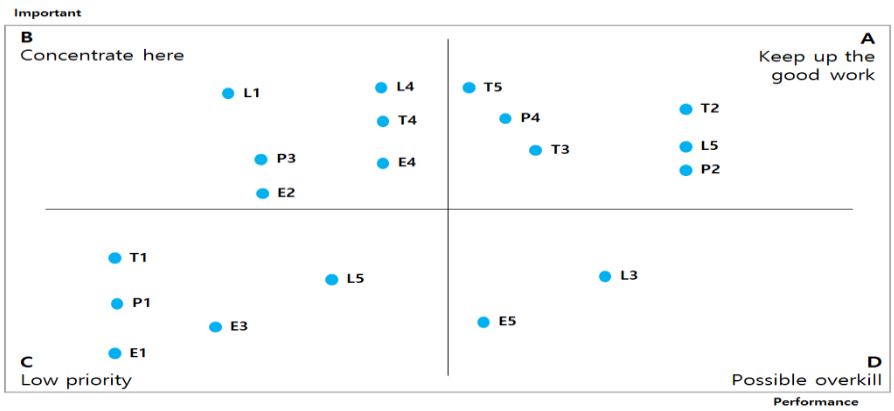

Fig. 3. IPA Matrix Results

The following Table 2 shows the results of the IPA analysis.

Table 2. IPA Results

Main Factor	Variables
Transaction	T1. Differentiated Product T2. Low Price T3. Ease of Transaction Procedures T4. Multilingual Homepage T5. Convenience of Purchasing Categories
E-Commerce System	E1. Consumer Protection Policy E2. Fast A/S E3. Prompt Consultation E4. Return and Refund System E5. Website Design
Logistics	L1. Quick Delivery L2. Low Delivery Cost L3· Diversification of transportation L4· Quick action for delivery errors L5· Delivery Information
Payment	P1· Simple Payment Procedure P2· Secure Payment System P3· Response to payment errors P4· Various payment methods

5 Conclusion

Based on ICT, the cross-border e-commerce market is growing rapidly, and its size is expected to expand further. In particular, cross-border e-commerce is expected to be a new way for small and medium-sized Korean companies and startups that need to enter the global market to overcome the limitations of the domestic market. At a time when cross-border e-commerce is rapidly increasing, this study derived important factors that Korean consumers consider when using cross-border e-commerce and analyzed their satisfaction accordingly. In order to achieve the purpose of this study, the relative importance was calculated through a comparative evaluation between each factor using the Analytical Hierarchy Process (AHP). In addition, Importance-Performance Analysis (IPA) was conducted to simultaneously determine the importance and satisfaction of cross-border e-commerce trade services. The AHP analysis in this study showed that the transaction factor (0.352) was the most important factor, followed by the logistics factor (0.282), the e-commerce system (0.221), and the payment factor (0.145). Meanwhile, IPA analysis shows that the key improvement factors are "multilingual homepage" in the transaction factor and "Fast After Service" and "Return and Refund System" in the E-commerce system. In terms of logistics factors, the two factors were 'quick delivery' and 'quick action for delivery errors'. The payment factors were analyzed as 'response to payment errors'. The three factors that should be maintained and grown were 'low price', 'ease of transaction procedures' and 'convenience of procuring categories'. It was analyzed as one factor of 'delivery information' in logistics factors and two factors of 'secure payment system' and 'various payment methods' in payment factors.

The limitations of this study are as follows. First, the study was conducted focusing only on Korean consumers. E-commerce trade is carried out in many other countries, so research on consumers in various countries and regions is needed. Second, cross-border e-commerce needs to be addressed from the corporate side. In particular, it is necessary to analyze what sectors are needed for overseas direct sales and entry. Third, it is also thought that it would be meaningful to analyze the differences between border e-commerce by product purchase type.

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Study of Effective Storage System for MPEG-7 Document Clustering

Byeongtae Ahn[0000-0003-3431-9493]

Liberal & Arts College, Anyang University, 22, 37-Beongil, Samdeok-Ro, Manan-Gu, Anyang 430-714, South Korea.
ahnbt@ anyang.ac.kr

Abstract. To use multimedia data in restricted resources of mobile environment, any management method of MPEG-7 documents is needed. At this time, some XML clustering methods can be used. But, to improve the performance efficiency better, a new clustering method which uses the characteristics of MPEG-7 documents is needed. A new clustering improved query processing speed at multimedia search and it possible document storage about various application suitably. In this paper, we suggest a new clustering method of MPEG-7 documents for effective management in multimedia data of large capacity, which uses some semantic relationships among elements of MPEG-7 documents. And also we compared it to the existed clustering methods.

Keywords: MPEG-7, XML, Clustering, Semantic Block, Multimedia

1 Introduction

Recently, as various multimedia applications such as MP3, video mail, and digital multimedia broadcasting (DMB) have appeared in mobile devices, the management of multimedia data under limited resources has become a very important research topic. However, in order to effectively manage a large amount of multimedia data under limited resources, it is essential to manage metadata for multimedia data.

Recently, MPEG-7 has been adopted as an international standard for multimedia data technology methods in order to be able to handle multimedia effectively [1]. MPEG-7 is a standard defining multimedia data description method, that is, multimedia metadata in XML format [2]. Therefore, using MPEG-7 can effectively handle multimedia data [3,4].

However, in order to handle MPEG-7 data more efficiently under limited resources, an appropriate clustering method is required, and MPEG-7 documents can be expressed in XML format. Therefore, existing XML clustering methods can be used for MPEG-7 document management. Fortunately, various clustering methods for XML documents have recently been proposed [5-8]. However, MPEG-7 documents have different characteristics from general XML documents. In other words, there are various semantic relations between the elements of the MPEG-7 document. Therefore, in order to manage MPEG-7 documents more efficiently, a new clustering method reflecting this is required.

Existing studies on XML clustering can be largely divided into a method targeting documents and a method targeting schema. Here, as in this paper, we will briefly examine the characteristics and problems of clustering methods targeting XML documents as well as targeting XML schemas. Document-based clustering is a method of determining an effective clustering policy by receiving only an XML document as an input without any information about the XML schema. This method mainly handles XML documents by recognizing them as a tree.

Guillaume and Murtagh [5] proposed an XML document clustering method. In this paper, the problem of clustering XML documents is regarded as a problem of finding the optimal partition using graph theory. In other words, documents in the database can be divided into multiple clusters by modeling each document in a database as a node and finding the optimal partition in a graph modeling links between documents as weighted edges between nodes. In addition, the accuracy of clustering is improved by adding keyword links between documents that share the same keyword. However, other semantic relationships between elements are not used.

Francesca et al. [6] proposed a method of extracting a matching common structure between elements of two trees representing XML documents. Through this, they extract the representative structure of the cluster through the process of merging and simplifying the trees. Then, a hierarchical clustering algorithm is applied based on the weight value defined as the size of the common structure. However, in the case of a complex tree, it takes a lot of time to merge.

Schema-based clustering is a method used when the schema representing the frame of an XML document can be known. In general, many well-defined applications have schemas for most XML documents they handle. MPEG-7 also has a well-defined schema [2]. This schema determines the structure of XML documents in advance. Therefore, by using this, a more effective clustering policy can be devised.

The XClust proposed by Lee et al. [7] measures the similarity between two DTDs representing a schema, and clusters DTDs in the same domain using a hierarchical technique based on the similarity. In this method, after modeling the DTD in the form of a tree, the linguistic and structural similarity is calculated by comparing the names, properties, and paths to the root node of each node constituting the DTD. In addition, contextual similarity is determined through the similarity between direct descendants and terminal nodes. The similarity between DTDs is calculated as a matrix through the obtained similarity between nodes, and the DTD instance documents are gradually clustered from DTD pairs with high similarity using this. This method has high accuracy in consideration of contextual factors between nodes of each DTD, but it takes a long time and has a problem that accurate similarity cannot be obtained between DTDs of different sizes.

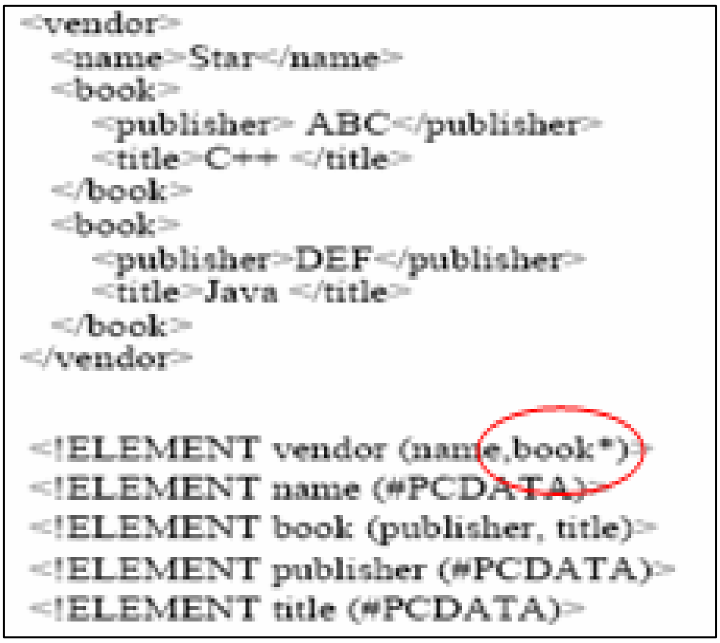
OrientX proposed by Xiaofeng Meng et al. [8] applies various clustering using schema. This is an improved method of dividing the XML document into subtrees and storing them in one record by grouping them into logical page units in consideration of association. First, the schema is analyzed to form a semantic block. This semantic block is a logical unit for storage as a group of related elements. OrientX uses an empirical method to obtain these semantic blocks. However, since only the grammatical elements of the schema (eg cardinality) are considered, it takes a lot of time to construct a semantic block in a complex schema structure, and contextual similarity between each element is not supported. In this paper, we propose a new clustering method that can efficiently manage MPEG-7 documents by improving this method. The paper is organized as follows. In Chapter 2, the proposed MPEG-7 clustering method is analyzed, and in Chapter 3, the proposed clustering method is compared with the existing methods. Finally, Chapter 4 proposes conclusions and future tasks.

2 MPEG-7 Document Clustering

This chapter proposes a new clustering method applicable to the management of MPEG-7 documents based on the analysis of the previous studies.

2.1 Motivation of the proposal

In OrientX introduced in the previous chapter, schema analysis is performed for clustering. A schema graph is drawn through the schema, where a node in the schema graph becomes the root of the semantic block. At this time, there are two cases where the root of the semantic block becomes the following. First, it is the case of the root of the schema graph. Second, it is the case of having child nodes while having * or + as cardinality. In this method, an instance of such a semantic block is viewed as one logical record, and if it belongs to the same semantic block, it is stored in close proximity (clustered). Fig. 1 shows an example of schema and XML document[9].



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<vendor>
  <name>Star</name>
  <book>
    <publisher> ABC</publisher>
    <title>C++ </title>
  </book>
  <book>
    <publisher>DEF</publisher>
    <title>Java </title>
  </book>
</vendor>

<!ELEMENT vendor (name,book*)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT book (publisher, title)>
<!ELEMENT publisher (#PCDATA)>
<!ELEMENT title (#PCDATA)>
```

Fig. 1. Schema & Xml Document

Fig. 2 shows the result of applying OrientX's clustering storage policy.

We intend to apply OrientX's clustering method applied to XML document management to MPEG-7 document management.

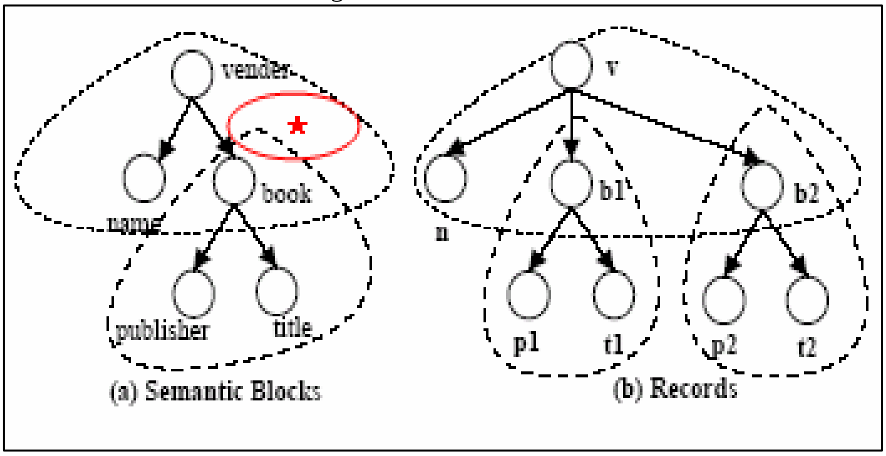

Fig. 2. OrientX Clustering Storage

This is because MPEG-7 documents are also XML documents and can be saved by applying the OrientX method. However, when MPEG-7 documents are saved only with the OrientX method, two main problems arise. First, since MPEG-7 schema has a very complex structure, it is difficult to construct a semantic block simply by grammatical meaning. Second, it is a storage ignoring the association between MPEG-7 elements[10].

Therefore, this paper presents two solutions. First, we introduce the R-CT attribute that represents the organic association between each element. Second, various semantic block generation rules are used in consideration of the complex MPEG-7 schema. Learn more about how to do it in the next section.

2.2 Clustering application procedure

We propose a three-step clustering application procedure for MPEG-7 document clustering. The application of the clustering method we propose consists of three steps. First, step 1 redefines the schema by adding an R-CT attribute value to indicate the elements related to the existing MPEG-7 schema. Step 2 constructs a semantic block based on the redefined schema. In the last 3 steps, clustering is performed using a clustering algorithm through the configured semantic blocks. Fig. 3 shows the procedure for applying this three-step clustering. A detailed description of this is made in the following sections.

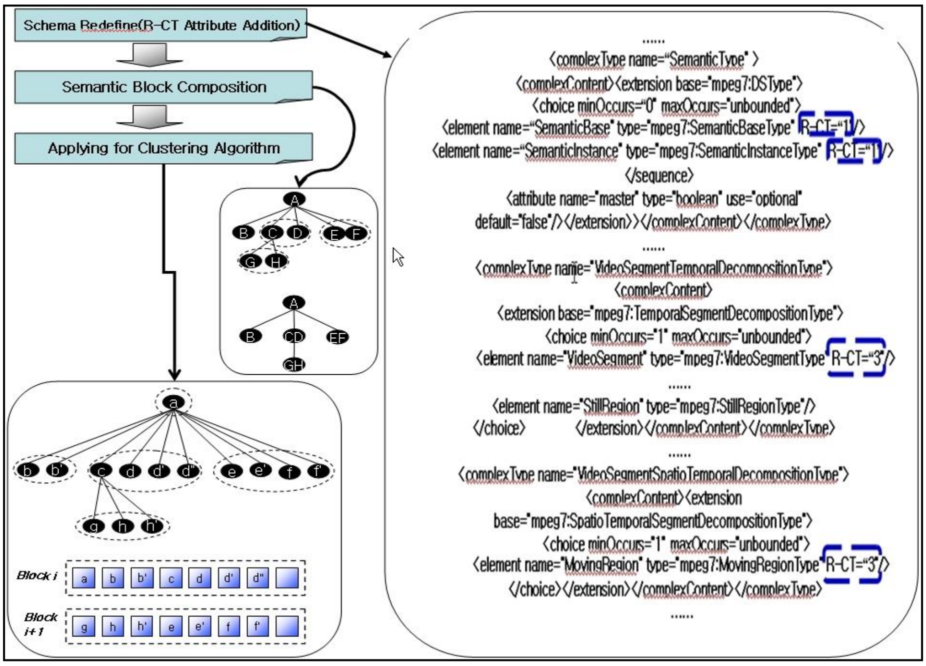

Fig. 3. Clustering Step of Mpeg-7 Document

Fig. 4 is the MPEG-7 schema for this. It consists of various descriptors (D: Descriptor), DS: Description Scheme, and data types defined in MPEG-7. In other words, movingRegionType and StillRegionType to describe each key image, MediaInformationType, CreationInformationType, and TextAnnotationType to describe information about other videos were used, centering on the VideoSegment type to describe metadata about the video[11].

```
      - <choice minOccurs="0" maxOccurs="unbounded">
          <element name="VisualDescriptor" type="mpeg7:VisualDType" />
        </choice>
      - <choice minOccurs="0" maxOccurs="unbounded">
          <element name="TemporalDecomposition" type="mpeg7:VideoSegmentTemporalDecompositionType" />
          <element name="SpatioTemporalDecomposition" type="mpeg7:VideoSegmentSpatioTemporalDecompositionType" />
        </choice>
      </sequence>
    </extension>
  </complexContent>
</complexType>
+ <complexType name="DSType" abstract="true">
- <complexType name="SegmentType" abstract="true">
  - <complexContent>
    - <extension base="mpeg7:DSType">
      - <sequence>
        - <choice minOccurs="0">
            <element name="MediaInformation" type="mpeg7:MediaInformationType" />
            <element name="MediaLocator" type="mpeg7:MediaLocatorType" />
          </choice>
          <element name="StructuralUnit" type="mpeg7:ControlledTermUseType" minOccurs="0" />
        + <choice minOccurs="0">
        + <element name="TextAnnotation" minOccurs="0" maxOccurs="unbounded">
        </sequence>
      </extension>
    </complexContent>
  </complexType>
+ <complexType name="MediaTimeType">
+ <complexType name="VisualDType" abstract="true">
+ <complexType name="VisualDSType" abstract="true">
- <complexType name="VideoSegmentTemporalDecompositionType">
  - <complexContent>
    - <extension base="mpeg7:TemporalSegmentDecompositionType">
      - <choice minOccurs="1" maxOccurs="unbounded">
          <element name="VideoSegment" type="mpeg7:VideoSegmentType" />
        </choice>
      </extension>
    </complexContent>
  </complexType>
- <complexType name="VideoSegmentSpatioTemporalDecompositionType">
  - <complexContent>
    - <extension base="mpeg7:SpatioTemporalSegmentDecompositionType">
      - <choice minOccurs="1" maxOccurs="unbounded">
          <element name="MovingRegion" type="mpeg7:MovingRegionType" />
        </choice>
      </extension>
    </complexContent>
  </complexType>
```

Fig. 4. Mpeg-7 Schema

Fig. 5 is an example of an instance document generated according to this MPEG-7 schema. It is largely divided into 3 video segments and each has a key image.

```xml
- <Video id="TRECVID2003_253">
  + <MediaInformation id="news1_media">
  + <CreationInformation>
  + <TextAnnotation>
  - <MediaTime>
      <MediaTimePoint>T00:00:00:0F30000</MediaTimePoint>
      <MediaDuration>PT6M10S16105N30000F</MediaDuration>
    </MediaTime>
  + <VisualDescriptor xsi:type="GoFGoPColorType" aggregation="Average">
  - <SpatioTemporalDecomposition>
    - <MovingRegion id="ManMR1">
      - <TextAnnotation>
          <FreeTextAnnotation>Man1 (MovingRegion1)</FreeTextAnnotation>
        </TextAnnotation>
      - <TemporalDecomposition gap="true" overlap="false">
        - <StillRegion id="ManKeySR1">
          - <MediaLocator>
              <MediaUri>image.jpg</MediaUri>
            </MediaLocator>
          - <TextAnnotation>
              <FreeTextAnnotation>Man (still region)</FreeTextAnnotation>
            </TextAnnotation>
            <MediaTimePoint>T00:00:13:15405F30000</MediaTimePoint>
          - <VisualDescriptor xsi:type="ScalableColorType" numOfCoeff="16" numOfBitplanesDiscarded="0">
              <Coeff>1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6</Coeff>
            </VisualDescriptor>
          </StillRegion>
        </TemporalDecomposition>
      </MovingRegion>
    + <MovingRegion id="ManMR2">
    + <MovingRegion id="ManMR3">
    </SpatioTemporalDecomposition>
  - <TemporalDecomposition gap="false" overlap="false">
    - <VideoSegment id="shot253_1">
      - <MediaTime>
          <MediaTimePoint>T00:00:00:0F30000</MediaTimePoint>
          <MediaDuration>PT27S20830N30000F</MediaDuration>
        </MediaTime>
      - <TemporalDecomposition>
        - <VideoSegment id="shot253_1_RKF">
          - <MediaTime>
              <MediaTimePoint>T00:00:13:15405F30000</MediaTimePoint>
            </MediaTime>
          </VideoSegment>
        </TemporalDecomposition>
      </VideoSegment>
```

Fig. 5. Mpeg-7 Instance Document

3 Conclusion and Future Works

In this paper, a new clustering method based on XML schema is proposed for efficient storage of MPEG-7 documents.

The advantages of the clustering method proposed in this paper are as follows. First, it improves query processing speed by supporting clustering based on MPEG-7 schema. Second, by generating the most suitable semantic block for MPEG-7 applications, it can be used to implement an MPEG-7 document storage system suitable for various applications. Based on these, unlike existing systems, it is possible to search and manage multimedia effectively in a mobile terminal. In addition, consistent processing is possible for a large amount of MPEG-7 document retrieval.

In this paper, we proposed two semantic block generation rules generated based on various MPEG-7 applications. However, in this part, we need more creation rules that are more suitable for the actual meaning. Therefore, in order to support the creation of a complete semantic block, additional research is needed to enable the setting of various R-CT attributes. At this time, it is necessary to adapt to the increasingly complex and diverse MPEG-7 applications.

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The Development of Medical and Nursing VR Lesson Plan with Data Visualization and Evaluation Feedback

Wen-Yen Lin[1]and Hao-Lun Peng*[2]

[1] Nation Taichung University of Science and Technology, Taichung 404336, Taiwan

[2] Nation Taichung University of Science and Technology, Taichung 404336, Taiwan

qqnice@gmail.com

aellen1229022@gmail.com

Abstract. Build a "cloud computing platform" and develop the "database interface API application" in the VR lesson plans to achieve the goal of cloudification and visualization of data conversion information. To provide four major benefits. (1) Accurate teaching-learning feedback to enhance learning effectiveness: assist students in learning feedback and record self-learning effectiveness, and provide teacher feedback to adjust teaching methods, and provide developers with suggestions for optimizing and improving teaching plans. (2) Accurate management-manufacturers can use the platform's access control, manage authorized software, and appropriately allocate the voice AI computing cost of each lesson plan. (3) Accurate marketing-the promotion of data analysis technology to stimulate the industry, through market data analysis and decision-making judgments, to effectively grasp project benefits, product value-added, and improve customer satisfaction, which is conducive to market promotion and development. (4) Cultivating cloud talents-the cross-domain cooperation of the school's research team improves the technical level of teachers and students in line with the industry, and cultivates professional talents that meet the needs of the industry.

Keywords: Virtual Reality Cloud Computing, Learning feedback, Medical and health education, Data Visualization.

1 Introduction

1.1 The trend of virtual reality

With the advent of the information age, the introduction of virtual reality technology into the field of academic education is becoming more and more extensive. At present, the more common VR teaching plans can be roughly divided into medical training, machine operation, and chemical experiments. Recently, the cooperation between enterprises to develop VR projects or the application of VR in the education scene is also increasing, and VR smart platform projects are actively introduced, but most of the projects are limited to the output of the final results, and the in-depth analysis and visual presentation of the user's learning history are still Relatively lacking.

1.2 Build the system

In view of this, this study will take a VR medical teaching plan as an example, and build a cloud computing platform with data visualization and evaluation feedback functions. It is hoped that big data analysis can be used to give full play to the availability of data, and the data will be sorted and analyzed. It is then presented visually to reflect the "information value", to create a smart learning environment, and to bring more convenient and perfect teaching aid effects to teachers and students at the teaching site.

1.3 Taiwan will face an aging society

On the other hand, Taiwan will enter a super-aged society in 2026. By then, the demand for medical and nursing VR teaching plans is expected to increase significantly. While designing VR teaching plans, if a comprehensive cloud learning platform can be introduced, the "VR digital evaluation method "The advantage of "will bring a more efficient training process to the medical care field that focuses on practice.

2 Related work

This research hopes to combine the advantages of cloud digital platform, data visualization and evaluation feedback to enhance the effectiveness of technology-assisted teaching.

2.1 Cloud digital platform

Covers the use of various related education clouds and teaching model platforms. Sharing learning information in the cloud is a current trend of integrating education into technology (王子華 & 黃榮杰, 2012); scholars point out that cloud computing has made competition in the digital learning industry in Taiwan become fierce(古蕾琪, 2011). The principle of cloud computing is that users do not need to perform operations on personal computers, mobile phones, and other personal terminal devices through large-scale network-based server clusters. The data generated by the software does not need to be stored locally, but stored in a network-based data center. In this way, the computing power and storage space that users can use can be saved, and networked users can obtain the resources they need through terminal devices(Liu et al., 2015; Xu, Cheng, Sugumaran, & Safety, 2020).

2.2 Learning journey

The learning process is based on the collection of learning works, learning process, learning perception and self-reflection to observe students' knowledge and skills and performance of learning process(陳德懷、黃亮華，2003). This research refers to the learning process, including the learning process and evaluation records on the learning platform. For students, it can present learning conditions in different periods and provide opportunities for self-examination; for teachers, it can be used as a reference for teaching feedback and improving teaching.

2.3 Data visualization

In order to effectively transmit information, the data is presented through graphs, statistics and other tools. Graphical data visualization is a way to quickly and effectively evaluate information. It can help us see the world from a new perspective and reveal unexpected patterns hidden in information.(阪智香 & 地道正行, 2017).

2.4 Evaluation feedback

Course feedback has been proven to be a factor that affects the learning process and learner performance. Everyone believes that by providing students with appropriate levels of feedback, feedback messages can help narrow the gap between students’ current performance and expectations(Hattie & Timperley, 2007). Moreover, feedback is a powerful driving force that enables humans to work towards their goals(Shute, 2008).

3 Methods

The development method and process of the system will be further discussed. Before system development, properly plan, establish methods and tools, and follow the results to establish development standards, as a reference point for evaluation and verification, to make the development process more structured and easy Management, while achieving the improvement of development efficiency and quality.

3.1 Development plan

This research is expected to adopt a two-stage "synchronous mode", and the development within each unit stage will be developed using the "waterfall mode". If errors are found in a certain stage, feedback between the stages can be allowed, and corrections can be made as soon as possible, except for focusing on After understanding user needs and performing subsequent analysis and integration, the system development process is also presented in visual diagrams, and important functions, activities and features are depicted through brief diagrams.

3.2 System structure

The system architecture mainly adopts cloud services, which is composed of virtual reality modules, application interface modules, website server modules, database modules, and visualization modules. As shown in Figure 1, it can be operated by a computer or Mobile devices use system functions.

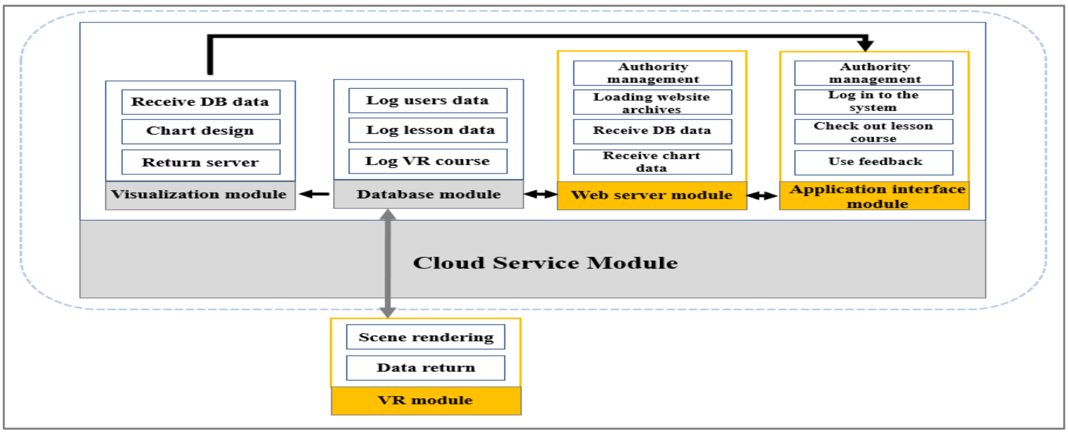


Figure 1. System structure

Module architecture. Cloud service modules include Microsoft Power BI service modules and Azure SQL service modules. The database module uses Azure SQL to record basic data, lesson plan data, and operation result data of VR lesson plan operations, and generates appropriate data tables after collating the data; the Microsoft Power BI service module will receive data from the Azure SQL database The data (historical data) is then designed and converted into visualized charts. The website server module is the carrier of the entire website, responsible for undertaking the functions and authority control of each end. The application interface module is the web interface that the user touches and operates. You can view a lot of information such as the learning history data of the VR lesson plan. Table 1 is the software and tools expected to be used in this study.

Table 2. Software and Tools introduction

category	Tool 1	Tool 2
UI Drawing	Adobe Illustrator	Adobe Photoshop
Modeling	3DS Max	-
Game Engine	Unity	-
Web	Html&css&vue.js	Node.js/express.js
Database	Microsoft Azure SQL Database	-
Data Visualization	Microsoft Power BI	-

System process. The user uses the Unity VR lesson plan. After the operation is completed, the program uploads the relevant data to the Azure SQL database, Google Forms, and also sends it to Power BI for information visualization. The website server then retrieves the visualization charts and data inventory. The data is presented to users for reference.

4 Results

4.1 VR lesson import to system

This research introduces a VR teaching plan for medical and nursing epilepsy (pediatric epilepsy), and will invite professional teams and medical teachers to develop relevant detailed evaluation standards and procedures, establish a cloud computing platform and combine with the assistance of big data analysis functions to build data visualization and The evaluation feedback function strives to give full play to the usability of the data and enhance the learning effectiveness of students.

4.2 System display

The following is the overall situation of importing courses into the system, taking the teacher's identity as an example. Figure 2 shows the screen when the user enters the web system at the beginning, and then uses FB for identity authentication, and the application interface module manages the identity of the loginer (The following will be demonstrated as a teacher)), and then Figure 3 is the screen to enter the website server module. This is the homepage of the system. The teacher can post new messages here to let students know the information. Figures 4 and 5 can let The teacher checks the recent learning history of the students. This page can display the learning status of each student, such as the percentage of each student’s score in the class in the children’s epilepsy course, and which chapter the student’s learning status is relatively poor can be shown by the line graph As well as the horizontal bar graph, we can see that Figures 6 and 7 can be used for class management, and new classes, students, and courses can be imported. You can plan here. Figure 8 shows that you can view the classroom and the student is here. The scores and time of the classroom learning children's epilepsy course are all based on the children's epilepsy course as a demonstration. In the future, different courses can be imported, and then the learning process of other courses can be analyzed.

Figure 2. Login page

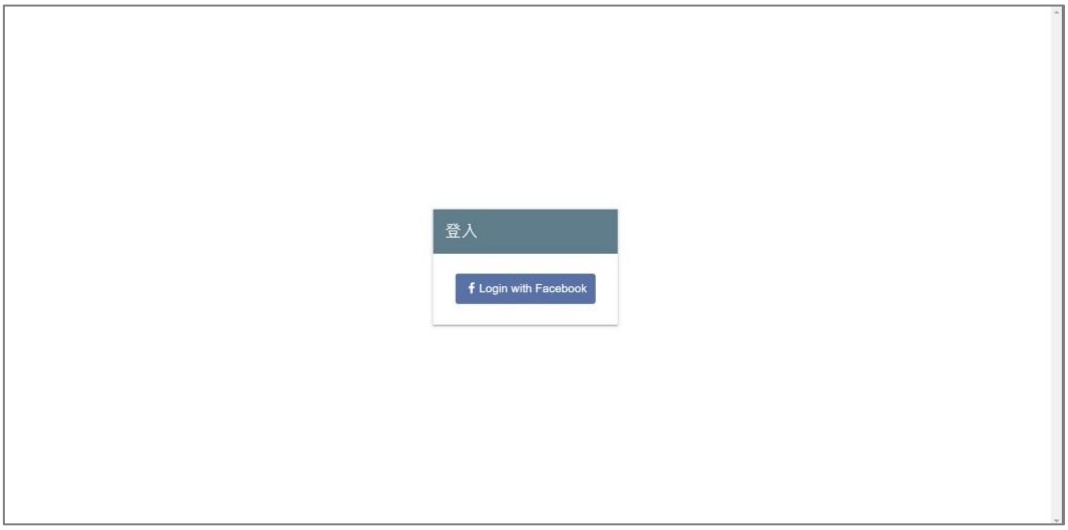


Figure 3. System homepage

Figure 4. Student learning journey

Figure 5. Learning journey for PowerBI

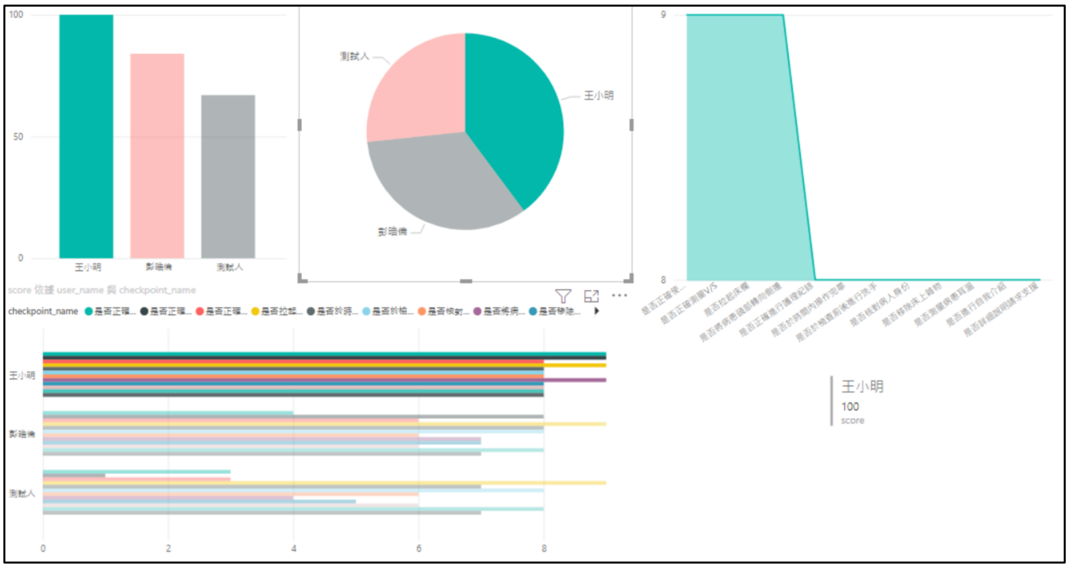


Figure 6. Class management

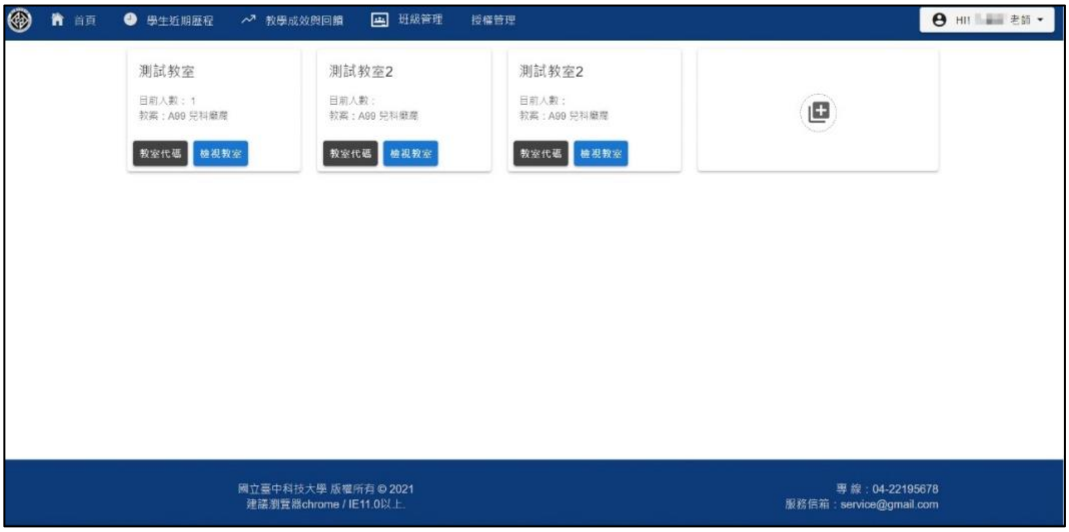


Figure 7. Import classes and courses

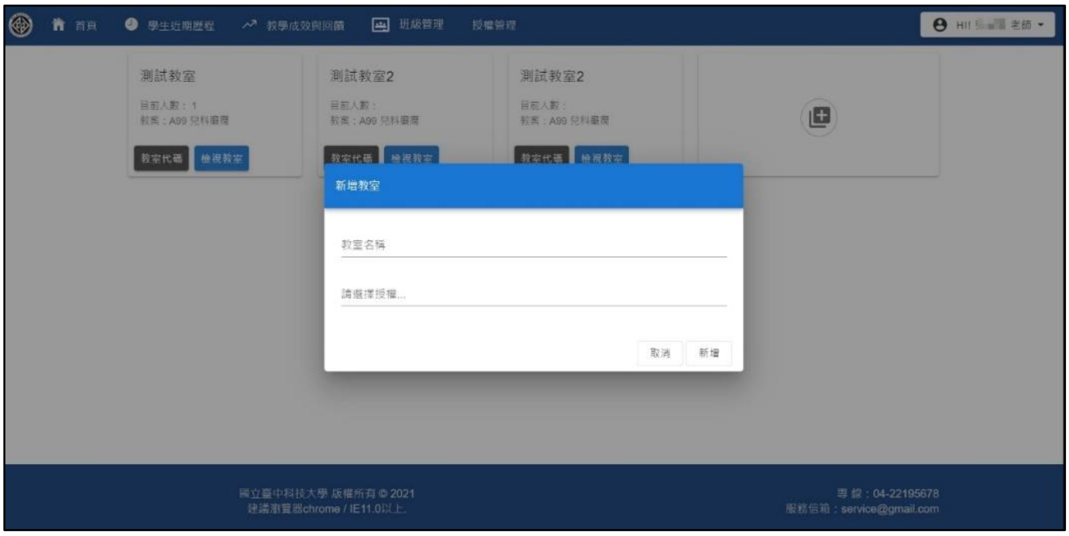
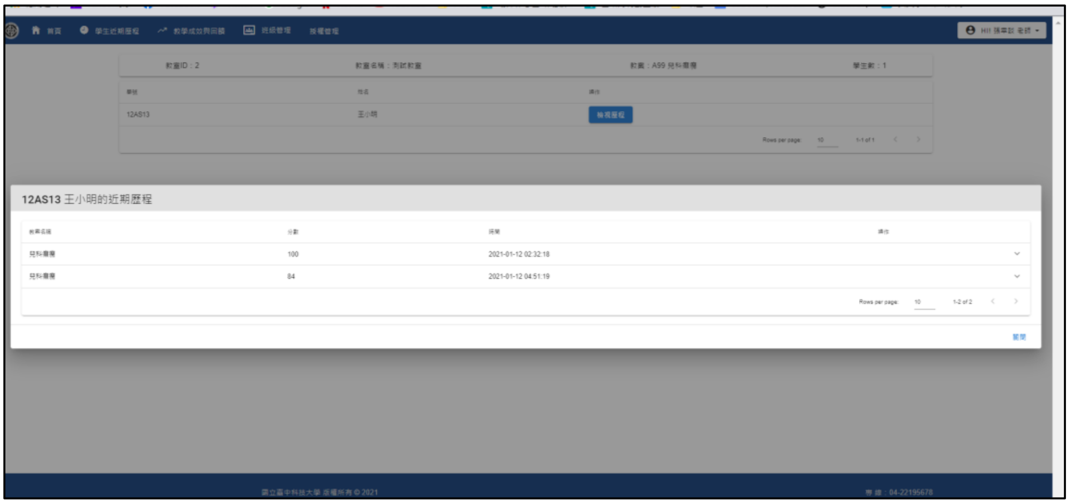


Figure 8. Check class status



4.3 Research results

The research results of this study are as follows:

(1) Import VR child epilepsy lesson plans to this system

(2) Using cloud computing platform combined with big data analysis applications

(3) Build a visual learning process in the platform system

(4) Platform system construction evaluation feedback function

(5) The evaluation feedback function of the platform extends the learning diagnosis function

4.4 Future work

Based on the above, this research hopes to use the advantages of virtual reality and big data analysis in the medical and nursing VR teaching plan, and extend the development of platform system functions, give full play to the availability of data, and actually apply it to the education site, create a smart learning environment, and improve the ease of teaching in the past. Encountered difficulties and learning bottlenecks, improve teachers' teaching effectiveness and students' learning effectiveness, expect to maximize the innovative value of applying virtual reality to the field of education and learning, and apply it to the cultivation of talents in the field of medical care that emphasizes practice, and improve medical care The training process.

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Multichannel convolutional neural network based soft sensing approach for measuring moisture content in tobacco drying process

YU Shusong[1[0000-0003-1554-5313]], BI Suhuan[2], DING Xiangqian[1] and ZHANG Guangrui[1]

[1]College of Information Science and Engineering, Ocean University of China, Qingdao, China
[2]School of Information and Control Engineering, Qingdao University of Technology, Qingdao, China
yushusong@ouc.edu.cn

Abstract. To address the issue that the control timeliness of the drying process is affected by the unavoidable time delay of moisture content measurement, a soft sensing approach for moisture content in tobacco is proposed, which is based on a multi-channel convolutional neural network (MC-CNN). Firstly, the filtered parameter features are sampled within the lag time and converted into a two-dimensional matrix. Then the parameters of different categories are cyclically transformed to build the input image-like data with multiple channels. Through multiple convolution layers and pooling layers, the MC-CNN model extracts multi-channel features from the feature maps. Moreover, the model effectively perceives the time-sequential and state-spatial coupling characteristics from the raw production data. The proposed method is then validated based on the production data collected from the real production process in the cigarette factory. An online prediction application has been finally achieved to measure the moisture content. Therefore, the detection delay is eliminated and the response time for exceptions is greatly decreased. The amount of tobacco with abnormal moisture content is greatly reduced in the drying process. As the result, the MAE and RMSE of the data measured by the proposed method in a normal production batch are 0.0136 and 0.0257, respectively. Through comparison and analysis of a variety of prediction models, the proposed model has a greater improvement in performance.

Keywords: Soft sensor, multi-channel, convolutional neural network, data-driven

1 Introduction

In industrial process control and optimization, it is important to keep efficiency, quality and energy consumption at the desired level. In practice, many of the associated variables are difficult to measure online due to technical and economic limitations, such as a severe measuring environment, large measurement delays, expensive costs, etc.[1] In the drying process of tobacco, the moisture content, as the feedback for the process control, is an important characteristic. Moisture measurement is difficult to be directly conducted especially when the tobacco is still in the dryer.

The soft sensing approach is to construct a mathematical model with measurable variables as input and estimated variables as output by selecting a series of related measurable variables. Data-driven soft sensors are recently applied to real-time prediction for process variables[2-5]. Yan et al.[6] proposed a novel soft sensor modeling method based on a deep learning network to estimate the oxygen content in flue gasses. A soft sensor based on DBN is applied for a debutanizer with unknown delay, which is a part of a refinery[7]. A spatiotemporal attention-based LSTM network is proposed for soft sensor modeling to predict the initial boiling points of heavy naphtha and aviation kerosene[8]. Literature proves that soft sensor modeling methods based on machine learning performed well in real-time predicting.

In the drying process of food and agricultural products, the moisture content is an important characteristic of product quality[9,10]. Vieira et al.[11] used a hybrid neural model as part of a soft sensor for the online measurement of milk powder. The applications of ELM and ANN for predicting the moisture ratio (MR) were investigated in the drying process of black cumin seeds[12]. Li et al.[13] applied a recurrent self-evolving fuzzy neural network to predict the temperature and moisture content in red maple drying process. However, the process variables involved in the abovementioned online prediction methods are few, it is necessary to develop a novel soft sensor modeling method for the tobacco drying process to deal with more process variables.

This paper proposes a data-driven soft sensing method for measuring the moisture content of tobacco based on a multi-channel CNN (MC-CNN). The raw production data is time-continuous, which contains abundant useful information that represents dynamic changes in drying process. It is difficult to extract the time-sequential characteristics from the production data when used single time sampling as input data. Furthermore, the state-spatial coupling between process variables and manipulated variables is a feature that should not be neglected in predictive modeling. The proposed method can effectively extract the features related to time-sequential and state-spatial coupling characteristics, predict the moisture content in tobacco.

2 Methodology

2.1 Moisture measuring with large delay

Generally, cut tobacco goes through warming, humidifying, drying and winnowing in the whole drying phase, as shown in Fig. 1. The moisture increase conditioner improves the consistency of tobacco by warming and humidifying it with hot steam. The rotary dryer with two drying zones can accelerate the dissipation of moisture by regulating working variables. The outlet moisture content is detected after the winnowing machine. The purpose of the process control is to keep the moisture content level within the required range. During the delay period (i.e., T), preventive and remedial actions are rarely conducted effectively and the tobacco is frequently over-dried or over-wet. Therefore, the quality of tobacco is always sacrificed while waiting for the time delay for moisture measurement in drying process control.

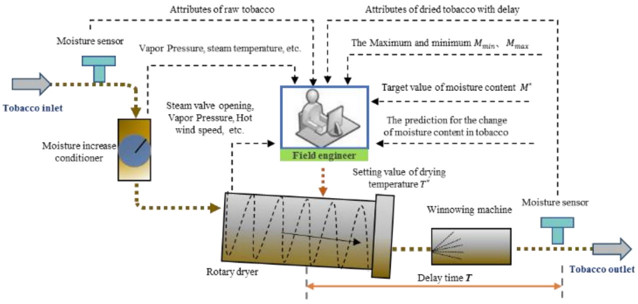


Fig. 1. Tobacco drying phase.

2.2 Data-driven soft sensing method

2.2.1 The detection delay elimination workflow.

An MC-CNN-based data-driven soft sensing method is presented to simultaneously perform feature extraction and moisture prediction to overcome the above-mentioned problems. The flowchart of the method and the current control method is shown in Fig. 2. The control process mainly includes rotating drying, moisture measuring, anomaly detection, and taking corrective actions for the current method. The average time it takes to get measuring results is about 5 minutes, which has an impact on process control efficiency and performance. The method removes the delay *T*, improving the control timeliness and lowering the amount of improperly dried tobacco.

The data-driven soft sensing method consists of two parts: data processing and fully trained MC-CNN. Production-related data collection, which closely depends on the business requirements and preprocessing, is necessary for modeling the running state from raw data of the drying process[14]. The production-related linear sequential data is firstly transformed into two- dimensional data as the required input of the model. The novel MC-CNN model performs feature extraction and soft sensing for moisture content. The CNN-based model is fully trained based on the historical production data and is being used as a soft sensor for moisture online measuring.

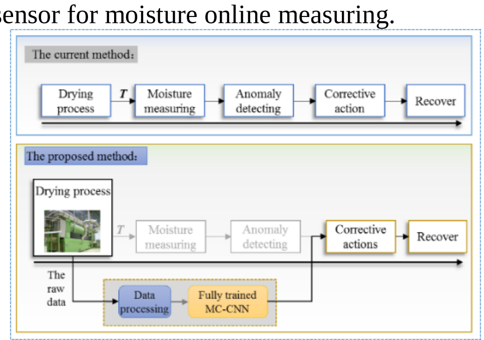


Fig. 2. Comparing regular control process and the proposed detection delay elimination method

2.2.2 Data description and conversion.

The process data obtained is usually a huge, diverse time-series data set generated by industrial equipment, instruments or sensors. The data offers information about drying conditions and equipment status, both of which are critical for the future production process. It is possible to construct a time-series prediction model based on historical production data, for projecting the dynamic changes in the long drying process[15], as well as for providing a basis for the production process control and intelligent decision-making. Normally, production data includes dozens of factors and their changes over time, many of which are related. As a result, to effectively anticipate moisture content in the drying process, the prediction model should have the ability to extract state control information from both the time and space dimensions. Parameter filtration and data conversion are designed for the preprocessing of raw production data.

(a) Parameters filtration

The data set is taken from the manufacturing line before the outlet of the dryer and includes inlet tobacco properties, batch number, formula parameters and equipment parameters. There are more than 100 different parameters in the practical data acquisition system of the drying phase. For soft sensor modeling, the most important essential parameters must be chosen. First, based on practical expertise, the process variables that contributed nothing to the prediction (e.g. fixed-value frequencies) are discarded. Second, using the out-of-bag (OOB)[16] data error as an index, the features to be modelled are selected according to the impact weight of parameters. The Bagging classifier is built to predict the best training sample fraction according to the OOB data error. With the minimal OOB data error as the goal function, the type and number of parameters in the training set are optimized[17]. As a result, 42 parameters for soft sensor modeling are selected, as listed in Table 1.

Table 1. Specifications of the experiment data

Parameters	Number
Inlet tobacco properties	11
Moisture increase conditioner	11
Rotary dryer	20

(b) Data conversion

Data conversion of time series data before used as model input is an important step for predictive analysis using deep learning method. In the study, the selected production data are sequentially transformed into multi-channel two-dimensional image-like data that matches the proposed two-dimensional convolutional neural network. The conversion method for the raw data is as follows:

Step 1: Sequentially number each parameter. The parameters are numbered sequentially according to the different categories $x_1, x_2, x_3, \dots, x_{11}$, $y_1, y_2, y_3, \dots, y_{11}$ and $z_1, z_2, z_3, \dots, z_{20}$, representing the parameters of inlet tobacco properties, moisture increase conditioner, and rotary dryer, respectively.

Step 2: Intercept data slice for modeling. The proposed method can perform online prediction when tobacco is still being dried in the dryer. The average time of tobacco moving from inlet to the moisture sensor is about 7 minutes and the sampling interval is 10 seconds. All data during this time period is taken as input data for modeling. A sliced 7min-length data set is presented as:

$$X = \{X_1, X_2, \dots, X_{11}\} = \{\{x_{1,1}, x_{1,2}, \dots, x_{1,42}\}, \{x_{2,1}, x_{2,2}, \dots, x_{2,42}\}, \dots, \{x_{11,1}, x_{11,2}, \dots, x_{11,42}\}\} \tag{1}$$

$$Y = \{Y_1, Y_2, \dots, Y_{11}\} = \{\{y_{1,1}, y_{1,2}, \dots, y_{1,42}\}, \{y_{2,1}, y_{2,2}, \dots, y_{2,42}\}, \dots, \{y_{11,1}, y_{11,2}, \dots, y_{11,42}\}\} \tag{2}$$

$$Z = \{Z_1, Z_2, \dots, Z_{11}\} = \{\{z_{1,1}, z_{1,2}, \dots, z_{1,42}\}, \{z_{2,1}, z_{2,2}, \dots, z_{2,42}\}, \dots, \{z_{20,1}, z_{20,2}, \dots, z_{20,42}\}\} \tag{3}$$

Step 3: Transform the data sequence into the 2-D image-like data. The abovementioned data sequences are converted into 2-D vector with size of *42×42* according to the sampling order.

Step 4: Convert the 2-D vector into multi-channel input vector. The input vector of soft sensing model is 2-D vector with three channels and the three channels can be presented as: $\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$、$\begin{bmatrix} Y \\ Z \\ X \end{bmatrix}$、$\begin{bmatrix} Z \\ X \\ Y \end{bmatrix}$.

The raw production data is transformed into multi-channel 2-D vector through the above steps, as shown in Fig. 3. All the original data in the data sequence N is firstly converted into a 2-D matrix according to the parameter numbers and sampling order, where $p(m, n)$ is the nth sample of the mth parameter. The size of preprocessed input vector is M×N×*3*. The advantage of this kind of input vector transformation is that it provides a method to explore 2-D features of raw production data and quickly obtains the multi-channel vectors with enhanced feature without any predefined parameter or expertise.

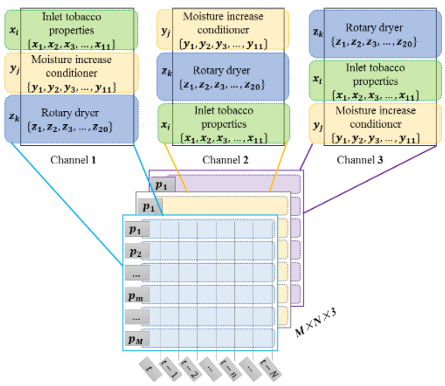


Fig. 3. The transformed 2-D input vector with three channels.

2.2.3 Multi-channel convolutional neural network.

The MC-CNN based soft sensing model is shown in Fig. 4. The input of model is the transformed multi-channel 2-D vector and the output is the prediction for moisture content of dried tobacco. The presented architecture includes three convolutional layers, two pooling layers and two prediction layers and the detailed configuration is listed in Table 2. The convolution kernel size of the convolution layers C1, C3 and C5 shows a decreasing trend successively, and the number of channels gradually increases, making the depth of the feature map gradually increase. In the pooling layers S2 and S4, the size of the pooling kernel is 2×2. The max-pooling strategy is applied for feature dimension reduction. The prediction layers perform the moisture prediction based on the multi-channel feature maps.

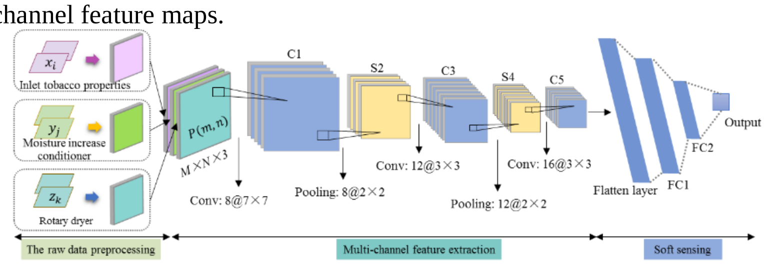


Fig. 4. The proposed MC-CNN model.

Three sources contribute to the multi-channel input vector: inlet tobacco characteristics, moisture increase conditioner, and rotary drier. Multiple convolution and pooling layers can improve the learning of meaningful information since parameters from the same channel have substantial spatial correlation. Convolution kernels can also be used to extract time continuity features from data sequences. As a result, using the acquired spatial and sequential characteristics, the proposed MC-CNN model could perform soft sensing for moisture content in tobacco.

Table 2. Detailed configuration of the proposed model

Layer name	Parameters and output channel size
input	size: 42×42, channel: 3
Convolution C1	kernel: 7×7, channel: 8
Pooling S2	kernel: 2×2, stride: 2, channel: 8
Convolution C3	kernel: 3×3, channel: 12
Pooling S4	kernel: 2×2, stride: 2, channel: 12
Convolution C5	kernel: 3×3, channel: 16
Flatten layer	channel: 576
Fully-connected	channel: 256
Fully-connected	channel: 128
Output	channel: 1

3 Experimental analysis

3.1 Experimental establishment

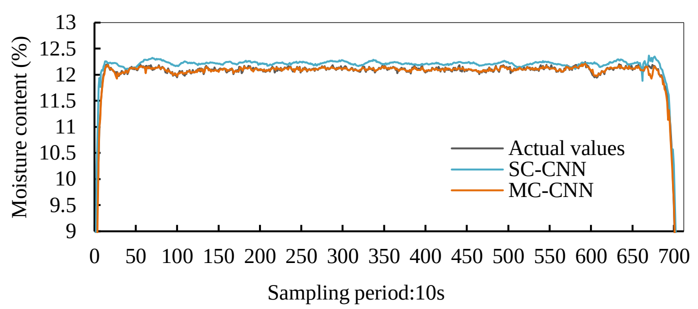
The soft sensing model is constructed using production data from a cigarette manufacturing factory's real-world production process. Tobacco is dried in batches, with each batch taking roughly 160 minutes to complete. As experimental data, 650 batches with approximately 480,000 records are randomly sampled. Among them, 500 batches are utilized as training sets, whereas 150 batches are used as testing sets. The prediction of moisture content is obviously a regression problem. Hence, the mean absolute error (MAE) and root mean squared error (RMSE) are employed to assess the proposed soft sensing model's performance.

3.2 Results and discussion

The sequence of data remains unaltered during model training in order to retain the continuity and variance tendency in the time dimension. A comparison of the suggested CNN model, the traditional CNN model, and various alternative models is undertaken in order to evaluate the soft sensing model's actual performance.

3.2.1 Comparisons with the standard CNN-based model.

The prediction results of the suggested method and the typical CNN-based model are compared to verify the feasibility of the multi-channel feature extraction strategy. Three batches are randomly selected for analysis, one normal instance and two aberrant productions. Aberrant production refers to a production shutdown or other abnormal situations caused by unknown reasons in the manufacturing process. Effective moisture content prediction in dried tobacco is especially crucial for production guidance in abnormal situations. The input of standard CNN-based model is presented as $\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$ and the model is denoted as a single channel convolutional neural network (SC-CNN). The soft sensing results of two models are shown in Fig. 5.



(a)

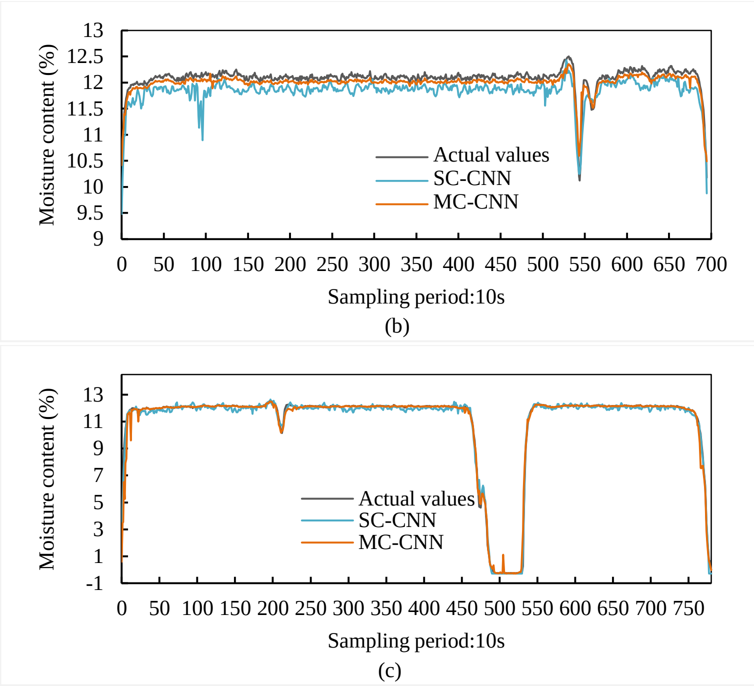


Fig. 5. The comparison of soft sensing results of two methods: (a) Normal instance; (b) Abnormal instance 1; (c) Abnormal instance 2.

In three cases, the MC-CNN model beats the SC-CNN model when the prediction curves are assessed, particularly in the abnormal production situation. Table 3 shows the prediction results of the two approaches in both normal and abnormal situations. When compared to the SC-CNN model, the MAE and RMSE of the MC-CNN model are much lower. The MAE and RMSE of the SC-CNN model were 0.0865 and 0.1135, respectively, in the normal instance (a). The MAE and RMSE of the MC-CNN model lowered by 0.0729 and 0.0878, respectively, after using the multi-channel feature extraction approach. The MAE and RMSE of the MC-CNN model were 0.0897, 0.2026 and 0.1025, 0.2738 in the two anomalous cases, respectively. The causes of anomalous manufacturing conditions in the actual drying process are complicated. Although the model's prediction performance is not as good as the ordinary batch, it is better than the SC-CNN model. The enhancement of prediction accuracy for the soft sensor model has great practical significance for the optimization of drying process.

Table 3. Prediction results of normal instance and abnormal instances

Methods	Normal instance (a)		Abnormal instance (b)		Abnormal instance (c)	
	MAE	RMSE	MAE	RMSE	MAE	RMSE
SC-CNN	0.0865	0.1135	0.1326	0.1801	0.5023	0.5326
MC-CNN	0.0136	0.0257	0.0897	0.1025	0.2026	0.2738

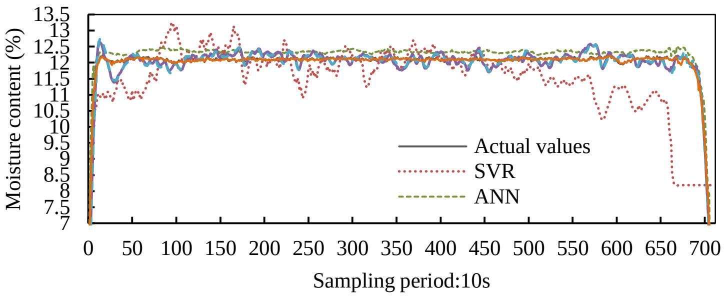
3.2.2 Comparisons with state-of-the-arts networks.

The performance of proposed prediction approach is compared against that of other methods such as SVR, RNN, ARMAX, and ANN.

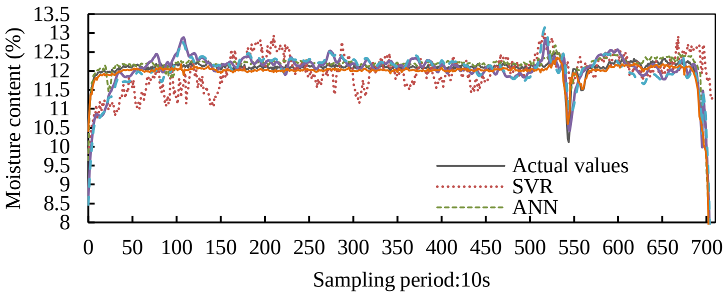
(a) Soft sensing within prediction instance

Fig. 6 presents the moisture content prediction curve amongst prediction instances. Among the compared approaches, the kernel function of SVR is set to RBF kernel function, and the ANN model involves a four-layer neural network. The ARMAX model adopts system identification tool of MATLAB for data import and prediction, and other models are implemented on the TensorFlow platform.

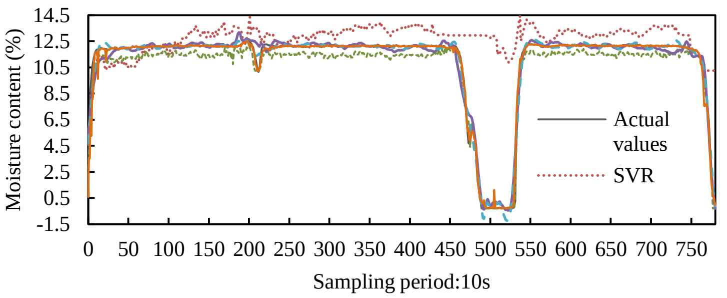
As demonstrated in Fig. 6, SVR model performed the poorest, ARMAX and RNN model take second place, and the MC-CNN model performs best. The prediction based on the model is difficult to perceive the dynamic production state when the parameters are relatively fixed, and there is a certain deviation in the prediction of moisture content.



(a)



(b)



(c)

Fig. 6. Results of different prediction instances: (a) Normal instance; (b) Abnormal instance 1; (c) Abnormal instance 2

MAE and RMSR in various scenarios are illustrated in Fig. 7 to represent the overall prediction performance. In normal instance (a), the MAE and RMSE of SVR model are 0.3477 and 0.4687, respectively. However, the MAE and RMSE of SVR in instance (c) are 1.2006 and 2.7912 respectively, which far exceeding the acceptable range in actual production. The ANN model's prediction performance is fairly decent, but the prediction error is rather significant when the production condition is abnormal in instance (c), with MAE and RMSE of 0.4556 and 0.4866, respectively, which makes ANN difficult to meet the process control need for prediction accuracy. The input data of the proposed MC-CNN model is a multi-channel 2-D vector, which can more comprehensively extract spatial features and sequential features from the raw data. MAE and RMSE in normal instance are 0.0136 0.0257, respectively, and the MAE and RMSE in abnormal production are smaller than those of other models.

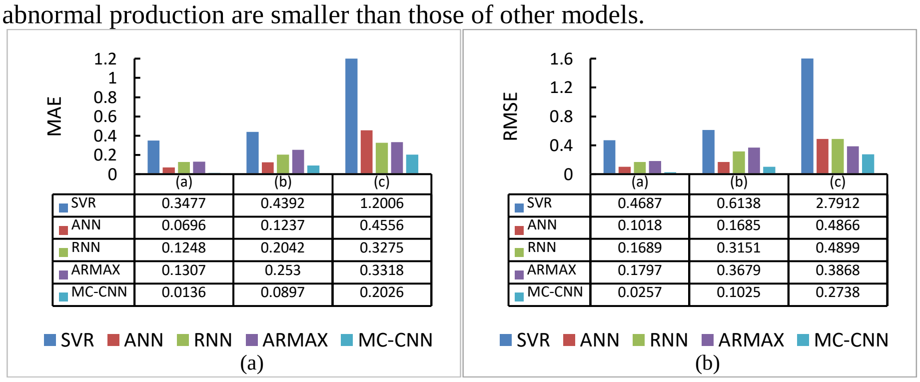


Fig. 7. Predicted errors under different conditions: (a) MAE; (b) RMSE

(b) Results on testing dataset

Table 4. The results on testing dataset.

Methods	MAE	RMSE
SVR	0.3571	0.4934
ANN	0.0740	0.1063
RNN	0.1276	0.1736
ARMAX	0.1339	0.1837
MC-CNN	0.0161	0.0291

Table 4 and Fig. 8 illustrate the mean of the prediction outcomes of several models on the test dataset. In actual production, the proportion of normal batches is very high, and the proportion of abnormal production is relatively small. Therefore, the mean value of statistical results is close to the predicted result of normal batches. The mean values of MAE and RMSE of MC-CNN are the smallest, followed by ANN, ARMAX and RNN, and SVR is the worst. The average MAE and RMSE of the MC-CNN model are 0.0161 and 0.0291 respectively. The prediction results can meet the requirements of the precision of moisture content in the actual process control, and can provide real-time predictions of moisture content for the optimization of tobacco drying process.

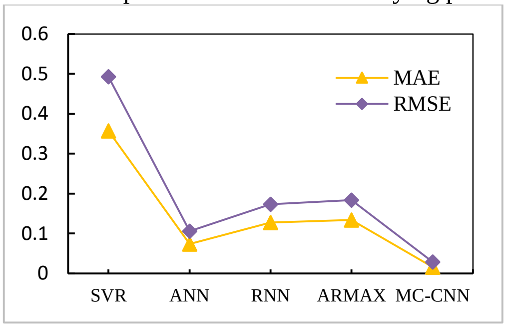


Fig. 8. Predicted errors on testing dataset.

4 Conclusions

In this paper, a novel multi-channel CNN model was proposed to handle the time delay problem of moisture measuring by applying the multi-channel feature extraction strategy. The multi-channel feature extraction CNN-based structure was designed to learn spatial and sequential relationships automatically. Meaningful information contained in the raw production data was retrieved comprehensively by multiple convolution and pooling layers through resampling, converting, and multichannel vector constructing. The MC-CNN model's prediction performance is validated by comparison tests with other prediction models.

With the support of the data, the detection delay is eliminated and the response time for exceptions can be considerably reduced using soft sensing modeling and multi-channel feature extraction. The proposed method introduces a new research strategy for addressing the issue of important production indicators being difficult to identify in the industrial process (e.g. lagging for the dryer in our case). Aside from soft sensing modeling for moisture content, the innovative coupling of control theory and deep learning for industrial process control optimization is an important and beneficial direction.

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Applying Decision Tree to Detect Credit Card Fraud

Wen-Chih Chang, Yi-Hong Guo, Ya-Ling Yang, Ming-Chien Hsu, Yi-Hsuan Chu, Ting-Yi Chu, Long-Cheng Meng
Department of Information Management, Chung Hua University, Taiwan
earnest@g.chu.edu.tw

Abstract. The topic we are participating in is the credit card fraud detection Artificial Intelligence Open Challenge 2019 Autumn Competition. The number of times the prediction results can be uploaded in this competition is five times a day. The competition period is from September 6, 2019 to 2019. On November 22, the end time is November 22, 2019. Our goal is to accurately predict whether the transaction is a fraudulent transaction. In this topic, we learn how to process data, analyze and predict, explore the analytical performance of different machine learning models, identify potential fraudulent transactions, and respond early to find key factors that can be judged as fraudulent, such as: When the transaction is located in a foreign country, the chance of being stolen is higher, the mobile phone is often used by others, the chance of being stolen is higher, the chance of using the Internet transaction is higher, the use of Fallback is easier to be stolen, and the chance of being stolen The key factors such as the high probability of being stolen and brushing. We applied the XGBoost model. This model has higher accuracy and faster training speed, which can greatly reduce the training time. Let us find that the XGBoost model is more suitable for predicting the data set of credit card fraud among other models. Effectively increase the prediction accuracy to 51.97%

Keywords: Credit Card Fraud, Artificial Intelligence, XGBoost Model, Big Data, Decision Tree

1 Introduction

1.1 Background and Motivation

In order to improve the ability of data analysis and prediction and cultivate the acuity of data observation, we decided to participate in the competition organized by T-Brain AI actual combat bar. The competition is divided into two major goals: predictive analysis and data classification. We chose Artificial Intelligence Open Challenge-"Credit Card Counterfeit Detection" competition. This competition is provided by the bank to help banks find counterfeit counterfeit transactions. Regardless of the size of the transaction amount, it can determine the characteristics of counterfeit counterfeit transactions, and can predict it Whether the transaction is fraudulent, prevent the occurrence of fraudulent brush as soon as possible.

The data type of the data set for this competition is relatively complex. The training set has a huge amount of data, diverse attributes, and data overfitting and serious problems. The goal of this prediction is to analyze whether the credit card will be stolen. It is suitable for us to in-depth study of data processing and analysis. , And use the past experience to compete with other participants to improve the ranking and improve our ability to process data.

1.2 Research Purpose

This topic mainly predicts whether the credit card used by customers of Yushan Bank is stolen. First, you must understand the key factors of the credit card transaction type, transaction amount, installment number... etc., and finally analyze whether the customer will be To steal, the data provided for this competition can be used to solve related problems. The purpose of this research is as follows:

1. Learn how to conduct in-depth analysis and prediction of data.
2. Cultivate the acuity of data observation.
3. Explore the analytical performance of different machine learning models.
4. Assist the bank to determine the key factors of potential fraud.

1.3 Research Process

After clarifying the background, research motivation and purpose of the problem, you can begin to collect and analyze the relevant literature to establish the scope of the research, based on the reference and arrangement of the literature, as the theoretical basis of the research framework of this topic.

The research process is mainly divided into seven stages. The first stage needs to confirm the purpose, the second stage collects and organizes data, and sorts out the data that are helpful to the forecast. The third stage is data pre-processing, and the collected data is subjected to feature engineering. And formalization. The fourth stage is for visual design. The important attributes in the data set are presented and observed using visual methods such as drawing charts to help us clearly understand the characteristics and correlations between attributes. The fifth stage is to establish a model and use different models to carry out Compare and use Gridsearch cross-comparison to find the most suitable machine learning model for this data set. The sixth stage evaluation model. After the model is established, use the decision tree model, confusion matrix, and classification report as the evaluation index of the machine learning model. Finally, the seventh stage presents the prediction results, which are explained in two parts below.

2 Related Works

2.1 Decision tree

Decision tree was first proposed by Hunt in 1996. It is a model that uses the concept of tree branch as a decision mode. Most of it can be used in classification prediction. It is divided into the following three types: classification tree, regression tree, and classification regression tree.

The classification tree is used to predict the strain number of the category type, the regression tree (Regression Tree) uses regression analysis to predict the value, and the classification and regression tree (Classification and Regression Tree, CART) was developed by American statistician Leo Breiman in 1984. It is proposed that it combines the characteristics of classification tree and regression tree, which can predict the type of classification and also predict the numerical data. The feature is that only two branches are generated for each classification, which is used to plan and analyze the data set, and it is not limited. Variable types have greater flexibility in analysis.

The establishment of the decision tree is divided into three steps:

1. Take the data matrix as the root node
2. Use different decision tree algorithms to find the largest attribute as the criterion for branching. Common methods include GINI (Gini coefficient) and Entropy.
3. If the accuracy of the judgment result of the algorithm rule used in the second step does not meet the condition, then calculate the next branch attribute.

GINI is an attribute selection index that uses binary division of attributes to build a decision tree, so each node has only 2 branches connected to child nodes. For example: CART decision tree uses this coefficient to select better data attributes to construct a complete decision tree.

2.2 Random Forest

Random Forest was proposed by American statistician Leo Breiman in 2001. The principle is to combine multiple CART decision trees, add a preset number of data attributes, and randomly select split points to build decision trees for training. The trees look similar to increase the final calculation result.

It is known from the principle that the random forest has multiple decision tree combinations. This machine learning is called Ensemble Method, which can also be called ensemble or ensemble. It must meet the condition that each classifier is different, and the accuracy is greater than 0.5. The overall machine learning algorithm (Ensemble learning) integrates the prediction results of multiple weak learners to enhance accuracy. The integration method creates a set of learners for training data, and votes based on the prediction results of each learner, so it is more stable and more accurate. There will be no deviation or overtraining. The operation steps of integrated learning are as follows:

1. Create multiple data sets
2. Construct multiple learners
3. Integrated learner (voting)

2.3 Support Vector Machine

Support Vector Machine (SVM), proposed by Corinna Cortes and Vapnik in 1993, is mainly for the classification of binary data, and the principle of minimum classification error rate is used for two-category segmentation. SVM uses the current data as training, selects several support vectors from the analyzed training data to represent all the data, removes some extreme values, and packs the selected support vectors into a model. SVM is a supervised learning classifier, it can be used to analyze the classification pattern in the data, the main purpose is to do classification and regression analysis. Take the following figure as an example. Given a training data set, each data (black dots, white dots) is given a classification answer 0 and 1, each data is a vector, and the length of the vector is 2(ex:x1,x2), SVM can construct a classification model to classify all data into 2 categories. If new test data is input into the model later, it can also be automatically classified into 0 or 1 category by the model.

2.4 Artificial Neural Network

Artificial Neural Network (ANN) is a mathematical model or calculation model inspired by biology that simulates the structure and function of the human brain. Each neuron is connected with other neurons and will be impacted by the state of other neurons, thereby determining whether it will be stimulated or not. ANN is a black box model that can find the relationship between input data and output data and form a pattern to make predictions for different input data.

2.5 eXtreme Gradient Boosting

Extreme gradient boosting (eXtreme Gradient Boosting, referred to as XGBoost), proposed by the initiator Chen Tianqi in 2014, Gradient means that the XGBoost module is developed in C++ of the Gradient Boosting Machine. Boosting belongs to the overall learning classifier, which will reduce the accuracy of many classifications. The model trees are combined to become a highly accurate model, which will be continuously revised, and a new tree will be generated every time it is revised. XGBoost proposes the concept of block, which sorts the data before training. Then save it as a block structure, and reuse the data in the structure in the subsequent process, so that the module can be parallelized and reduce the training time.

3 Analysis Model

3.1 Data Set Description

The files are provided for this competition data, namely training set, test set, and prediction result data set. The training set data can be used for data pre-processing and visualization design and model building. After the model is established, use the processed training set to predict the data in the test set, and finally generate a data set of prediction results, we will also introduce the fields in the data set. Figure 1 and Figure 2 shows the training set and test set. Table 1 is the data description of each column.

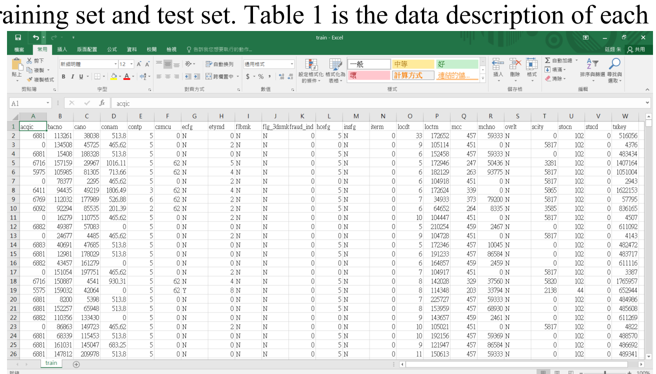

Figure 1. Training data set

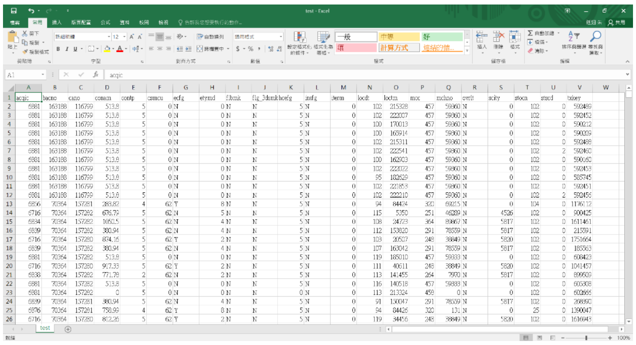

Figure 2. Test data set

Table 1. Data information

Id	Column description
acqic	The bank code of the store's credit card POS machine
bacno	User Id
cano	The credit card number and sponsor code of the transaction
conam	The organizer has uniformly converted the data unit to NewTaiwan dollars
contp	Sponsor code, 0-6
csmcu	The currency used for the transaction
ecfg	Whether the transaction is an online transaction, yes=Y, no=N
etymd	The transaction type of the transaction, the organizer code, 0-10
flbmk	Whether the transaction is completed by swiping the magnetic stripe, yes=Y, no=N
flg_3dsmk	Whether the transaction uses 3DS, yes=Y, no=N, (3DS is a safe design for online card or cardless payment)
fraud_ind	Whether the transaction has been stolen, yes=1, no=0 (only the train file has a note)
hcefg	The payment type of the transaction, the sponsor code, 0-9 (excluding 4)
insfg	Whether the transaction has installment, yes=Y, no=N
iterm	The transaction is divided into several periods, 0-8 periods
locdt	The number of days after the authorization base date, train(1-90), test(91-120)
loctm	In seconds, the time format is 24-hour system, (235610 means 23:56:10)
mcc	Merchant category code, organizer code
mchno	The transaction store code, organizer code
ovrlt	The credit card amount exceeds the credit limit, excess=Y, none=N
scity	According to the city location of the transaction store, the organizer code
stocn	According to the country location of the transaction store, the organizer code
stscd	Sponsor code, 0-4
txkey	Refer to (locdt and loctm two fields) coding

3.2 Models and Kits

We used some models and kits in this research.
The Model:
1. XGBoost model: used to predict the accuracy rate, the accuracy rate is high and the training speed is very fast, and the XGBClassifier type is selected.
2. Random Forest model: used to predict the accuracy rate, combine multiple CART trees, and add randomly allocated training data to increase the final calculation results.
The Module:
1. CSV module: used to read and write CSV format. CSV file format is a common format for importing and exporting electronic forms and databases.
2. Numpy module: mainly used for data processing, which can quickly manipulate huge data in multi-dimensional arrays.
3. Sklearn module: used for machine learning. Used to divide training set and test set. Make a classification report to show the accuracy and recall rate of each category
The Package:
1. Pandas package: supports a variety of text and data loading, and can quickly understand the data structure
2. Matplotlib suite: used to build charts, can be used with numpy.
3. Seaborn suite: used to show the relationship between data.

3.3 Data Pre-processing

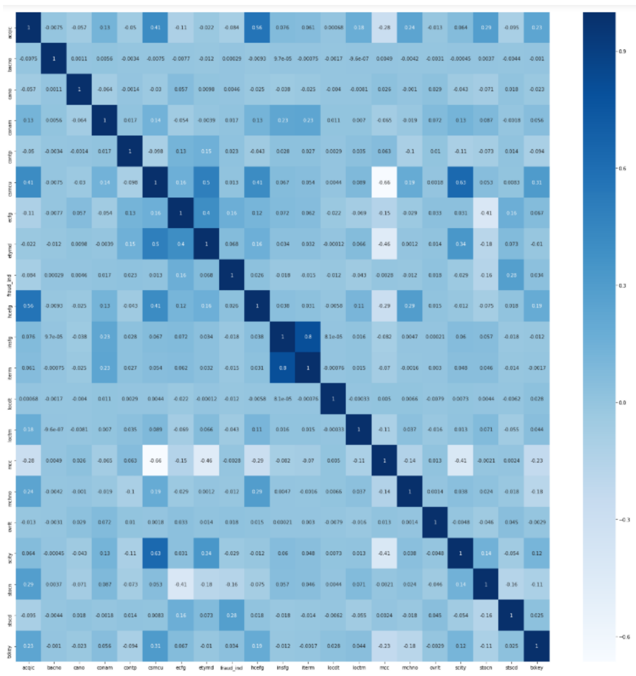

Figure 3. The attribute relations with heat map

1. We applied heat map (Figure 3) to discover every data column relation
2. Loctm authorization time: We found that the time field is composed of hour, minute, and second in order, so we cut the field and created an Ampm field to store it in hours.
3. Conam consumption amount: The forum administrator has stated that the unit is Taiwan dollar. We take foreign consumption as the starting point that it is easier to be stolen, and hope to find out the decimal point of the transaction amount for Taiwan dollar consumption and foreign consumption.
4. Bacno return account: Accounts that have a precedent for fraudulent brushing are more likely to be stolen again.
Figure 4 shows the distribution of fraud id abd Figure 5 shows the distribution of etymd attribute stealing.

```
In [14]: ampm_fraud_ind = pd.crosstab(train['ampm'], train['fraud_ind'])
         ampm_fraud_ind.plot(kind ='bar')

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x1fe0006b860>
```

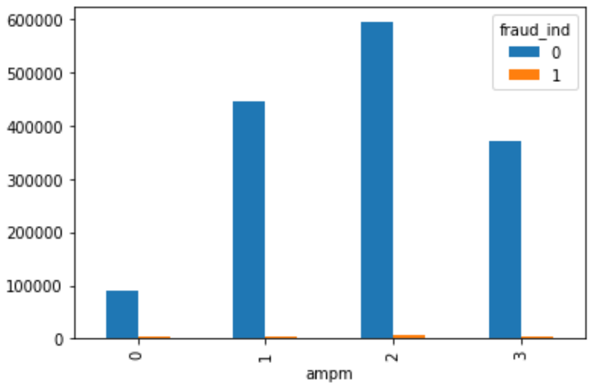

Figure 4. View the distribution of attributes

```
In [28]: sns.countplot(train["etymd"],hue=train["fraud_ind"])
         #發現2跟8比較多盜刷

Out[28]: <matplotlib.axes._subplots.AxesSubplot at 0x1fe14a51860>
```

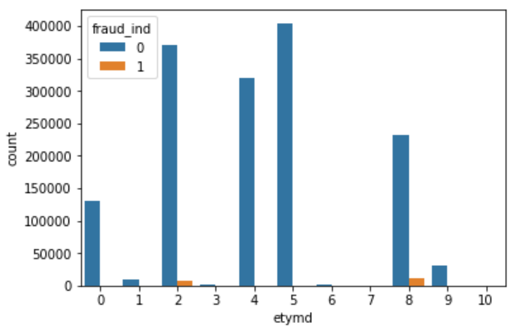

Figure 5. View the distribution of etymd attribute stealing

```
In [37]: from graphviz import Digraph
         from xgboost import plot_tree
         import matplotlib.pyplot as plt

         # 創建呈現在每一棵樹上的feature name

         plot_tree(fc, # 引入上面訓練好的xgb model
                   num_trees=0, # 第幾棵樹
                   ) # 引入feature name
         fig = plt.gcf()
         fig.set_size_inches(20,20)
         plt.show()
         fig.savefig('flbmk_tree.jpg')
```

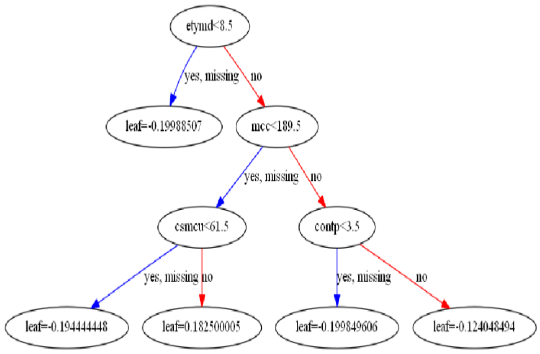

Figure 6. Drawing machine learning model decision tree

```
In [40]: from graphviz import Digraph
         from xgboost import plot_tree
         import matplotlib.pyplot as plt

         # 創建呈現在每一棵樹上的feature name

         plot_tree(fc, # 引入上面訓練好的xgb model
                   num_trees=0, # 第幾棵樹
                   ) # 引入feature name
         fig = plt.gcf()
         fig.set_size_inches(20,20)
         plt.show()
         fig.savefig('flg_3dsmk_tree.jpg')
```

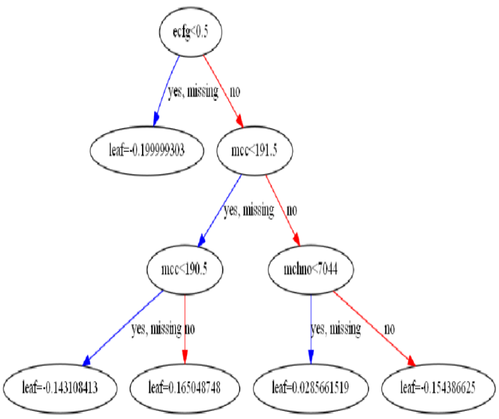

Figure 7. Using XGBoost model to fill in empty values and redraw machine learning model decision tree

Figure 6 shows the first time drawing of the machine learning model decision tree with some blank data. We Used XGBoost model to fill in empty values and redraw machine learning model decision tree in Figure 7.

4 Model Prediction

4.1 Confusion Matrix

In machine learning, especially statistical classification, the confusion matrix is also called the error matrix. Each list of the matrix reaches the class prediction of the sample by the classifier, and each row of the second matrix expresses the true category to which the version belongs. The reason why it is called the "confusion matrix" is because it is easy to see whether the machine learning is confused or not.

The confusion matrix is divided into four categories.

TP: The real situation is "Yes", and the module predicts the number of "Yes"

TN: The real situation is "No", and the number of modules that predicts "No"

FP: The real situation is "No", and the number of modules predicting "Yes"

FN: The real situation is "Yes", the module predicts the number of "No"

4.2 Classification Report

The classification report has three elements. They are the precision, recall and F1_score.

Precision: is the prediction accuracy

Recall: the same ratio of the real situation and the predicted situation of the module

F1_score: It is a combination of accuracy and recall, and is often used as an indicator for model selection.

4.3 Prediction Accuracy/Score Generation Process

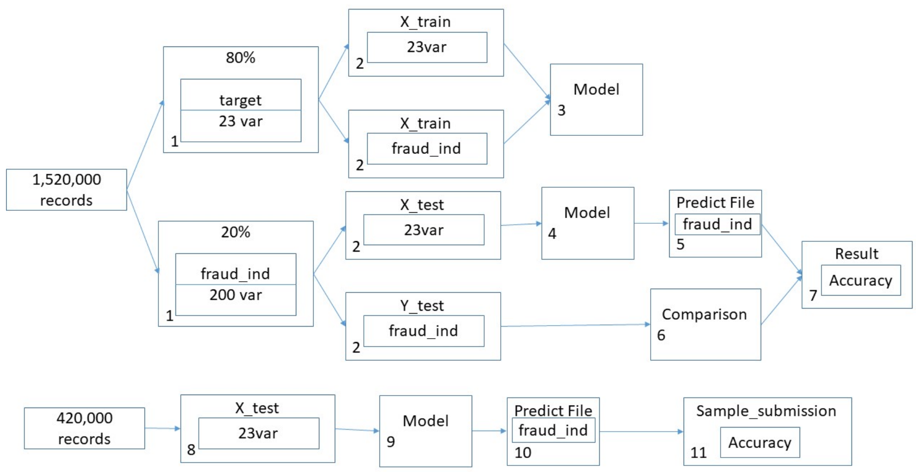

Figure 8. Forecast accuracy rate generation flowchart

Figure 8 shows the method we applied to divide two set (test set and training set). With the chosen data columns, we kept modulating the model and predicted the credit card fraud.

5 Conclusion

We use the complete 1.52 million data for analysis, but due to the imbalance of the data, the training module will be misjudged, and the accuracy rate is only about 10%. Later, we observed and processed the field information. Delete some fields that are not very helpful for data prediction, and then merge some fields with high relevance to effectively reduce the misjudgment rate, and use this result for training, and the accuracy rate begins to improve significantly.

At the beginning, the random forest model was used to predict, but the accuracy of the data trained by the random forest was limited. After the accuracy rate reached 37%, it could not be effectively improved. Therefore, we used the calculation model XGBoost learned in the previous competition. Further predictions finally made a breakthrough and effectively improved to 51% prediction accuracy.

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Integrating object detection and semantic segmentation into automated pallet forking and picking system in AGV

Ruei-Jhih Hong[1], Yong-Ren Li[1], Min-Hsien Hung[2], Jia-Wei Chang[2,*], Jason C. Hung[2]

[1] Industrial Technology Research Institute, Hsinchu County, Taiwan
[2] Department of Computer Science and Information Engineering, National Taichung University of Science and Technology, Taichung City, Taiwan
{rayhong, itriRen}@itri.org.tw, hsien1126@gmail.com, {jhung, jwchang*}@nutc.edu.tw

Abstract. The integration of the Internet of Things and artificial intelligence technologies in picking and distributing automated guided vehicles (AGVs) will reduce the ineffective walking time and reduce the workload of logistics operators during the picking process. It is expected to improve their work efficiency and speed. In the proposed system, calculating the travel path and rotation diameter of the self-propelled forklift with algorithms can make AGVs moving to the correct position for pallet forking and picking. In addition, AGVs achieved good object recognition and automatic pallet forking and picking by object detection and semantic segmentation. We believe the AGVs can reduce the workload of logistics operators and save the working time to improve their efficiency.

Keywords: Object Detection, Semantic Segmentation, Pallet Forking and Picking, Automated Guided Vehicles.

1 Introduction

With the development of automation, Internet of Things and artificial intelligence technology, intelligent logistics has been the current trend. As the labor force decreases and the number of logistics operators decreases, it is necessary to develop picking and sorting trucks with automatic forklift pallets to help reduce the workload of logistics operators and improve the overall efficiency and speed. In the past, the traditional logistics picking and sorting mainly used manpower with trolleys to sort incoming or outgoing goods. The intelligent picking and sorting self-propelled vehicles are different from the previous sorting mode, as the self-propelled vehicles help the staff to carry and move to the sorting location independently, which will effectively reduce the staff walking and transporting time.

Currently, there are many technologies on the market that support forklift autonomous movement, such as magnetic rail, SLAM, laser positioning, WIFI positioning and other movement technologies, which can effectively assist forklift autonomous movement. In the part of automatic fork picking, such as fork picking of common pallets, the technology that needs to be considered is not only the accuracy of the fork carriage, but also the pallet position, the angle of the hole, the depth of fork picking and the way of moving, and other factors need to be calculated.

Therefore, the focus of this study is on how the forklift can accurately fork different types of pallets autonomously. In the pallet placement of Taiwan's logistics environment, there are usually different types of items around, so it is more difficult to identify the pallets in this kind of field than general items.

2 Purpose

To make the forklift to automatically fork the pallet accurately, this study will use the machine learning model training and depth camera to identify the hole position of the pallet to achieve the accurate automatic forking. With the shortage of manpower in logistics centers and the increasing workload, it is necessary to use the assistance of automated forklifts to help logistics personnel to complete their work more efficiently. Therefore, with the existing forklifts running automatically, the most important thing is to develop functions that can automatically fork different types of pallets and reduce the cost of introducing them into the logistics system. The function of automatic fork picking is very important to the logistics operation. At present, the domestic self-propelled forklifts are mainly made by SICK 3D camera from Germany, which is not only too costly, but also cannot match with different types of pallets. However, it is the main challenge of this study to combine the existing self-propelled function with the automatic forklift function, and to recognize different types of pallets effectively to complete the automatic forklift.

3 Related work

3.1 YOLOv4

YOLOv4[1] is a fast and accurate object detection system that can use a small number of GPUs, which is extremely suitable for combining with this research. YOLOv4 is composed of Input, Backbone, Neck, and Dense Prediction. The content of Input is image. Backbone chose to use CSPDarknet53[2] because its receptive field is larger than the input network resolution. In the COCO data set test, the number of acceptable parameters is the largest, and the FPS value is the highest. Neck chose to use the SPP block[3] because it can not only greatly increase the receptive field but hardly reduce the network speed. Instead of choosing to use FPN[4] in YOLOv3[5], Neck uses PANet[6] as a parameter aggregation method for different detectors and backbone levels. The head part chose to use YOLOv3.

YOLOv3 uses Darknet53 as Backbone, while YOLOv4 base on Cross Stage Partial Network (CSPNet), combined with ResNext50 and Darknet53 to form CSPResNext50 and CSPDarknet53.The experiment in Table 1 proves that the CSPResNext50 model is suitable for target classification. CSPDarknet53 model has higher accuracy in target detection, and can use Mish[7] and other techniques to improve the classification accuracy. Therefore, YOLOv4 uses CSPDarknet53 as the Backbone.

Table 1. Parameters of neural networks for image classification.

Backbone model	Input network resolution	Receptive Field size	parameters	Average size of layer output (WxHxC)	BFLOPS	FPS
CSPResNext50	512x512	425x425	20.6 M	**1058 K**	31 (15.5 FMA)	62
CSPDarknet53	512x512	725x725	**27.6 M**	950 K	52 (26.0 FMA)	**66**
EfficientNet-B3	512x512	**1311x1311**	12.0 M	668 K	11 (5.5 FMA)	26

The purpose of CSPNet is to enable the network structure to obtain more gradient fusion information and reduce the amount of calculation. The author of CSPNet believes that the repetition of gradient information in network optimization leads to a high amount of calculation for prediction. Therefore, Cross Stage Partial connections (CSP) is used to divide the feature map of the base layer into two parts, and then merges them through a cross-stage hierarchical structure. This method improves the learning ability of CNN, reduces the weight of the model and maintains accuracy, reduces the amount of computation, and increases the computation speed.

YOLOv4 adjusts for Spatial Pyramid Pooling (SPP) original architecture, to maintain the output of the spatial dimension. The method is to use multiple kernels of different sizes for pooling and concatenate the generated feature maps to output. Compared to a single-size single pooling kernel, using SPP can effectively increase the backbone of the receptive field, and separate salient features.

Path Aggregation Network (PANet) is an improvement based on the FPN used by YOLOv3. PANet adds an extra layer of upsampling to the number of layers connected in series and merges the originally added part to strengthen the ability of feature extraction and integration.

3.2 EfficientNetV2

EfficientNetV2[8] is a new convolutional neural network model in the EfficientNets series. Compared with other models in the same series, EfficientNetV2 has faster training speed and better parameter efficiency. EfficientNetV2 combines Training-Aware NAS and Scaling to jointly optimize training speed and parameter efficiency. EfficientNetV2 improves the progressive learning method, dynamically adjusting the regularization (such as dropout) according to the size of the training image, which not only improves the training speed but improves the accuracy.

EfficientNetV2 studied the bottlenecks of EfficientNet [9] and pointed out that when the size of the training image is large, the training speed will be very slow. Therefore, EfficientNetV2 applies FixRes [10] to train with smaller image sizes but does not fine-tune anything after training. This approach can reduce the amount of calculation, have a larger batch size, and speed up training.

The depth-wise convolution used by EfficientNet in the shallow layer of the network causes the training speed to be very slow. Table 2 is an experiment on

EfficientNet-B4. It is found that gradually replacing the shallow MBConv with Fused-MBConv can improve the training speed. However, replacing all stages with Fused-MBConv will significantly increase the number of parameters and increase the amount of calculation, and the training speed will also be reduced. So EfficientNetV2 uses NAS search technology to automatically search for the best combination of MBConv and Fused-MB Conv.

Table 2. Replacing MBConv with Fused-MBConv

	Params (M)	FLOPs (B)	Top-1 Acc.	TPU imgs/sec/core	V100 Imgs/sec/gpu
No fused	19.3	4.5	82.8%	262	155
Fused stage 1-3	20.0	7.5	83.1%	362	216
Fused stage 1-5	43.4	21.3	83.1%	327	223
Fused stage 1-7	132.0	34.4	81.7%	254	206

EfficientNetV2 uses EfficientNet as the backbone. Compared with EffifientNet, EfficientNetV2 widely uses MBConv, uses a smaller expansion ratio in MBConv to reduce memory usage, and adds Fused-MBConv in the shallow layer. Table 3 is the structure of EfficientNetV2, which uses a 3x3 kernel and increases the number of layers in each stage to compensate for the reduced receptive field caused by the smaller kernel size. Considering the problem of parameters and memory usage, EfficientNetV2 completely deletes the last stride-1 stage of EfficientNet.

Table 3. EfficientNetV2-S architecture

Stage	Operator	Stride	Channels	Layers
0	Conv3x3	2	24	1
1	Fused-MBConv 1, k3x3	1	24	2
2	Fused-MBConv 4, k3x3	2	38	4
3	Fused-MBConv 4, k3x3	2	64	4
4	MBCon4, k3x3, SE0.25	2	128	6
5	MBCon6, k3x3, SE0.25	1	160	9
6	MBCon6, k3x3, SE0.25	2	272	15
7	Conv 1x1 & pooling & FC	-	1792	1

3.3 EfficientFCN

EfficientFCN [11] can realize efficient and high-accuracy semantic segmentation while considering the overall context of the input image. The backbone of EfficientFCN is an

ImageNet pre-training network without any dilated convolution. It has introduced a holistically-guided decoder (HGD) and can obtain high-resolution feature maps through multi-scale features. Table 4 compared with the most advanced method based on dilatedFCN, EfficientFCN uses only 1/3 of the calculation amount and fewer parameters on the PASCAL Context[12], PASCAL VOC 2012[13], ADE20K[14] data sets result in equal or even better.

Table 4. Comparisons with classical encoder-decoder methods.

Method	Backbone	OS	mIoU%	Parameters (MB)	GFlops (G)
FCN-32s	ResNet101	32	43.4	54.0	44.6
dilatedFCN-8s	Dilated-ResNet101	8	47.2	54.0	223.6
UNet-Bilinear	ResNet101	8	49.3	60.7	87.9
UNet-Deconv	ResNet101	8	49.1	62.8	93.2
EfficientFCN	ResNet101	8	55.3	55.8	69.6

HGD decomposes the feature upsampling task into a series of holistic codewords from the high-level feature map to capture the global context. And linearly combine codewords at each spatial position to perform feature upsampling with rich semantics. The purpose of HGD is to restore the three feature maps of the last three blocks of the ResNet encoder backbone to high-resolution (OS=8, Output Stride) feature maps, which are mainly divided into three parts: multi-scale feature fusion, holistic codebook generation, and codeword assembly for high-resolution feature upsampling.

The fusion of multi-scale feature maps usually produces better performance. Take the feature maps of OS=8, OS=16, and OS=32 in the encoder, first compress the channels of the three feature maps to 512 through 1x1 convolution and then downsampling the feature maps of OS=8 and OS=16 through channels Connect with OS=32 to form m32.

Multi-scale fused feature maps m32 created for high-level and mid-level features, but their small resolution makes them lose many structural details of the scene. The small resolution of the multi-scale fusion feature map m32 results in the lack of details, so a series of unordered holistic codewords are generated from m32, which implicitly simulate the global context.

Holistic codewords can capture various global contexts of the input image, but most of the structural information has been removed during the codewords encode process. Therefore, the OS = 8 multi-scale fusion feature m8 is used to predict the linear combination coefficients of n codewords at each spatial position to create a high-resolution feature map.

3.4 SETR

SETR[15] is an image semantic segmentation model based on Transformer, which combines Transformer as an encoder instead of stacked convolution for feature extraction. To evaluate the effectiveness of the features encoded by SETR, three different decoders are designed. The composition of SETR consists of input preprocessing and feature extraction, conversion, and output. Unlike the fully-convolutional network(FCN) model based on the Encoder-decoder structure, SETR regards the semantic segmentation task as a sequence to sequence problem.

The transformer used as the encoder, the image must be converted to a format that Transformer can accept. SETR refers to the practice of ViT [17], slices the input image, and treats each 2D image patch as a 1D sequence, as the entire input into the network. To encode the spatial information of each slice, learn a specific embedding for each local position, and add it to a linear projection function to form the final input sequence.

Input the sequence into the Transformer architecture for feature extraction, which mainly consists of two parts: Multi-head Self-Attention (MSA) and Multilayer Perceptron blocks (MLP). The features extracted by the Transformer are consistent with the dimensions of their input and output. For semantic segmentation, it is necessary to reshape the original spatial resolution. SETR provides three methods: Naive upsampling (Naive), Progressive UPsampling (PUP), and Multi-Level feature Aggregation (MLA).

4 Method

In this study, object detection by Yolov4 or EfficientNetV2. At the beginning, we collected photos of different types and angles of pallets, and learned them through the object detection models, and then manually adjusted the accuracy of the models to complete pallet recognition. Then, the semantic segmentation models, such as EfficientFCN or SETR, using depth camera identifies the hole position of the pallet, and the algorithm calculates the angle and path of the self-propelled vehicle to achieve the automatic forking of the pallet.

4.1 Recognize the Pallet by Object Detection

In the implementation process, the first step is to collect color photos of the pallet by hand. The second step is to train the model by Yolov4 or EfficientNetV2 so that the model can recognize commercially available wood, plastic and various colors of pallets. The third step is to adjust the accuracy of the learning and then continuously optimize and improve the model so that the accuracy of the identification can be continuously improved, as shown in the Figure 1.

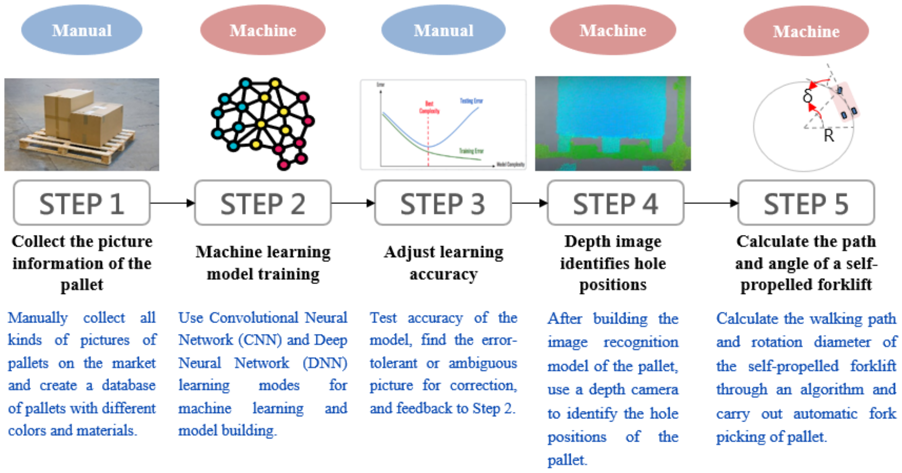

Fig. 1. The Implementation Process

4.2 Recognize the Fork Plate Hole by Semantic Segmentation

After the training of the object detection model is completed, the AGV automatic pallet picking system can automatically identify the pallet information by image acquisition after the self-propelled forklift reaches the target point, and then further analyze the pallet position and pallet hole angle through the algorithm. The depth distance of the target is sensed by the depth camera on the forklift, and the images of the front view and top view of the pallet are used to do semantic segmentation and to calculate the slope and relative position of the forklift and the target pallet, as shown in the Figure 2.

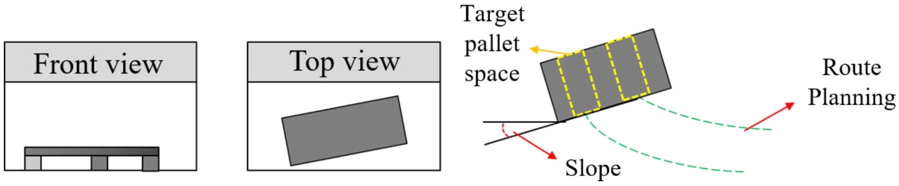

Fig. 2. The Pallet Position and Hole Angle Calculation

4.3 The Position Correction Algorithm

After knowing the pallet position and pallet hole angle, the steering wheel will control the rotation angle and make the self-propelled forklift travel to the planned path. The self-propelled forklift is driven by a single wheel, with the front wheel as the driving wheel, the rudder wheel with both walking and turning functions, and the last two driven wheels, whose turning radius exists, and the minimum radius of rudder wheel turning is calculated according to the planned path, meaning that the radius of self-propelled forklift rotation (R) is calculated under the limit angle of rudder wheel rotation, as shown in the Figure 3.

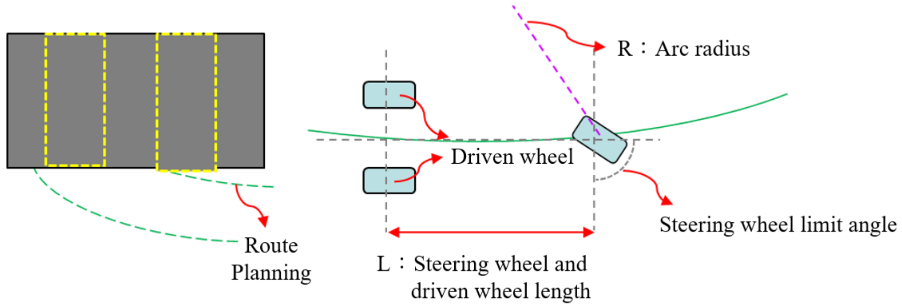

Fig. 3. Calculation of the Minimum Diameter of the Rudder Wheel

The motion model of the single rudder wheel is established at the minimum diameter of the self-propelled forklift, as shown in the Figure 4. The motion model of single tiller wheel is based on the initial position of the self-propelled forklift, and the target rotation angle of δ tiller wheel can be solved, and a high-precision sensor is used to collect the rotation angle data and travel steps (at least 1000 pulse per revolution) to accurately calculate the diameter of each meter of the tiller wheel, and then the sensor feedback is corrected to obtain the current rotation angle of θ tiller wheel and accurately control it. Only when the AGV automatically forks the pallet system can enter the pallet without hitting the center of the pallet and finish forking the pallet automatically.

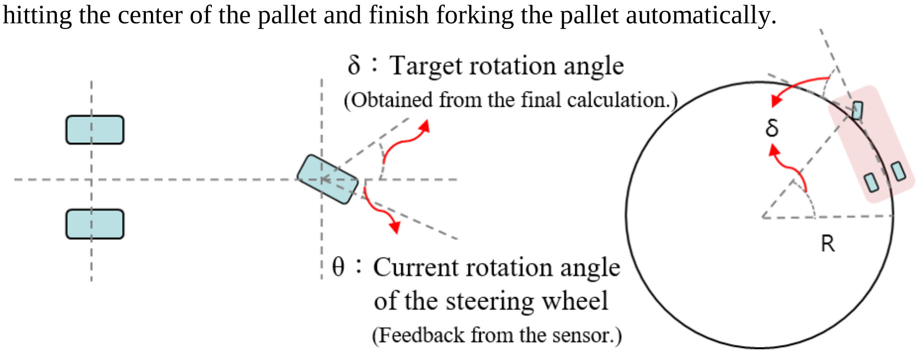

Fig. 4. The Rudder Wheel Movement Model

5 Conclusion

Through object detection and semantic segmentation, we can obtain effective object recognition results and calculate the travel path and rotation diameter of the forklift through algorithms to achieve automatic pallet forklift. This result can help logistics operators to solve the problem of manpower shortage, so that logistics personnel can reduce the workload and save a lot of operating time with the help and service of AGV automatic forklift pallet system, which can greatly improve the overall work efficiency.

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Impact and Application of Block chain Technology on Urban Traffic Based on Artificial Intelligence

Zhenxing Bian(✉)

Software Engineering Department, Shandong Polytechnic College, Jining, Shandong 272000, China
(✉)Corresponding author: 1147705561@qq.com

Abstract. In recent years, with the development of artificial intelligence, blockchain technology has been used in many industries. The development of the financial industry is the fastest and most mature. Now in the transportation field, blockchain technology and big data technology are combined; it can solve some of the pain points in traffic. Blockchain technology is a decentralized technology. Decentralization means that each node in the network is independent of each other and carries out point-to-point information data transmission. In this process, there is no organization or individual pairing and transmission process. Using blockchain technology in traffic scenarios can put information and data on the chain to ensure that information and data will not be tampered with and can be traced back at all times. This article proposes a method to build a big data platform for urban intelligent transportation using blockchain technology. The method takes data as the core, eliminates the centralized computer management of multiple organizations, changes the methods of data collection, data processing and analysis, completes the data storage modules and methods, and realizes the complete platformization of the urban intelligent transportation system. The results show that the urban intelligent transportation big data platform architecture using blockchain technology overcomes the limitations of multiple organizations, discovers urban intelligent transportation data, and further solves the problem of insufficient data in existing network archives.

Keywords: Artificial Intelligence, Blockchain Technology, Urban Transportation, Transportation Big Data Platform

1. Introduction

With the rapid development of modern information and communication technologies, big data, Internet of Things, cloud computing, etc. have been widely used in modern urban rail transit. Among them, blockchain technology provides a basic guarantee for the intelligent and intelligent construction of urban rail transit through data collection, access, processing, analysis, mining and modeling [1]. At present, the intelligent development of urban rail transit involves a wide range of data sources and a huge amount of data, with the characteristics of multi-source, heterogeneous, and self-organizing. With the explosive growth of data volume in the later period, traditional data storage methods, data storage volume, data types and hardware architecture restrict the use of data value, and can no longer meet the needs of urban rail transit for the development of intelligence and intelligence [2]. More importantly, traditional data storage uses a centralized architecture. Once the data information center is destroyed, the entire information system will be paralyzed, seriously threatening the operational safety of urban rail transit [3]. Therefore, how to improve data sharing, storage and security has become a hot topic in the development of urban rail transit.

Blockchain is the supporting technology of Bitcoin. It has the characteristics of decentralization, non-tampering, and traceability. It is gradually applicable to the fields of finance, digital copyright, document storage, Internet of Things, and notarization, and has achieved great results. Technology comparable to artificial intelligence, big data, cloud computing, etc [4]. Artificial intelligence is based on huge data and powerful computing power. The characteristics of blockchain technology are well integrated into artificial intelligence applications to promote the development of artificial intelligence. The blockchain is a distributed storage structure, all nodes of the blockchain are the same, there is no central manager, all users can upload the data information of the next node through the protocol process [5]. The biggest feature of blockchain is decentralization and uniform openness. Once the link is successful, the data is difficult to modulate, and the data of all nodes are consistent, which has a wide range of application prospects in the field of intelligent transportation [6].

Although there are a large number of people trying to reduce the traffic load, the situation will continue to deteriorate [7]. Now, thanks to the technology of the fourth industrial revolution, experts are optimistic that cities can eventually eliminate the traffic load [8]. According to a report from the World Economic Forum, there are two technologies that make the transformation of urban transportation possible: driverless cars and Bitcoin's blockchain technology. According to Thomas Birr and Carsten Stöcker, in order to realize this dream, blockchain technology is decisive: Travel expenses will be automatically withdrawn from passengers' digital blockchain wallets or loaded into their credit cards, and payments will immediately flow to the car [9]. Passes, ID cards and P2P transactions will make it easier and safer to share vehicles and infrastructure, such as charging stations, toll stations, and parking lots. Each user's identity, age proof, insurance and payment will be blocked ability to identify, while protecting the security of passenger names, travel information and payment mechanisms. Smart contracts that control such transactions are based on standard shopping malls. Tax records and visual reports can ensure accuracy no matter where the trip takes place sex [10].

2. Method

2.1 Data Statistical Algorithm

Statistical algorithms are used to obtain the main components of the signal matrix Y. In short, it is the process of decomposition and sampling:

The first is to decompose the covariance matrix, that is, the decomposition formula (1):

$$E(yy^H|G) = \rho GE(xx^H)G^H + E(nn^H) \tag{1}$$

The above formula can be decomposed into:

$$\mathrm{E}(\mathrm{yy^H}|\mathrm{G}) = \rho \mathrm{UD^2U^H} + \mathrm{I_M} = \begin{bmatrix} \mathrm{U_s} & \mathrm{U_N} \end{bmatrix} \begin{bmatrix} \rho \mathrm{D_S^2} + \mathrm{I_L} & 0 \\ 0 & \mathrm{I_{M-L}} \end{bmatrix} \begin{bmatrix} \mathrm{U_S^H} \\ \mathrm{U_N^H} \end{bmatrix} \tag{2}$$

When T is large, $\Sigma \approx \mathrm{E}(\mathrm{yy^H}|\mathrm{G})$ decomposes Σ, then:

$$\Sigma = \begin{bmatrix} \hat{\mathrm{U}}_\mathrm{S} & \hat{\mathrm{U}}_\mathrm{N} \end{bmatrix} \begin{bmatrix} \hat{\mathrm{D}}_\mathrm{S} & 0 \\ 0 & \hat{\mathrm{D}}_\mathrm{N} \end{bmatrix} \begin{bmatrix} \hat{\mathrm{U}}_\mathrm{S}^\mathrm{H} \\ \hat{\mathrm{U}}_\mathrm{N}^\mathrm{H} \end{bmatrix} \tag{3}$$

In the base station antenna, $V^H X$ is unknown and the object to be estimated. From the derivation process of equations (2) and (3), the PCA analysis method shows that:

$$V^H X = \frac{1}{2}\left(\sqrt{\hat{\mathrm{D}}_\mathrm{S} - \mathrm{I_L}}\ \right)^{-1} \hat{\mathrm{U}}_\mathrm{S}^\mathrm{H} \mathrm{Y} \tag{4}$$

2.2 Multi-type Blockchain Collaborative Management

Urban traffic problems involve many aspects, and the channels to obtain traffic information involve all levels. However, all types of traffic information from collection to analysis, from release to update, the entire process is controlled by the transportation functional department, and the public and other government functional departments are rarely involved. Adopting a completely open information management model so that the public can be used as a node link information platform to read or publish traffic information at will. This approach is not desirable. Because only adopting completely open information management based on the public chain model will bring about two fatal problems. First, it is difficult to ensure that the traffic information uploaded by the public is true and accurate. The inability to tamper with the data of the blockchain technology determines that once the node is successfully linked, the published information is difficult to modify. Second, even if the information released is true and accurate, the complete transparency of the data may bring about a series of unpredictable traffic operation problems. To effectively use the co-financing traffic information provided by the public, we must not only delegate power to the public, allow them to participate in traffic management, improve management flexibility, but also strictly control the information released by the public to avoid unpredictability. Therefore, we adopt a multi-type blockchain collaborative traffic information management model to delegate power to the public while taking into account the reasonable management and control of information. The information management mode based on the private chain is adopted for the transportation functional departments, that is, the block chain is established in the functional departments with high trust, and the reading authority has a certain degree of restriction on the public.

2.3 Promote the Implementation of Blockchain Technology

The application mode of blockchain technology has three types: public chain, private chain and client chain. Blockchain technology has 7 types of open agreement, anonymity, trustlessness, immutability, decentralization, traceability and programmability. Although the development of international blockchain technology has undergone an obvious acceleration process, there is no substantial transportation application in the blockchain technology industry. The state should actively promote in-depth research on the level of blockchain technology and provide good research on the application of blockchain technology for urban transportation. Research and investigation will be conducted through a variety of methods. Blockchain technology needs a reliable network to drive. It needs a reliable identity, reliable ledger, reliable calculation and reliable storage technology to realize the application of blockchain technology in urban transportation. Therefore, urban transportation rights can be quickly and safely circulated and used on the blockchain, and quickly confirm its value in urban transportation. Through the application of blockchain technology, it not only promotes the safety of urban traffic, but also improves the mobility of urban traffic and improves the quality of urban traffic.

3. Experiment

3.1 Subject

In recent years, the urban economy of City A has developed rapidly, urban expansion, population surge, and motor vehicle ownership continue to rise, but traffic management problems such as traffic congestion, lagging public transportation facilities, insufficient parking space supply, and frequent traffic violations are also increasing. In order to study the impact and role of blockchain technology in urban transportation in the context of artificial intelligence, this article takes the actual urban traffic situation of City A as the research object, and analyzes the current status of traffic in City A and the experience with the support of blockchain technology. Compare the status quo of urban traffic after reform to understand the impact of blockchain technology on city A's urban traffic.

3.2 Experimental Method

The main research methods used in this experiment are as follows:

The first is comparative analysis. On the one hand, through horizontal comparison, that is, compared with the level of developed countries, we can clarify the gaps and shortcomings between the current urban traffic development of my country and City A and the international level. On the other hand, through longitudinal comparison, that is, time series comparison, we can clarify the development process and current situation of urban transportation.

The second is the case analysis method. When studying the development mode of urban transportation under the support of blockchain technology in foreign countries, case studies were carried out with typical developed countries such as Europe, the United States, and Japan, and provided valuable experience and useful enlightenment for the development of urban transportation in Province A.

The third is model analysis. Starting from the analysis of the consumption and urban traffic characteristics of City A, the relationship between the annual consumption, residents' transportation mode and GDP data of City A is decoupled and analyzed, and the current status of urban traffic and the passing blocks of City A are obtained. The current status and impact of city A's urban traffic after the support of chain technology.

The fourth is the questionnaire survey analysis method. By issuing a questionnaire to some residents of City A, the degree of satisfaction of the residents of City A with the urban traffic of City A was investigated, and thus the impact of City A on the urban traffic of City A after experiencing the blockchain technology on the urban transportation reform was analyzed.

4. Results

According to statistics from the Planning Bureau of City A, the city's land area is about 12,065 square kilometers, and the sea area is about 11,000 square kilometers. Beginning in 2017, the built-up area of the urban area has reached 255 square kilometers (ranked 40th in the country and 3rd in the province), an increase of 6.0 square kilometers compared to 2016. The city's total highway mileage is 14,700 kilometers (5 national roads, 445 kilometers, provincial roads 6, 322 kilometers), and rural roads account for 68.7%. The total length of urban roads in the urban area is 1165.5 kilometers, and the total area is 35.07 square kilometers. The length of the newly built road is 36.66 kilometers and the total area is 1.21 square kilometers; the length of the renovated and modified road is 11.24 kilometers, and the road area is 0.44 square kilometers.

According to the calculation of the urban permanent population of 3,003,500 in 2017, the per capita road area in the urban area was 12.21 square meters, an increase of 0.58 square meters compared with 2016; the average road area of vehicles was 51.5 square meters, a decrease of 1.9 square meters from the previous year. The indicators are shown in Table 1. Judging from the road conditions of City A, it is still in an orderly development, but the development trend is slowing down, and the density of the expressway network is far below the standard requirements.

Table 1. Urban road indicators of city a in 2017

Urban road	Length (km)	Area (km^2)	Average width (m)
Over 12 meters	1153.0	34.95	30.3
Ancient city 7-12 meters	12.5	0.12	9.6
Total	1165.5	35.07	30.1
Dongtou	121.73	1.60	
Total	1287.23	36.66	
Road area per capita		12.21	

According to statistics, in 2017, the average traffic congestion index (traffic index ranges from 0 to 10 during the working day of the congestion in urban area A, the higher the value, the more serious the traffic congestion) value is 5.91, which is an increase from 5.71 in 2016 0.20. In 2017, the urban congestion lasted about two hours during the working day, compared with an increase of 32 minutes in 2016, the degree of urban traffic congestion increased significantly.

According to the questionnaires issued and collected, regarding travel time, the urban area of City A is not large, but 19.03% of citizens still need to spend 30-45 minutes to travel, and even 12.01% of citizens need to spend more time. Regarding the degree of satisfaction with traffic conditions, 34.88% of people think that the traffic conditions are not very good and even 16.78% think it is very bad.

In the end, we have conducted a survey on the current status of urban traffic in City A after the blockchain technology reform, and the results are completely different from those before the reform. Most people are satisfied with the reformed urban traffic and only occupy one.

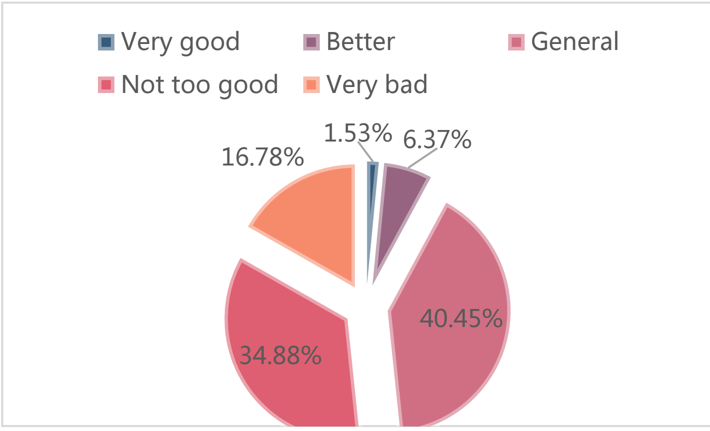

Figure 1. Questionnaire survey on traffic satisfaction in City A

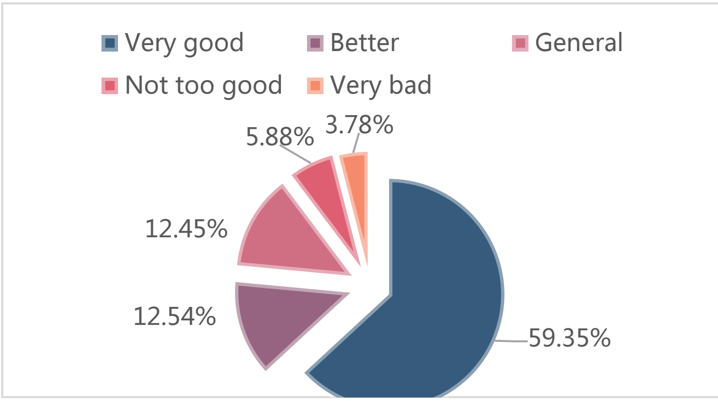

Figure 2. Questionnaire survey on traffic satisfaction in City A

According to our Wenjuan investigation and analysis, it can be known that the urban transportation network of City A is relatively developed. Before the introduction of blockchain technology to reform the urban transportation of City A, the urban traffic of City A was crowded, and many residents were the city's traffic is dissatisfied, which affects their commuting and other life travel. However, after experiencing the reform of the blockchain technology on the urban traffic in City A, the urban traffic in City A has been greatly improved. It has basically been recognized by the residents. Most residents are satisfied with the urban traffic in City A. It can be concluded that the influence of blockchain technology in urban traffic is still great.

5. Conclusion

At present, the research of blockchain technology at home and abroad mainly focuses on the application of theoretical concepts and macrostructures, but the research on specific technologies and methods is not in-depth. With the active development of big data mining technology, artificial intelligence, intelligent identification technology, and network communication technology, integrated urban traffic management not only inherits traditional and standardized processes, but also changes creativity, innovation and development, intelligence, humanization, and flexibility and effectiveness. With the diversification of management modules, today with the rapid development of transportation informatization, blockchain technology clearly has the characteristics of decentralization, prevention of data modulation, data transparency and transparency, and will be integrated in all aspects of urban transportation And acceptance. Blockchain technology plays an important role in developing innovative solutions for developers and entrepreneurs to reduce the burden of traffic. The combination of blockchain technology, drive and driverless vehicles will significantly change the traffic situation. Our goal is to develop a series of previously incredible solutions and eliminate all traffic loads. On this basis, future research will focus more on specific technologies and methods. To promote the application of blockchain technology in big data, more blockchain technology and application cases will be proposed.

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Data Mining Analysis Based On Cloud Computing Technology

Yizhi Li (✉)

College of Internet of Things, Jiangxi Teachers College, Nanchang, Jiangxi, China
(✉)Corresponding author: ytxy2015@163.com

Abstract. With the rapid development of computer technology, Internet technology and artificial intelligence technology, the amount of global data has exploded, and the era of big data has come. This paper mainly studies the data mining analysis based on cloud computing technology. All the data needed in the experiment are put into the name node, which is responsible for copy management to other machines. All the intermediate data generated during the experiment are stored in the distributed file system of the cluster. Firstly, the data set to be mined is uploaded to Hadoop distributed file system (HDFS), and the program reads the data from HDFS when using it. At the same time, the output file name is set so that the system can store the calculation results in HDFS. The selection of indicators follows the scientific design principle to ensure that the indicators are comprehensive, scientific and operable, and the indicators are verified and selected by expert analysis. In the case of using complete 150g data, 72% of the single machine does not use Hadoop platform, and the accuracy of using Hadoop platform is 71%. The results show that the combination of cloud computing technology and data mining can significantly improve the operation effect of the algorithm.

Keywords: Cloud Computing Technology, Data Mining, Hadoop Cluster, Algorithm Analysis

1 Introduction

Data mining involves a wide range of fields, which has attracted many experts, scholars and enterprises to participate in the research, innovation and improvement of data mining related algorithms. Huge data information has high requirements for algorithm, and the quality of an algorithm is directly related to the efficiency and timeliness of data mining.

Cloud computing is the development trend of information technology in the future. If association rules and related algorithms are brought into cloud computing, it can not only increase the service scope of cloud computing, but also improve the performance of association rules algorithm, and make it reach a new level [1-2]. In addition, the virtualization technology of cloud computing also includes features and functions such as virtual machine replication and migration, which simplifies the management of large-scale computer cluster and improves the overall operation security of the platform [3-4]. Single machine data mining algorithm performance is limited, the amount of data processing is also very limited, usually cannot exceed the memory size, unable to conduct in-depth analysis [5]. Application deployment and maintenance on multiple servers is very cumbersome, application monopolizes the server, and the waste of software and hardware resources is serious [6]. Therefore, it is necessary to introduce cloud computing, divide the calculation into several sub parts, each sub part is calculated by a server, and finally merge the calculation results of each sub part [7]. Cloud computing not only solves the problem of limited single machine memory, but also significantly reduces the computing time of data mining algorithm [8]. The data mining platform based on cloud computing is committed to providing data mining capability and big data storage capability services, which is convenient for other industries to build their own business system on this basis, which will greatly save the R & D investment cost of enterprises and improve the efficiency of the company [9-10].

At present, many enterprises have built their own cloud computing platform. Facebook has the largest cloud platform system, which can store and process 100pb of data. It is one of the largest clusters in the world. All kinds of sources, such as social media, news channels, science labs, meteorological departments, produce a lot of data every day. These big data need the most effective storage and efficient analysis technology; these technologies can bring some knowledge, which is a huge challenge for the data world.

2 Cloud Computing Technology and Data Mining

2.1 Cloud Computing

Cloud computing has unlimited data storage, computing and mining functions to provide services to customers with "leasing" services. This can not only save the cost of software and hardware equipment purchase and maintenance, but also reduce the cost, and ensure the reliability and scalability of data storage, calculation and mining. The data collected on the Internet of things and computing devices are scattered, so the parallel data mining function of cloud computing must be used.

2.2 2.2 Data Mining

With the rapid development of science and technology, the amount of data obtained by all walks of life is increasing, and the information contained in these data is also growing by geometric multiples. In order to solve the above problems, discover useful information and knowledge from the huge data in time, and improve the utilization rate of data, data mining technology came into being, and has been vigorously developed, and gradually become one of the most cutting-edge research directions in the field of database and information decision-making.

Assume that each sample consists of multiple training attributes $A_k(K=1,2,...,k)$ and prediction attributes. Divide N samples into a set of c different samples, and the number of samples in the category Ci is Ni. The initial amount of information in the decision tree is:

$$I(C_1,C_2,\cdots,C_C)=\Sigma_{i=0}^{C}-(\frac{N_i}{N})\log_2(\frac{N_i}{N}) \tag{1}$$

Select the training attribute as the classification node. When each training attribute is set to $A_k(K=1,2,...,k)$ and the number of samples belonging to the category C_i is n_{kji} for the n_{kj} samples of each branch, the expected entropy based on the training attribute A_K is as follows:

$$E(AK)=\sum_{j=1}^{J}\sum_{i=1}^{I}(\frac{n_{kj}}{N})*(\frac{-n_{kj}}{n_{kj}})*\log_2(\frac{n_{kji}}{n_{kj}}) \tag{2}$$

The information gain $Gain(S,D)$ can be expressed as:

$$Gain(S,D)=I(S_1,S_2,\cdots,S_m)-E(S,D) \tag{3}$$

In the expression, $E(S,D)$ represents the entropy weight of k subsets divided by the quotient of attribute D.

3 Data Mining Test

3.1 Experimental Environment

The test environment consists of one IBM server and six Dell desktops. The IBM server is configured with Xeon e5506 processor, 16g memory, dual Gigabit network card, 500g SATA hard disk. The Dell desktop is configured with i5760 processor, 4G memory and 500g IDE hard disk. Computers are connected by Huawei Gigabit switches, and all network cables are connected by gigabit network cables. All the data needed in the experiment are put into the name node, which is responsible for copy management to other machines. All the intermediate data generated during the experiment are stored in the distributed file system of the cluster.

3.2 Experimental Test

Firstly, the data set to be mined is uploaded to Hadoop distributed file system (HDFS), and the program reads the data from HDFS when using it. At the same time, the output file name is set so that the system can store the calculation results in HDFS. The selection of indicators follows the scientific design principle to ensure that the indicators are comprehensive, scientific and operable, and the indicators are verified and selected by expert analysis.

4 Discussion

4.1 Algorithm Classification Accuracy Comparison

The relationship between cluster size and runtime is shown in Figure 1 when dealing with graph of fixed size. As can be seen from the figure, on the premise that the number of edges in the graph remains unchanged, increasing the number of computing nodes in the cluster can greatly shorten the running time of optimdm algorithm and improve the performance of the algorithm. The experimental results directly prove that the performance of optimdm algorithm is scalable and depends on the size of the cluster. In other words, optimdm algorithm can make full use of distributed computing resources and reduce the time cost of the algorithm. Compared with the original KNN algorithm, the classification accuracy of the improved KNN algorithm does not decrease when the selection of the limit nearest neighbor distance is more conservative, but for the classification task of large data sets, the classification efficiency of the algorithm has been significantly improved. If the limit nearest neighbor distance of the algorithm is further reduced, the operation efficiency is expected to be further improved. Of course, the classification accuracy of the algorithm will not be effectively guaranteed. When executing small data sets, the parallel algorithm consumes less computing resources, and the communication between parallel clusters has a fixed resource overhead, which makes the execution time of the algorithm longer when executing small data sets. If the data set size increases, and the communication between clusters is basically fixed, the ratio of computing cost and communication cost of the algorithm will be greatly increased, which can reflect the advantages of computer cluster computing, that is, the speedup ratio will also increase, and the performance of processing large-scale data will be better. Reasonable configuration of cluster nodes can improve the performance of the platform. In the experiment of changing support, it can be seen that the change of support also has a certain impact on the performance of the algorithm. The larger the selected support is, the faster the running speeds is, but it may have a certain impact on the accuracy of the generated rules. So choosing the appropriate number of support can speed up the running speed and get better rules.

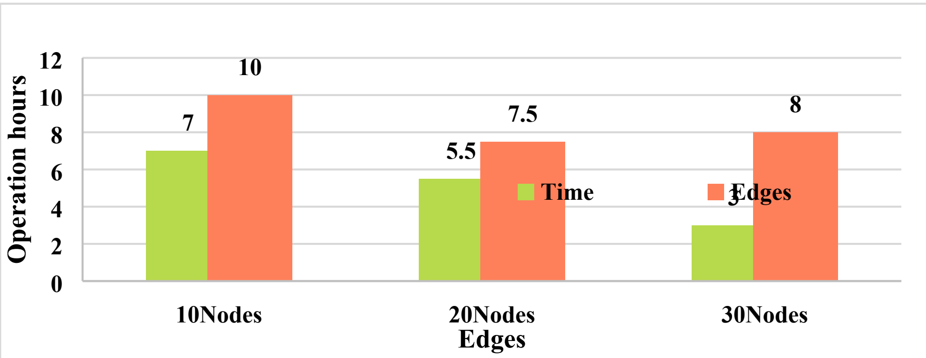

Fig 1. The relationship between cluster size and running time

The cluster speedup results are shown in Fig 2. It can be seen from the Fig that the cluster parallelization speedup is always less than the number of cluster computing nodes. With the increase of the number of cluster nodes, the speedup ratio is rising, and the overall computing time of the cluster is less and less, which reflects the strong overall computing power of the cluster. When the number of nodes is 2, the size of the sample number cannot see the performance difference, but with the increasing number of nodes, we can clearly see the trend of speedup under different samples.

The more the number of nodes, the more linear the speedup of the algorithm, and with the increase of the sample size, the more obvious this trend is. Therefore, we can draw a conclusion that the improved Apriori algorithm greatly improves the computational efficiency and performance of the algorithm under the cloud platform, saves the time cost, and provides a guarantee for the high reliability of the system. The insertion and update performance of cloud storage system is much higher than that of traditional SQL, and the query performance is several times of that of traditional SQL. For the frequent insertion and query of massive GSM-R data, cloud storage system has incomparable advantages. Slicing will have a certain performance impact on the insert, update and query operations, but compared with the traditional SQL cloud storage system, the performance is still very strong after slicing, and it can support data expansion and solve the problem of storage capacity limitation.

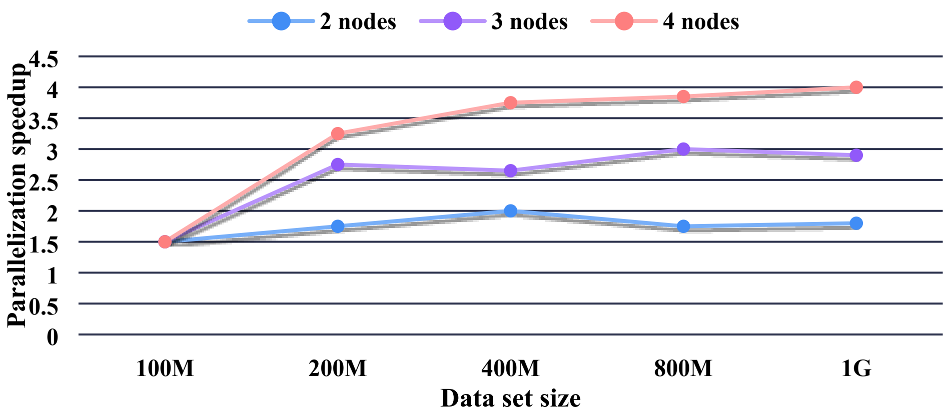

Fig 2. Cluster speedup results

4.2 Algorithm Running Time Comparison

The execution time of aldck means algorithm in different clusters is shown in Table 1. When dealing with small dataset dataset1, the execution time in stand-alone mode is shorter than that in cluster mode. This is because dataset1 has a small data scale, and the cluster takes up few resources for clustering calculation. In Hadoop platform, certain resources are also needed for initialization, task allocation and communication between clusters. However, with the increase of the data set size, the communication tasks between clusters remain basically unchanged, while the proportion of computing tasks occupied by clustering algorithm will increase, which will show the advantages of parallel algorithm, and the parallel execution time will be far less than the serial execution time. In terms of the accuracy of logistic regression model, in the case of 60g data, the accuracy of single machine without using Hadoop platform is 73%, and the accuracy of using Hadoop platform is 69%. In the case of using complete 150g data, 72% of the single machine does not use Hadoop platform, and the accuracy of using Hadoop platform is 71%. We can find that the accuracy of larger samples is slightly higher than that of smaller samples. The possible reason is that the training samples are segmented when the feature variables are selected to enter the regression model. In the case of large data scale, each node will get more data, so the accuracy will naturally increase. For fixed datasets of different sizes, the speedup increases linearly with the number of nodes. It shows that with the growth of the number of nodes, the processing time will be greatly reduced, and the parallel running speed of multiple hosts is higher than that of one host. At the same time, it is noticed that the experiment gets better speedup ratio with the increase of data set. The speedup of 10m data set is closer to the ideal speedup than that of 100k when the number of nodes is large.

Table 1. ALDCK-means algorithm execution time in different clusters

Data set	Stand-alone	2	3	4	5	6	7	8
Dataset1	151	170	169	167	164	162	160	159
Dataset2	1013	972	917	840	810	789	761	750
Dataset3	2175	1740	1302	1037	917	830	801	771
Dataset4	4368	2834	1963	1687	1257	1069	972	942
Dataset5	8918	4652	3183	2739	2116	1792	1713	1646

5 Conclusions

This paper designs the virtualization and resource management scheme, and constructs the cloud computing data processing model, and does some research on its performance optimization and tests and compares the performance before and after optimization.

Data mining is the key technology of effective data management, the traditional data mining method is only suitable for the database with small amount of data, for massive data sets, parallel distributed processing is a good way, we will deploy it to the cloud computing platform, and we can quickly mine out the effective information.

Using the combination of data mining technology and social network, users' preferences are clustered and correlated in many aspects to achieve more accurate recommendation effect. It also verifies that cloud computing can not only improve the efficiency of data mining, but also provide more new ideas for the original data mining scenarios.

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Data Security of Internet of Things under Cloud Environment

Weiwen He

School of Information Engineering, Guangzhou Nanyang Polytechnic, Guangzhou 510000, Guangdong, China
11hww@163.com

Abstract. With the increasing demanding of Internet of Things (IOT) and the improvement of information technology, the IOT service is facing greater challenges. The birth of cloud computing brings great opportunities to confront these challenges, but it also brings security problems. Considering the IOT data security problem under cloud service mode, this paper develops a trust framework and trust authentication scheme to solve problems including security from data network transmission, cloud data protection and acquisition terminal trust verification. It is believed that the framework will solve the data security problems to a certain extent.

Keywords: Internet of Things (IOT), Data Security, Trust Framework, Trust Authentication Scheme

1 Introduction

With the development of global economy and the strategic objectives of "reading China" and "digital city", the adjustment of industrial structure in China has been gradually speeding up. Information technology, which is regarded as the key of enterprise development, is expediting the profound industrialized change. The services of Internet of Things (IOT) [1] based on cloud Computing Technology [2, 3] integrate Enterprise Resource Plan(ERP), supply chain, customer relationship, product data, financial and other information into an organic integration. It breaks the bondage of the enterprise resources, and makes links between management and public cloud platform. It also connects global industrial, reduces cost and improves enterprise competitive ability.

IOT is a new field of technology composing of the multi-disciplines form the perception of data processing. It can be divided into sensing layer, network layer, data layer and application layer. Sensing layer has the ability of transferring samples from the network layer to the data layer by two-dimension code, Radio Frequency

Identification (RFID) and other sensor devices; application layer analyzes and mines dates from data layer to achieve different needs of enterprise services; IOT, based on the environment of technology of cloud computing, synthesizes cloud computing, grid computing, parallel processing and distributed computing, shifting data storage, data distribution, service response to the cloud services. However, IOT based on cloud service uses external network storage and sensor devices to automatically push regular data to the cloud, which inevitably brings many new unstable factors [4, 5]. The reliability of IOT network access and the security of data in cloud have become the primary concern.

There are still important problems to be solved in the research of IOT: 1. The credibility of network accessing can be guaranteed because of lacking the description of trust service specification. 2. Because the stored data in cloud is uncontrollable, it will face various types of threats, such as data leakage. The article has put forward a data trust scheme of IOT under cloud environment, it improves the security of IOT cloud data transmission and IOT cloud data storage.

2 Trust Framework

The development of communication technology and users' demand have determined the change from simplification to diversification on data collection terminal of modern IOT services. This paper puts forward a trust framework under cloud environment for data transmission of IOT, which ensures data reliable transmission and strong fault tolerance, it provides credibility monitoring, diagnosis and recovery to ensure transmission data movement. It also provides a security guarantee of stored data in the cloud. As shown in figure 1.

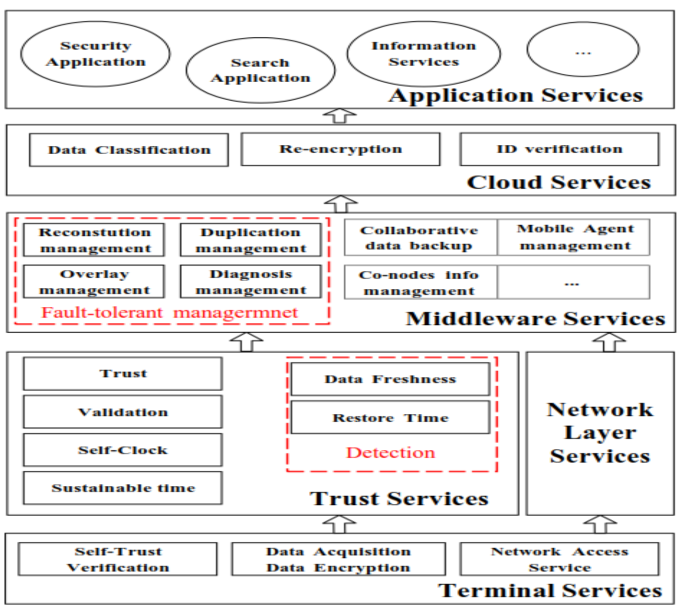

Figure 1. The Trust Framework.

In design of reliable data transmission, the main idea is to create middleware layer to isolate network service layer and application layer, using the middleware layer network node management and data management. The key issues are: trust and cooperative relationships between the networks, mutual authentication of network object and so on. In terms of cloud storage, we use the re-encryption for data security over the middleware layer, which prevents cloud service provider's privilege to access the stored data in cloud [6, 7]. In fact, re-encryption method is performed by the cloud service agency, but it only can operate encrypted data after obtaining authorization. Although cloud service providers have data access privileges, they can't get any information from the encrypted data. When the final users receive the re-encryption of data and authorized decryption key, they can easily decrypt the data without extra computational overhead.

Considering many factors, this trust framework combines the trusted chains transmit and re-encryption [8]. In the bottom layer, it uses the TPM chip to ensure the self-trust of acquisition terminal; in the network layer, it uses dependable certification scheme to ensure reliable internet access; in the application layer, and it uses re-encryption to protect stored data in cloud[9]. From all above, it provides three-dimensional reliable protection.

3. Trust Authentication Scheme

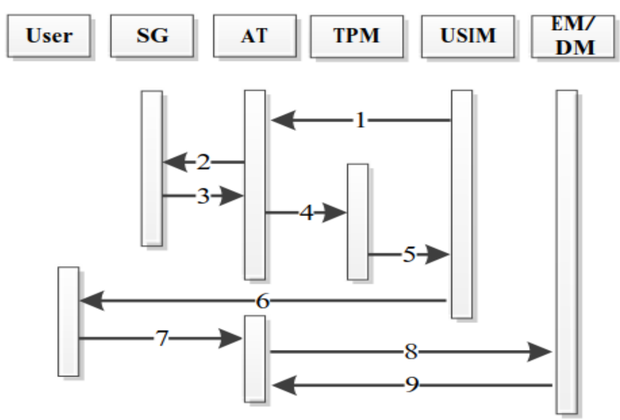

Figure 2. The trust authentication scheme.

In dynamic IOT, the stored data in cloud often do increment operations, which is easy to implement re-encryption method. But the mobile acquisition terminal in the network will keep changing frequently, which complicates the cooperative relationship between network access terminal and acquisition terminal[10]. This article focuses on these problems and converts the relationship between network access terminal and acquisition terminal into measuring the dependence of self-trust authentication and mutual trust authentication. Combing with requirement cloud service, this paper propose the trust authentication scheme as shown in figure 2.

In figure 2, assumed that acquisition terminal of IOT holds the authority of terminal access. SG is sensor group, which collect data samples, AT represent the acquisition terminal, it mainly implement data summary. AT has the USIM module, which is a component of network. It is not only able to support multiple applications, but also includes authentication of USIM to network. EM/DM is an encryption/decryption module, which including many functions, such as password operation, digital certificate, sensitive information storage and so on. TPM module is the unit to ensure the credibility of sampling, it can implement self-trusted authentication. This scheme also contains its own private key, certificate TPMCert, and sharing SG keys Keyshare, it implements as following steps:

3.1 USIM→AT: r_1, $USIM_{ID}$, PR_1

Acquisition terminal of IOT needs to check its own platform integrity when power is on, so USIM module send random number r_1, USIM identification $USIM_{ID}$ and platform verification requests PR_1 to AT.

3.2 AT→SG: r_2, AT_{ID}, PR_2

After receiving PR_1 by the USIM platform, AT will transmit a random number r_2 , AT's identification AT_{ID} and SG verification request PR_2 via the I/O bus.

3.3 SG→AT: EAC_{SG}

$$EACSG\ \ AC(E(Keyshare , r2), ATID\ \| SGHash) \qquad (1)$$

SG calculates Hash value after it receives integrity checking request PR_2, and then uses Key_{share} to encrypt these collected random numbers r_2.Finally, we can calculate SG authentication codes EAC_{SG} by formula (1). Then SG will send back authentication codes to AT for verification. Where AC and E represent the encryption algorithms, symbol | | represent cascade.

3.4 AT→TPM : r_3 ,TPM_{Sig} , ER

$$TPM_{Sig}\ Sig(TPM_{SK}, r_1 \| r_3 \| USIM_{ID} \| PCR) \qquad (2)$$

AT needs to verify authentication codes after receiving EAC_{SG} from SG. Because SG integrity Hash value SG_{Hash} is stored within the TPM in advance, so the AT use random number r_2 generated by itself and SG_{Hash} to calculate EAC'_{SG} by formula (1), then do the cooperation. If $EAC_{SG} \neq EACS'_{G}$, it shows that SG information is not integrated or tampered. Thus, AT end its own credible verification process. If $EAC_{SG} \neq EAC'_{SG}$, it shows that the external acquisition is reliable and integrated, AT will go to next verification process. After that, AT will generate random number r_3 , and use its own private key TPM_{SK} to signPCR, transaction affairs ER and r_3 by formula (2), then send to the TPM.

3.5 TPM→USIM:TPM $_{Cert}$,r_3 ,TPM $_{Sig}$,ER

TPM only needs to do one operation after AT acquire TPM's authentication, it will send r3 ,TPM $_{Sig}$, ER and TPM certificate TPM_{Cert} to USIM.

3.6 USIM→User: TS, r_1 , r_3 ,TPM_{CertID} , NAI , ER,TPM $_{Sig}$, EAC_{TPMID}

$$EAC_{TPMID}\ AC(Key_{AU}, TS \,||\, TPM_{CertID}, || \, r_1 \,||\, r_3 \,||\, ER) \tag{3}$$

The certificate TPM_{Cert} will be send by USIM to the mobile network access terminal, it needs timestamp TS, TPM certificate TPM_{CertID} and Key_{AU} to verify the legitimacy of the mobile terminal platform by EAC_{TPMID} generate by formula (3). If it already has TPM_{Cert} , it will directly check the legitimacy of the signature TPM $_{Sig}$. If the signature verification fails, the certification process terminate. If not, it requests enduser password to obtain permissions to control the AT.

3.7 User→AT: (PR_{re} , Key_{Usk}) / (PR_{se}, Key_{Upk})

If end user inputs the wrong password, login fails. If the user inputs the correct password, two types of actions can be performed. The first one is sending package, sending request PR_{se} and public key Key_{Upk}. This action will ask AT to send encrypted data to the cloud for re-encryption operation. The second one is to receiving package. After sending request PRre and decryption key Key_{Usk}, AT will request to receive encryption data packets and do decryption operation. Considering the security of stored data in cloud, it will keep changing Key_{Usk}, so $Key_{Usk} \neq Key_{AU}$.

3.8 AT→EM / DM: $Data_E$ / $Data_D$

AT needs to determine the types of user's requirements after receiving them, then distributes encryption and decryption work to EM/DM module respectively according to different requirement.

3.9 EM / DM→AT: Data

$$EAC_{Data}\ \ AC(Key_{Data}, TPM_{ID} \,||\, TS) \tag{4}$$

AT must verify its integrity by formula (4) before data decryption. If integrity verification fails, AT sends verification results to the USIM to receive package again. If verification succeed, DM decrypts the data package, then sends the data to operational areas.

4. Conclusions

With the increasing demanding of IOT and the improvement of electronic information technology, the IOT services are facing more requirements and challenges. The birth of cloud computing brings great chances to confront these challenges, but it also brings security problems. To address the IOT data security problem under Cloud environment, this paper, investigated problems of security from data network transmission, cloud data protection and acquisition terminal respectively self-trust verification. It built a trust framework and it solved the data security problems to a certain extent.

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Reform of International Economics and Trade Professional Course System in the Internet Age

Ping Wang(✉)

Henan College of Industry & Information Technology, Jiaozuo 454000, Henan, China
(✉)Corresponding author: wangping_9394@163.com

Abstract. With the development of science and technology, Internet technology has become more and more mature. Now, we have entered the Internet era. International Economics and Trade has always been a popular major. Under the background of the Internet era, the traditional international economics and trade professional curriculum system can no longer meet the needs of the times. For this reason, this article expands the reform of the international economics and trade professional curriculum system in the Internet era. In the research, this article first conducted a questionnaire survey on the enterprises related to international economics and trade in our city, and analyzed the demand for talents in international economics and trade in the Internet era. Secondly, taking the international economics and trade major of our school as an example, researched its curriculum system and proposed reform measures for the international economics and trade professional curriculum system in the Internet era. The research in this paper finds that there are many factors that employers attach importance to when recruiting professionals in international economics and trade. Most employers value comprehensive quality. A total of 108 companies choose the factor of comprehensive quality, with an overall percentage of 93.91%. In addition to practical ability and professional knowledge, foreign language proficiency and social skills are also factors that companies pay more attention to when recruiting. In addition, in the analysis of the school's international economics and trade professional curriculum system, it is found that the current school pays more attention to general courses in the curriculum, while ignoring professional courses and practical courses. For this reason, we propose some reforms of the international economics and trade professional curriculum system The measures call on schools to pay attention to the education of professional knowledge and the cultivation of practical ability while paying attention to basic education, so as to cultivate better professionals in international economics and trade for the country.

Keywords: Internet Era, International Economics and Trade Major, Curriculum System, Talent Demand

1. Introduction

The advent of the Internet era has caused tremendous changes in all aspects of the social environment [1-2]. The advent of the Internet era has promoted the development of cross-border electronic business, and has provided more information exchange methods and trade methods for international trade, broke the traditional trade model and market area restrictions, and formed a globalization with information technology as the link Trade market [3-4]. In addition, the advent of the Internet era has spawned many new international trade methods, such as online ordering, online payment, online sales, etc., both parties can use electronic information systems to complete commodity declaration, inspection, insurance, transportation management, foreign exchange settlement, etc. Work to improve trade efficiency [5]. In the Internet age, the society's requirements and needs for talents in various fields are constantly updated, especially for application-oriented talents who can meet market needs [6].

Nowadays, in the context of the Internet era, the traditional international economics and trade professional curriculum system can no longer meet the needs of the times [7-8]. We know that the international economics and trade professional curriculum system includes a lot of content, and the quality of the curriculum system directly restricts or promotes the quality of teaching [9-10]. In the Internet age, reform the international economics and trade professional curriculum system so that it can meet the needs of the development of the times and cultivate better professionals. In this way, it can effectively promote the development of international economics and trade.

This article provides a simple explanation of the Internet era and international economics and trade majors, and selects the city’s international economics and trade-related enterprises to conduct questionnaire surveys and interviews, and analyzes the talent needs of international economics and trade in the Internet age. And taking the international economics and trade major of our school as an example, researched its curriculum system, and proposed reform measures for the international economics and trade major curriculum system in the Internet era.

2. Overview of the Internet Era and International Economics and Trade

2.1. Internet Era

The Internet age means a longer period of time with Internet technology as the core. Combined with the research views of many experts and scholars, the Internet age is generally divided into four stages, namely the CPU stage, Web1.0 stage, Web2.0 stage and In the big data stage, the development and use of Internet technology in each stage are different, and the manifestations are different, but all have a transformative impact on the government information management at that time.

The "Internet era" referred to in this article mainly refers to the fourth stage of Internet development, namely the big data stage under the new information technology environment. In the Internet age, mobile Internet, social networks, and emerging media have greatly expanded the boundaries and scope of the Internet, the information flood valve has been opened, all kinds of data have rapidly expanded, and the entire society has entered a period of information explosion, that is, the stage of big data.

2.2. International Economics and Trade Major

(1) Professional definition of international economics and trade

"International Economics and Trade Major" mainly includes two parts of international economics and international trade in professional learning, and it takes into account the cultivation of theoretical knowledge and practical ability in talent training. International economy and trade is a unit that cultivates applied talents that combine economics and trade.

(2) Talent training requirements for international economics and trade

The training of talents in international economics and trade must first emphasize the learning of applied economic management and trade theory. Should have the corresponding knowledge of international economics, international trade, management, accounting and other economic management and trade theories, and be familiar with relevant theoretical literature, which can provide scientific theoretical guidance for subsequent actual economic and trade operations. Secondly, we must pay attention to the cultivation of practical operation ability, execution development ability, communication and coordination ability and related professional skills. Emphasizing practice and hands-on operation is the most vivid interpretation of "application". Cultivating applied talents in international economics and trade is first to focus on the cultivation of their practical and operational capabilities, that is, to be able to apply theoretical knowledge and existing scientific research results in the field of international trade to practical international trade work. To become an excellent international trade application-oriented talent, we should focus on the training of market project execution ability and market development ability, so as to maximize the use of effective market information, grasp customer resources and do every international trade work with maximum efficiency At the same time, the ability of "execution and development" is also a concrete manifestation of emphasizing practice and application ability, and coordination ability is an important indicator of comprehensive quality.

(3) Problems in International Economics and Trade

1) Talent training target is too single

In my country's universities, there is great convergence in the training objectives, curriculum systems, teaching plans, and teaching content of international trade talents, resulting in a lack of hierarchy and characteristics in the overall training of international trade talents. In the Internet age, international economics and trade majors the development of my country cannot meet the needs of our country's international trade, and reform is urgently needed

2) Poor practical teaching effect

Practical teaching is an important part of teaching in colleges and universities, but the current practical teaching effect of international economics and trade majors is not significant, resulting in students not being able to use trade knowledge to solve practical problems. The main reason for the above phenomenon is that most of the international trade majors in our country currently implement passive practice methods, that is, the status of students' learning subjects is ignored, most of the practical routes and methods have been determined by teachers, and students cannot rely on their own knowledge system to learn. Complete teaching practice activities.

3. Research Ideas and Research Design

(1) Research ideas

This article adopts the literature analysis method to provide a theoretical basis for the research of this article by collecting and analyzing online and offline data. Secondly, we use a combination of questionnaire survey method and interview method to analyze the demand for international economics and trade professionals in the Internet era, and take the international economics and trade major of our school as an example to analyze the international economics and trade professional curriculum system, Thus proposed reform measures for the international economics and trade professional curriculum system in the Internet era.

(2) Research design

1) Analysis of talent needs

This article takes 120 international economic and trade-related enterprises in our city as the research object, and analyzes the current demand for international economic and trade professionals. The research was conducted by a combination of questionnaires and interviews. In this research, a total of 120 questionnaires were distributed and 115 valid questionnaires were returned. The questionnaire efficiency reached 95.8%, and each questionnaire corresponds to a company.

2) Course system analysis

Taking the international economics and trade major of our school as an example, the curriculum system of the international economics and trade major of our school was studied, and 200 students majoring in international economics and trade of our school were randomly selected to conduct a questionnaire survey. Inquiries ask students what they think about international economics and trade professional courses, and sort them into categories. Among them, the views on international economics and trade professional courses are divided into five types: very reasonable, reasonable, general, unreasonable, and very unreasonable.

4. Analysis and Discussion of Research Results

4.1. Analysis of the Demand for International Economics and Trade Professionals in the Internet Era

This article uses a combination of questionnaire surveys and interviews to analyze the demand for international economics and trade professionals in the Internet era. The results are shown in Table 1 and Figure 1.

Table 1. Factors that employers attach importance to when recruiting professionals in international economics and trade

Value factors	Number of employers making selection	Overall percentage (%)
Professional knowledge	72	62.61
gender	12	10.43
Comprehensive quality	108	93.91
Appearance	20	17.39
social relationship	8	6.95
Foreign language level	56	48.70
Social skills	63	54.78
Academic performance	32	27.83
Actual ability	95	82.61
Knowledge	38	33.04

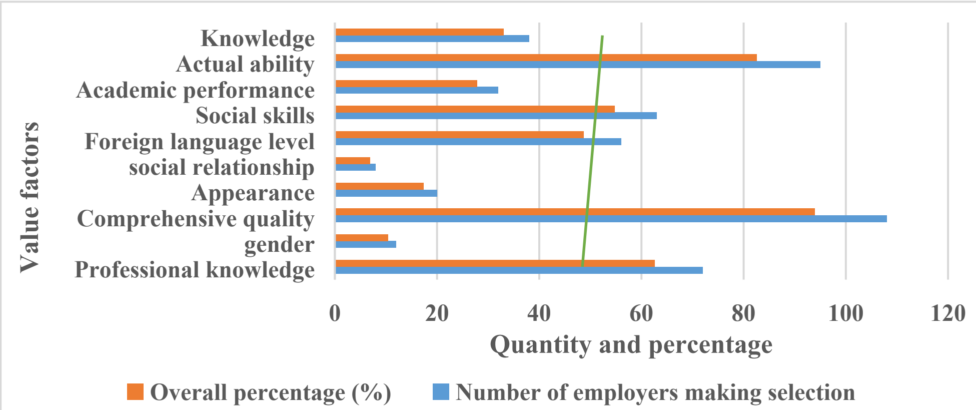

Figure 1. Analysis of the demand for international economics and trade professionals in the Internet era

As shown in Table 1 and Figure 1, there are many factors that employers attach importance to when recruiting professionals in international economics and trade. Among them, most employers value comprehensive quality. A total of 108 companies choose the factor of comprehensive quality. The overall percentage is 93.91%, followed by actual ability and professional knowledge. 95 companies choose the factor of actual ability, the overall percentage is 82.61%, 72 companies choose the factor of professional knowledge; the overall percentage is 62.61%. In addition, foreign language proficiency and social skills are also more important to companies when recruiting. Among them, 56 companies chose the foreign language factor, the overall percentage is 48.70%, and 63 companies chose the actual ability factor, the overall percentage is 54.78%. In addition to the appeal factors, some companies attach great importance to gender, appearance, social relations, learning ability and knowledge, but the proportion is not high. Only a few companies pay more attention to these factors. To sum up, most employers prefer to recruit graduates with high comprehensive quality, strong professional knowledge and ability, and outstanding practical ability.

4.2. The Reform of the International Economics and Trade Professional Curriculum System in the Internet Era

(1) Analysis of the international economics and trade professional curriculum system

Analyzing the analysis of our school's international economics and trade professional curriculum system, the credits, hours and ratios of some courses in the curriculum are shown in Table 2.

Table 2. Credits and proportions of some courses in the course

Course type	Credit	Percentage of total credits (%)	Class hours	Percentage of total hours (%)
General course	65	39.4	1206	39.0
Foundation Course	21	12.7	336	10.9
Professional core courses	32	19.4	544	17.7
Professional Development Course	20	12.1	320	10.3
Concentrated practical teaching project	27	16.4	672	21.8

It can be seen from Table 2 that in the international economics and trade professional courses, the general education courses have 65 credits, accounting for 39.4% of the total credits, and 1206 credit hours, accounting for 39.0% of the total credits. The credits of the basic courses are 21, accounting for 12.7% of the total credits, and the class hours are 336 hours, accounting for 10.9% of the total credits. The professional core courses have 32 credits, accounting for 19.4% of the total credits, and the credit hours are 544 credits, accounting for 17.7% of the total credits. The credits of professional development courses are 20, accounting for 12.1% of the total credits, and the class hours are 320, accounting for 10.3% of the total credits. The intensive practice teaching project has 27 credits, accounting for 16.4% of the total credits, and 672 credits, accounting for 21.8% of the total credits. It can be seen that the international economics and trade majors of our school pay more attention to general courses, while the emphasis on other professional courses and practical courses is relatively low. This will result in poor professional basic knowledge and low actual ability of students.

A questionnaire survey was conducted with students majoring in International Economics and Trade, and the results were shown in Figure 2. A total of 200 questionnaires were distributed in this article, and 200 valid questionnaires were returned.

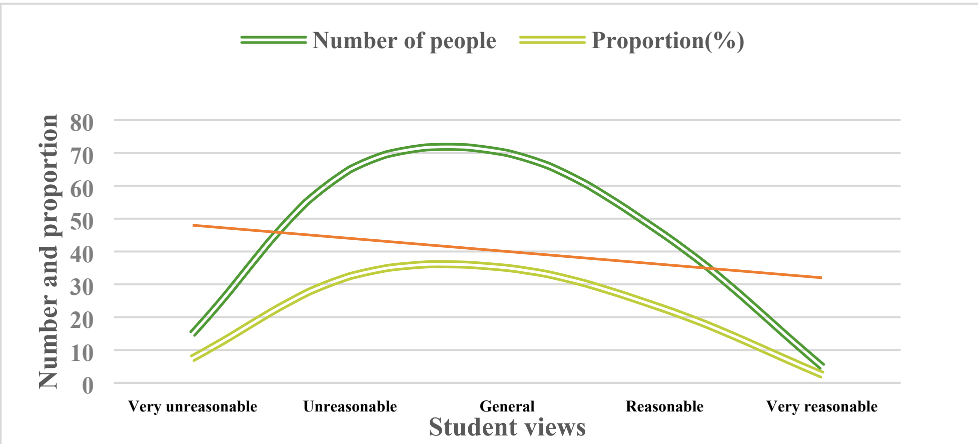

Figure 2. Students' views on international economics and trade professional courses

As shown in Figure 2, there are 15 people who think the course is unreasonable, accounting for 7.5%, 65 people who think the course is unreasonable, accounting for 32.5%, and 70 people who think the course is normal. The proportion is 35%, 45 people think the course is reasonable, accounting for 22.5%, and 5 people think the course is reasonable, accounting for 2.5%. It can be seen that students think that the international economics and trade professional courses are not very reasonable, and the school should reform the international economics and trade professional curriculum system.

(2) Reform of the international economics and trade professional curriculum system in the Internet era

In the Internet era, international economics and trade professionals should have the following characteristics: First, in terms of quality, they should have the necessary communication and cooperation capabilities in foreign trade activities, as well as a good sense of ethics, professionalism, and sense of responsibility. And other non-professional qualities. Second, in terms of knowledge, there should be a complete knowledge structure, and graduates of international trade majors should have a complete knowledge structure. Thirdly, in terms of ability, according to the needs of society, it has certain expression ability, learning ability, social ability, innovation ability and practical ability. For these kinds of abilities, the corresponding curriculum should focus on cultivating talents who meet these needs.

In order to adapt to the development of the times and cultivate more and better international economics and trade talents in the Internet age, we should reform the international economics and trade professional curriculum system. The specific reform measures are as follows:

(1) Curriculum setting of basic theory modules

The basic theory course module includes the related theory courses of the public basic course. Although there are many courses, the credits cannot be used for more. It is appropriate that the hours of basic courses account for one-fifth or even less of the total hours.

(2) Curriculum of professional ability module

The professional competence module is the core of the entire course structure of the international trade major; the professional competence module is a major compulsory course for the international trade major. It mainly learns major compulsory knowledge in economics, management, law, etc., and lays the foundation for future international trade work.

(3) The setting of capacity development module courses

The ability development module is a course that is not offered in the existing applied undergraduate international trade majors. According to the needs of the society, these abilities are social skills, communication skills, organization and coordination skills, etc. Based on these abilities, corresponding courses can be set up to lay the foundation for future international trade work. Ability development courses include website management and web production, Vietnamese, Thai, Korean, Japanese, Malay, speech and eloquence, international business negotiation, business English listening and speaking, social etiquette, ASEAN profile and customs, etc. In addition to classroom teaching, ability development courses can also set up some platforms, such as foreign language corners, so that students can strengthen the abilities they encounter in the classroom during exercise. In the process of teaching, teachers can also instill in students the ways to behave and do things, and better guide students with their own practical experience.

(4) The setting of the fourth practical ability module course

The practical ability module is a synthesis of the first two modules. Only by consolidating the foundation and highlighting the professional ability can the practice be carried out better. Practical course modules include customs declaration training, comprehensive international trade experiments, professional internships, employment and entrepreneurship internships, e-commerce, customs declaration practices, accounting computerization and other courses. The class hours of such courses can be extended, reducing classroom teaching and increasing practical training. Wait for practical lessons.

5. Conclusions

With the development of science and technology, the era of the Internet has quietly arrived. Nowadays, the Internet has had a huge impact on our lives. Under such a background, if the training of talents in international economics and trade remains unchanged, it will not be able to meet the needs of the development of the times. This article studies the reform of the international economics and trade professional curriculum system in the Internet era. In the research, this article analyzes the demand for talents in international economics and trade in the Internet era through a questionnaire survey of enterprises related to international economics and trade in our city, and takes the international economics and trade major of our school as an example. The system has been studied, and the reform measures of the international economics and trade professional curriculum system in the Internet era are proposed. This article believes that while the school attaches importance to basic education, it should also focus on the education of professional knowledge and the cultivation of practical ability, so as to cultivate better international economics and trade professionals for the country.

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Visual Metaphor of the Short Video Eco-Syste

Xiaomin Zhang(✉)

Faculty of Journalism & Communication, Communication University of China, Beijing, China
(✉)Corresponding author: 408541469@qq.com

Abstract. The developments of short videos appear poised for growth. As image communication, short video presents an ecological chain development mode from content to platform, then to users, and finally to the formation of market influence. In this commercialized ecosystem, visual metaphor, which exists in artificial media using visual images, has become a set of strategies to stimulate insight. At the same time, visual metaphor is also a tool for users to think. Visual metaphor plays an important role in short video communication. This paper takes "happy country leaders program" on SnackVideo as the research object and applies the case analysis method to explore the generation mechanism and performance characteristics of metaphor mechanism in the theoretical perspective of visual metaphor, so as to provide useful references for the development of short videos.

Keywords: Short Video, Ecological Chain, Visual Metaphor, Happy Country Leaders

1. Introduction

Recording self-growth and reflecting social transformation, short videos reshape the power of cultural communication and social innovation with richer and more sharing culture, knowledge and information. As a new media growing up in the Internet environment, the development of short video is challenged by both content and video-traffic.

Flow is the market vane, content is the cornerstone of development. In the era of new media, the scarcity and uniqueness of content are still of great value, and the new media based on channel needs the support of content. Visual metaphor exists in the artificial media using visual image, which is not only a strategy to stimulate insight, but also a tool for users to think. It is called "metaphor in metaphor", and its biggest advantage is to rely on the visual image constructed by visual practice for persuasion. These characteristics just fit the short video ecological chain development mode, from content, platform to users, influence and market. Therefore, under the theory of visual metaphor, it is beneficial to promote the development of short video to analyze how images act on the viewer, how to use visual symbols to express meaning, and how to grasp visual text through metaphor.

The "happy rural leader program" aims to enhance the leadership, business management ability and social responsibility of Chinese rural entrepreneurs, promote rural revitalization and talent cultivation, and help rural development [1]. Through the short videos display, local products in poor areas will be advertised, and produce economic benefits, which is an important goal of this kind of short videos communication. This demand is highly similar to the development model of “content-platform-users-influence- market” short video ecological chain that we are trying to explore. Therefore, this paper takes “happy rural leaders” as a case, selects four leaders, which are “laughing Shirley” “seven fairies of Dong family” “Yang Lili's wheat straw painting" and “PingWuGuanBa DuYong”, as the research objects by random sampling method, and uses visual metaphor theory to analyze the generation rules and performance characteristics of metaphor mechanism, so as to provide useful reference for the development of short videos.

2. An Overview of Visual Metaphor Theory and Literature Review

Metaphor is an ancient way of thinking, which plays an extremely important role in human language, thought and culture. In ancient Greece, Aristotle's rhetorical study gave metaphor a high position and weight [2]. After metaphor entered the field of concept from the field of language, Victor Kennedy and John Kennedy found that metaphor has gone beyond the linguistic category of daily life and art, and become the most critical rhetorical device in visual art [2]. In the metaphor theory system of George Lakoff and Mark Johnson, the father of cognitive linguistics, metaphor is considered as a cognitive phenomenon and a basic cognitive way for people to know things and establish a conceptual system [2].

After the confluence of vision and reason, visual metaphor establishes its core position through the tradition of “visual centralism” [3]. As a common phenomenon in human thinking, metaphor is mediated by metaphorical words and is transformed between noumenon and vehicle. Its meaning is not fixed and needs to be explored by the observer. After entering the field of concept, visual metaphor becomes a set of visual images for communication and expression [3]. It is convinced that vision can objectively record the reality and accurately reflect the object, which is the psychological mechanism and structural basis of resorting to images, symbols and other visual images [3]. At the same time, visual metaphor is the source of thought, which is widely permeated in the knowledge system, ethical relations and power operation [3].

On the study of visual metaphor, Yan Gao combs the visual metaphor and spatial turn from the perspective of ideological history, and believes that focusing on the visual metaphor behind visual culture is the critical path to understand modernity, postmodernity and the modern life [3]. Tao Liu made a series of discussions from the perspective of visual rhetoric, such as *Metaphor Theory: Generation of Transferred Meaning and Analysis of Visual Rhetoric, Interactive Model of Metaphor and Metonymy: From Language to Image, Metonymy Theory: Image Reference and Visual Rhetoric Analysis, Sub Image Iconicity: Symbol Movement and Visual Metaphor of Pyles, etc.* Yiqing Hu pays attention to the metaphor of “entity or relationship”, Danling Liu constructs the visual recognition framework of “image” of the national image, Wei Zhu analyzes the metaphor mechanism from the perspective of metafunction and discourse, Lang Chen constructs the concept of metaphorical discourse ability, Xiaoyun Li discusses the realization of metaphorical function from the perspective of media technology, and Jiang Chang expounds media from the perspective of media evolution Metaphor and imagination in ecology.

3. The Original Ecology is Chosen as the Source Domain, and the Target Domain Metaphor is Realized through "Cross Domain Mapping"

According to the mapping theory, the thinking process of metaphor is reflected as the cross-domain mapping in the conceptual system. The occurrence mechanism of metaphorical practice is a kind of mapping or projection from the cognition of vehicle to the cognition of noumenon [2]. That is to say, when the interpretation process of a symbol system is in trouble, it is necessary to acquire another symbol system with universal cognitive basis, so as to approach and grasp the meaning system of the former along the meaning system of the latter [2]. In the image era, it is to use the image symbols of the original domain to explain the target domain through cross domain mapping.

The object presented in image text consists of "substantial part" and "element" [4]. The "substantial part" refers to the part that can leave the whole and self-maintain and present, with independence [4],Such as trees, mountains, rice fields, mobile phones, farm tools, the sun, children and so on. "Elements" refer to the parts that cannot be concrete objects and cannot be separated from the whole to which they belong, which are self-sustaining and independent, such as speed, tone, expression, posture, etc. The nature of the object in the visual text determines that the attribute recognition framework of the viewer in the cognitive process is completed by "joining" and "condensing" [4].

When watching , a user first confirms what is short video through the substantial part of video text, then identifies the elements that are attached to it, and discover and identify its feature. For example, Yang Lili's wheat straw painting represents the production and inheritance of wheat straw painting in Duolun County, Xilingele League, Inner Mongolia, PingWuGuanBa DuYong represents the daily life of forest protection in GuanBa village, PingWu County, Mianyang City, Sichuan Province, laughing Shirley and Romantic Seven Fairies of Dong Family are all set in Qiandongnan Miao and Dong Autonomous Prefecture, Guizhou Province. Among them, laughing Shirley mainly shows her daily life, while Romantic Seven Fairies shows Dong culture. These joining and condensing image features are called recording the world and recording you on the SnackVideo, that is, the emphasis and compliance on the original ecology.

The Four ID numbers are presented from the first perspective. They respect the original appearance of life, and use the method of true record to create and spread different cultures, showing the diversity and richness of life. Such as PingWuGuanBa DuYong's short videos show the placement of the infrared camera, the antelope jumping on the road, the life of workers fighting dams, Cattle and sheep on the mountain and so on. The most original life is exactly what users want to see. Here, the original ecology is affinity and penetration. The works of "Romantic Seven Fairies of the Dong Family" shows the food, scenery and ceremony of Dong village. From the perspective of visual metaphor, it mainly uses audio-visual language montage, relies on the time dimension of lens A and lens B to realize the construction and transmission of meaning, and guides the audience to form the metaphorical association that A is B. In this set of videos, A is every shot and every frame in the video, which exists in the context created by the author, and is concrete, vivid, sensible; B is built on the basis of cross- domain mapping, which needs to form a new understanding of the ontological attributes and connotation through the meaning construction of cognitive psychology. This process, in the Romantic Seven Fairies of the Dong Family, is to understand the logic and significance of the target domain along the meaning and logic of the original domain. Among them, the original domain is the content presented in the short video, and the target domain is to attract more people to pay attention to the Dong culture and travel to Shanbao village to get rid of poverty and become rich. At present, this goal has achieved initial results in gaibao village.

In poverty alleviation stories, visual metaphor builds a bridge between producers and users, satisfies emotional expression in coding and decoding, enhances social identity, and realizes communication value. Summing up the characteristics of these original stories, mainly in three aspects: first, the visual text has a real sense of reality. This sense of reality is similar to the situation or experience of the viewer, which easily leads to empathy or compassion. Second, the expression of visual practice is far from the experience of the viewer, which can arouse the curiosity, thinking and even action of the viewer. The third is that the point of view implied by visual discourse, whether agree or disagree, means profound, which can at least touch a certain point in the heart.

4. Encodes Concrete Spiritual Symbols and Obtains the Content Market through Metaphorical Persuasion

Metaphor is called “metaphor in metaphor”, and its importance lies in the pursuit of persuasive effect. One of the characteristics of visual metaphor is to rely on the visual images constructed by visual practice for persuasion, which is symbolic action in the sense of social construction [2]. The following is a sample of ID number “laughing Shirley”, which has the highest number of fans and attention, to analyze the mechanism of its metaphorical effect.

Yuan Guihua is the author of “laughing Shirley”. She comes from a big family of 14 people in leizhai village, Tianzhu County, Guizhou Province. Because of the need to bear the responsibility of supporting her family, Yuan Guihua chose to give up her studies after graduating from high school. Those short videos show her life,such as doing farm work, selling agricultural products and building houses,and so on. As Guy Debord said, almost every detail of life has been alienated into the form of landscape [5]. These Landscapes are visual and objective scenes displayed, which also means a subjective and conscious performance and show [5]. As Gérard Genette put it, this kind of display, performance and viewing are at different narrative levels. There are different rules of interpretation and different systems of partition between them.They are logically independent of each other [6]. Through representation and narration, the similarity between two parallel narrative layers is found, which makes the generation and flow of meaning possible [6].

In the “laughing Shirley”, the land of idyllic beauty is constructed with materials such as melon bitten by insects, rose on the mountain, wild cherry, local bayberry, stone painting, girl catching fish, spring water, etc. Similarly, the image of tough girl also exists as a metaphor, and the noumenon is moving mountains’s girl, challenging girl, female Rambo, poking horse honeycomb’sgirl, carrying a piece of sky, etc. In these two metaphors, that which are “paradise” and “tough girl, and their corresponding construction materials are in two narrative levels, and their structural relevance is due to the similarity of spirit. The recognition and meaning of object image in visual text is because an image can be regarded as a non-material entity, a ghostly, phantom like appearance, depending on some material support to surface or obtain life [7]. It is an intentional structure given in experience, which integrates all appearances, perspectives and images [8]. It is the meaning that lies in what it expresses and hides behind them [8].

Shirley is a phenomenal product of platform for poverty alleviation. Short video creation not only solved the livelihood problem of Yuan Guihua's family, but also opened a market for local agricultural products. The achievement is built on the short video ecological chain of content platform user influence market. The key is the communication power and influence brought by visual metaphor. The emergence of visual metaphor also leaves the communication mechanism of CO production, participation and sharing bred by not short video soil. The advantages of this mechanism are mainly manifested in two aspects:

The first is that in the process of consuming products, users reproduce and redistribute products through individual forwarding, commenting, sharing and other behaviors, so as to create new product value. Laughing Shirley often interacts with users in short videos by asking questions. For example, in the short video of spring water published on June 24, 2017, the author's message is: what does mean of that “Cao jie”? The result is a heated discussion. Some say it is safe. Some say it is for health. Some say it is a ceremony to send water god. Some say it is to separate things from the water, or to tell others that the water is boiling water. Comments not only focus on the cursive knot, but also extend a lot of new topics, forming a new discourse. The old fellow described the comment as better than the video.

The second is the algorithm distribution mechanism based on platform and social network, which extends the diversified relationship between people, and breeds the soil for the production and dissemination of content. SnackVideo’s Gini Coefficient mechanism is used to distribute the principle to avoid the polarization of attention resources and let the sun shine on more people. The figure below shows the relevant indicators of short video works produced by four happy rural leaders in the process of poverty alleviation.

These indicators directly show the inclusive communication based on the Gini Coefficient mechanism. Any person, even a naive person, can post short video on SnackVideo. And the system will match the number of basic users that may be interested in this video, at least 100 people. There is also a climbing mechanism. If the popularity index of 100 basic users is high, such as viewing time, comments, downloads, etc., the system will distribute it to more users again. On the other hand, for the head users, the platform takes measures to limit the flow. Compared with the popular video, Snack Video pays more attention to the distribution of long tail video. And at Snack Video, the head video accounts for only 30% of the platform traffic [9].

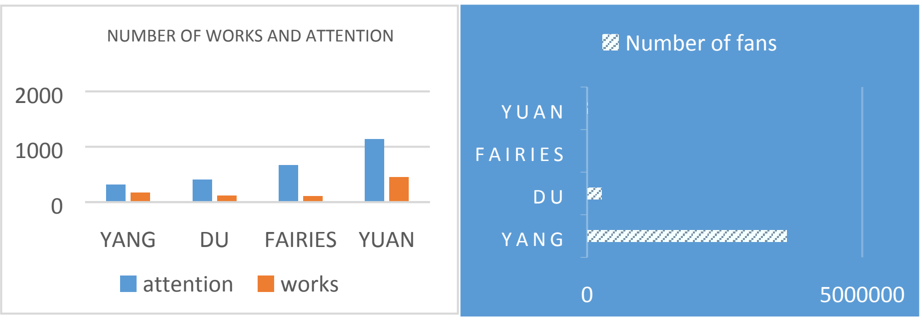

Figure 1. Number of works, attention and fans of four happy rural leader

American sociologist Michael Collins defines an interactive ritual chain, which is a chain formed by the constant interaction between individuals in a certain situation [10].Collins believes that the interactive ritual chain is the foundation of social structure. In the chain of interactive rituals, people's experience involves resources, status, exchange and other factors, so people's interaction has market characteristics [10]. In this interactive ritual market, people use emotional energy and capital symbols for social communication. The process of social communication is essentially a process of value production and exchange [11]. Therefore, short video can be spread in the metaphorical mechanism of content construction, and form a market extended by content.

5. With the Help of Allusion and Emotional Metaphor, the Meaning outside the Painting can be Activated through “Punctum characterization”

Shirley has lost nearly 10000 fans in three hours after she interrupted the advertisement which does not match her image, and has not recovered to the previous level of fans in a short time. This mismatched advertisement, according to Roland Barthes' theory, is called punction in visual communication. It can pass through studium, burst into the center of visual attention, evolve into the cause of meaning increment, ignite the fire rope of emotion involvement, and activate the emotion recognition framework [4].

Roland Barthes put forward the concepts of studium and punctum to clarify what moves people in the images. Roland Barthes believes that studium is a kind of extensive element, which aims to convey information, reproduce situations, surprise people, emphasize meaning. It is smooth and arouses casual desire, changeable interest and inconsistent tastes, or even half desire, half desire ", and" enables me to approach a world " Some basic knowledge has provided me with a set of local conditions of objects and touched some fetishism in me. Prick point is a "detail" in the picture, a kind of "nameless" stimulus, where there is huge abnormality and destructiveness. Its existence always tempts people to ponder over some elusive meaning out of the picture [4].

Roland Barthes points out that the essence of studium identification is to touch the intention of the text producer, and the punctum is to “summon all possible meanings out of the picture”. It emphasizes the foundational role of those infectious moments in the interpretation of the works, and the most authentic, natural and sensitive inner experience [4]. It can be seen that the punctum is the key to the interpretation of visual image in the visual metaphor mechanism. These punctums are usually expressed in two ways: space experience and time experience. Sherry's two short videos, “city boys and mountain girls” and “brother Niu are confused” can explain what is the punctum of visual metaphor and how it is expressed in time and space.

Shirley's short video focuses on everyday life, such as farming, cooking, catching fish, painting, carpentry, building a house, doing farm work, carrying wood, paving cement, etc. In the process of recording and sharing, What users feel is a Miao girl, who is sunny, kind, beautiful, cute, strong, and optimistic. However, in the two short videos , There are comments like “Can you change your clothes” “It's Keng duo duo all over the Internet” “Here's advertising again”,etc. After the broadcast of “city boys and mountain girls”, the number of fans did not fluctuate significantly, but after the broadcast of “PinDuoDuo”, the number of fans decreased by nearly 10000 within three hours, and the mood and attitude of users fluctuated significantly. Therefore, what users perceive and understand is not only the image they see in front of their eyes, but also “the vision composed of potential and absence surrounds the actual presence of things” [4].If this potential perception is found to be unfavourable by the viewer, it will have a destructive effect.

As the punctum of time transcendence, it is manifested in the split, dramatic and conflict of image time expression [12]. For example, the user's evaluation of the tools in Shirley's video has changed on the timeline. At first, the videos show shovel, sack, rope, axe, etc. After that, there were famous chainsaw, cutting machine, UAV and so on. Old fellows felt that such a good tool must be very expensive ,common people can't afford it, and there is conflict and split. This kind of punctum is opposite to the studium formed by poor family and independent girl. These emotions and attitudes eventually evolve into emotion recognition of users. In short videos, the number of fans decreased. Here, the culture, including experience, custom and knowledge, stipulates the habitus between the signifier and its implied meaning of the associated image symbols. Therefore, the specific objects, places, attitudes, references and frames of reference in the image have the potential to refer to other things and meanings [12].

6. Conclusion

Visual Metaphor mechanism is the driving force of short video ecological chainVisual metaphor is not only a figure of speech, but also a basic cognitive way for people to understand things and establish conceptual system [13]. In the age of image, visual metaphor has incomparable rhetorical ability and persuasive effect [13].It shows great development potential. From the above analysis, we can see that in the publicity of poverty alleviation, short videos carry the technological advantages of large bandwidth, large connection and low delay, and promot the production and dissemination of visual images with unprecedented speed, power and effect. The platform mechanism, by calling individuals to participate in production, encourages grass-roots creation, and enables more original content to be displayed and transmitted through visual metaphor with the power of original nature. It provides a new framework for creating things, a new perspective for viewing things, and a new meaning for understanding things.

As an ordinary forest ranger, PingWuGuanBa Du Yong has no skillful shooting skills. His videos are often patchwork of photos. However, It is such a real expression that conveys the simple values of the protagonist, the forest protection, which is a dynamic teaching material to promote the concept of ecological and environmental protection. Wu Yusheng, once known as “the Secretary of the unorthodox poverty alleviation”, reconstructs the communication time and space, expands the communication path of the Dong culture, and explores a way for the tourism transformation of Shanbao village through the operation of Romantic Seven Fairies of the Dong Family. Yang Lili's wheat straw painting and laughing Shirley have created a number of popular products on short video platforms, driving the consumption of new cultural landscape and new trends.

With the promotion of short video, the net red villages, scenic spots, products in poverty-stricken counties continued to emerge, which help the construction and dissemination of regional image, effectively drived the development of local tourism market, injected new momentum into economic development, and proved the feasibility of the short video ecological chain of “content-platform-users- influence-market” driven by visual metaphor mechanism effectiveness.

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Artificial Intelligence in Digital Media Technology

Jin Cai (✉)

Sichuan Vocational and Technical College, Suining, Sichuan, China
(✉)Corresponding author: 38306833@qq.com

Abstract. With the advancement of society and the increase of computer, network and digital media technology, digital media technology has become an indispensable part of the modern service industry. The application of digital media technology in artificial intelligence has enabled the development of all aspects of life, such as the company's internal training, system development, update and maintenance from "quality" to "quantity". This article mainly introduces the application analysis of artificial intelligence in digital media technology. This paper uses the application analysis of artificial intelligence in digital media technology and proposes a visual media management model. Use artistic innovation methods to analyze and analyze the application of digital media technology in artificial intelligence to improve the standardization and accuracy of digital media. The experimental results of this paper show that the application of visual media and the technology of artistic innovation combined with artificial intelligence technology have increased the innovation rate of digital media by 23%, and improved the interactive synthesis of images and video materials.

Keywords: Artificial Intelligence, Digital Media, Visual Media, Artistic Innovation

1 Introduction

At present, digital media and film and television industries are cultural and creative industries produced by the combination of media technology and computer computing, but digital media technology based on artificial intelligence analysis has pushed digital media technology to a new level [1-2]. The transformation of visual art in the context of digital media not only includes the creative reconstruction of new media art in terms of technology, form and concept [3-4], but also includes the improvement of traditional visual media, the production of new visual media materials, and the old and new The cross-media of visual media [5-6].

Visual communication has become the most important means of communication in the information society. In terms of concept and technology, the emergence of new media directly affects visual communication [7]. Levy believes that visual forms and characteristics, communication media and content, image delivery methods, manufacturers' creative methods and consumer experience have undergone tremendous changes [8]. In the in-depth construction of the sustainable development of cross-cultural, industrialization and sports under the cultural background, the transformation of visual art can also be seen [9-10]. The transformation of visual art is not limited to the field of visual art creation, but a comprehensive transformation of the entire mechanism of visual art creation, the composition of visual communication, and the behavioral activities that consumers participate in [11-12].

The innovation of this article is to propose an analysis of the application of artificial intelligence in digital media technology. According to the visual media technology and the secondary innovation of art, the analysis and application of digital media are strengthened. This article combines practical theory and uses standard case studies to conduct specific analysis, thus providing fresh materials and research for the application of digital media art.

2 Digital Media Innovation in Artificial Intelligence Environment

2.1 Picture Rendering for Digital Media

The image rendering module still occupies a dominant position in the digital entertainment system, and the development of image rendering technology is changing with each passing day. Based on the continuous development of computer image rendering technology, design and implement a graphics rendering subsystem with complete functions and good performance, and at the same time give secondary developers a good function configuration mechanism to facilitate the secondary development of the application system and improve the overall computing performance of the digital entertainment system. And user experience is an important part of the research content of this article.

Technologies such as artificial intelligence and network communication have become indispensable components of current digital entertainment systems. In order to achieve the integrity of the system functions, enrich the fun and interactivity of the digital entertainment system, and verify the results of the system scalability research in this article, this article will also discuss the artificial intelligence and physical simulation applied in the digital entertainment field. The technical methods are researched and realized, and a general method for applying these extended technologies to the overall system is proposed. Finally, the work of this article is a system-level research work. Based on the technical research of various sub-fields, these sub-technologies are effectively carried out. The system integration and application integration enable it to meet the immediate needs of reality. To this end, this article will combine actual project cases to verify the research work of this article. The technical characteristics of these specific projects have their respective focuses, which belong to different types of digital entertainment software products, which can fully prove the versatility and effectiveness of the system framework described in this article. As a graphics rendering engine, take the rendering of a sky as an example. At the top of the sky, you need to map the location of the flat square map to the hemisphere. When constructing a hemispherical dome, the longitude and latitude angles of the dome can be used as input parameters. Then, the local coordinates and latitude and longitude of any point in the dome have the following calculation relationship

$$\begin{cases} x = r\cos\beta\cos\alpha \\ y = r\sin\beta \\ z = r\cos\beta\sin\alpha \end{cases} \tag{1}$$

By setting static or dynamic light sources in the virtual scene, the color of illuminated objects can be changed in real time, or shadows can be cast on other objects. The formula is as follows.

$$L_D = \max(LdotN, 0.0) \tag{2}$$

If the object is only affected by Duse lighting and does not have a normal map, when there is no Specular reflection light, the simplest lighting Shader is used. The calculation method is as follows:

$$C_{Result} = C_{texture} * L_D \tag{3}$$

2.2 Digital Media Visualization Rendering

Rendering cycle: The graphics rendering system needs to go through a series of primitive drawing operations when drawing each frame of 3D scene and object picture. The whole system draws the same frame continuously, and finally forms a continuous animation effect. The series of drawing operations performed by the system in each frame is called a rendering cycle. System architecture design characteristics before proceeding with our system architecture design, it is necessary to clarify the unique functions that the system architecture design of this article needs to achieve. Compared with a pure game engine, our system architecture design should not only emphasize due resource management and object management functions, so as to facilitate developers to program descriptions of the virtual world, but also to integrate extension technologies well to reduce multi-party engines. Or the expansion of middleware. Object-oriented virtual world management includes two aspects.

The first is to use object-oriented program code development to realize the functional reuse of objective objects and logical objects in the virtual world and improve work efficiency. The second is to use the description mechanism between the agent-oriented objective and logical objects and the virtual world to make Agnet the basic element in the virtual world. These Agents can be used to describe the living "objects, such as virtual characters, or inanimate dynamic objects can also be used as packaging containers for some logical control units, such as event triggers. In this article, we will name these Aget packaging containers "Entity" between Entity and the system as a whole and between Eny the relationship between different technology types of development engines or functional packages (such as physics, AI, network, etc.) each has different initialization and release mechanisms, object description mechanisms, data representation methods and loop control procedures. These different engines must be used at the same time In a digital entertainment system, a lot of extra design, interface integration work and process control work are required, which not only increases the difficulty of development, but also affects the efficiency of the system. For this reason, the digital entertainment software system architecture in this article will place the digital entertainment system the required physics, AI, and network sub-modules are designed in a unified abstraction to standardize the control rules and operating procedures of the entire system. In the interface design of these sub-modules, this article will fully consider the current general physics, network and the design mode of the AI engine enables it to smoothly connect to these interfaces.

3 Visual Digital Media

3.1 Visualization System

Flexible rendering loop control as mentioned in the first chapter of this article, graphics rendering and rendering are the most fundamental function of digital entertainment software systems. It is responsible for presenting digital content to users from the most basic sensory way of vision. In the work of this article, the graphics subsystem is the only indispensable technical sub-module in the entire digital entertainment software system. The information processing results of other technical extension modules need to be finally presented through the graphics module, so they need to be surrounded by graphics Sub-module to do the work. The pre-built graphics sub-module, this article needs to make the graphics sub-module meet two requirements: one is the graphics drawing function, which can meet the needs of most application development; the other is the digital entertainment in real applications when there are special needs in software, physics, AI, and network modules often exist as auxiliary modules of the rendering engine. The fundamental reason is that the final processing results of the physics, AI and network communication modules need to be rendered with the help of graphics rendering functions.

3.2 Visual Media System Design

For physics simulation and AI operations, the internal architecture of these sub-modules is similar to the graphics rendering engine, which is composed of a procedurally described world model and abstract physics or AI individuals of objects that are constantly moving and changing in the world. Since their results are presented through a graphics engine, we can streamline the results presentation steps in the system design. We use a unified abstract interface IEXTENDMODULE to describe the management and control of all physics, AI and other sub-modules or third-party engine components. It is an overall manager. Positive EXTENDOBJECT is the object of specific physical simulation, a operation or network communication managed by IEXTENDMODULE, and generally corresponds to each Entity. Just like the initialization of XTENDMODULE, the released interface program initialization and the interface OnEngineInit, this interface is the interface of the sub-module engine manager, and the interface internally handles the related operations of the initialization of the sub-module engine. Under normal circumstances, the submodule engine is initialized together with the entire program system. Therefore, in the system of this article, the interface is called when the entire system is initialized. The program releases the interface ONENGINE DEIN. This interface is the interface of the submodule engine manager, and the interface internally processes the submodule. Operation related to engine release.

(1) Under normal circumstances, the submodule engine should be released together with the entire program system, so in the system of this article, this interface is called when the entire system exits.

(2) The operation interface of IEXTENDMODULE during scene loading and release. When the virtual scene is loaded and released, in addition to the relevant 3D rendering model data that needs to be changed, the agent Entity in the scene needs to be recreated, and the corresponding A, The description model of physics should also be changed accordingly. Therefore, the sub-module engine sets the corresponding operation interface scene loading interface On New WORLDLOAD for these times. This interface is the interface of the sub-module engine manager. It is called when a new virtual scene is read, used to update the new scene except 3D rendering data to describe the model, or to perform other related operations. The specific results are shown in Table 1.

Table 1. Terminal video media formats

Media format	Description
sound	WAV,MP3
Static picture	JPEG,GIF,PNG,TIFF,PSD,BMP
Animated picture	GIF, M-JPEG
FLASH animation	FLASH
Web document	HTML, D-HTML, XHTML
text	TXT,XML

4 Artistic Innovation of Digital Media

4.1 Digital Media Visual Communication Model

Visual communication is the behavior of people sharing visual information and presentation methods. "Visual communication" exists as an independent form of communication, and compared with other types of communication, it has become a more meaningful form of communication. Visual communication creates a form that exists as an important force in the content and provides a form with insignificant value in the content. The specific results are shown in Figure 1: Using this model to solve, you can quickly find the optimal capacity allocation method. LR reaching 1.2 is the minimum value. When the category is relatively large, the calculation amount of the traversal search is very large, which is obviously undesirable. The meaning of solving the rate-distortion bound of the reversible information hiding under the non-uniform distortion metric is to quickly find the optimal allocation strategy.

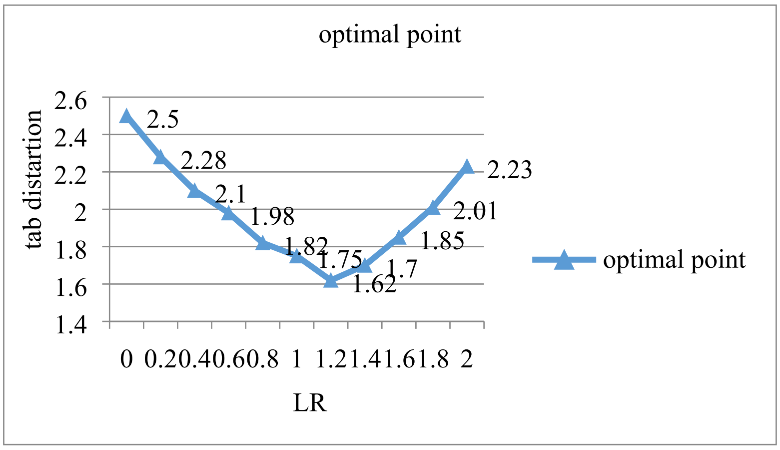

Fig 1. The optimal capacity allocation

4.2 Artistic Innovation in Visual Media

The main purpose of the design and construction of the visual media material library is to provide various types of visual media material sharing and editing and reuse services for the digital content industry. Therefore, in addition to researching system architecture, efficient retrieval, material editing and other issues, breakthroughs are needed. The interactive technology of the web-based visual media material library system is how the system provides users with friendly interactive functions, such as real-time playback of video materials, visualization of human motion materials, real-time interaction and rendering of 3D models based on Web browsers, and similarity Material metadata comparison, etc. Systems and applications with reasonable design architecture, reliable systems, complete functions, and good user experience are the trend of future web-based visual media material library research. In the model browser, the user can realize the interactive operation of real-time rotation, scaling and movement of the three-dimensional model through the operation of the mouse or keyboard. The model browser also supports users to set the position and color of the light source and the color of the ambient light source to better display the model effect. The specific results are shown in Table 2.

Table 2. The performance analysis of 3D model browser

	Windmill model		Airplane model	
Performance parameter	Before optimization	Optimized	Before optimization	Optimized
Memory footprint	17.82	12.56	30.48	26.52
Rendering time	6	4	42	30
Frame rate	24	32	8	12

McLuhan's view of "distributing information to the media" shows that the truly meaningful information is not what the media drives on people every time, but the media itself. He believes that the creation of each new medium, the new way of social life and social behavior, the form of visual communication and the meaning of value in the process of image reading have long been independent and transcends the value of content, which greatly affects people Understanding and mentality. In fact, as a term with good communication connotation, visual communication itself is the result of rich visual efficiency.

A large number of micro-cultural phenomena with micro-cultural features have appeared in the application of network technology in the new media environment. In the field of network economy, a long tail theory of small strokes has appeared, and the development of network technology. The crowdsourcing model (Crowd Sourcing) in Crowd Sourcing has created the accumulation of group wisdom to achieve development and innovation similar to the magic of gathering sand into a tower; the rise of microblogs in recent years has demonstrated the power behind seemingly simple gossip, and small mobile applications have dozens of apps Millions of downloads have helped the smart communication terminal represented by Apple mobile phones to become a novel and fashionable learning lifestyle for young people nowadays. The specific results are shown in Figure 2. In the case of 1 thread, our algorithm is slightly slower. This is because the parallel mechanism introduces some additional overhead, which cannot be offset in the single-threaded case. These overheads are masked in the context of high parallelism.

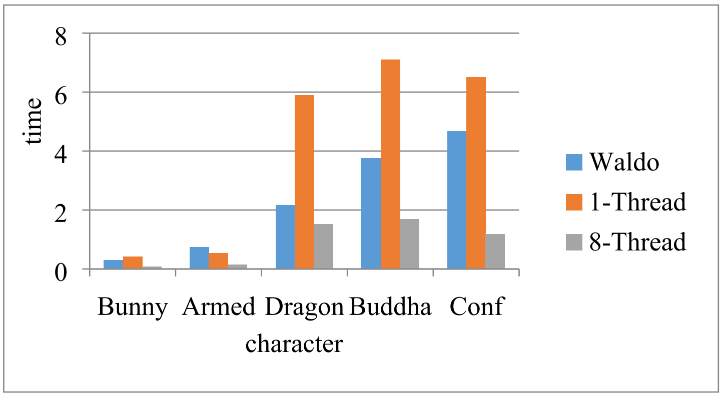

Fig 2. Comparison of running time

5 Conclusions

Although this paper has made some research results on the application and analysis of artificial intelligence in digital media technology, there are still many shortcomings. Based on the analysis of the application of artificial intelligence in digital media technology, there is still a lot of in-depth content worth studying. There are many steps in the visual media process that cannot be covered due to reasons such as space and personal ability. In addition, the actual application effects of artistic innovation can only be compared with traditional models from the theoretical and simulation levels.

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Application Prospect of Film and TV Special Effects Synthesis Technology under Digital Media Technology

Dong Wang(✉)

School of Digital Arts and Design, Dalian Neusoft University of Information, Dalian, Liaoning, China
(✉)Corresponding author: wangdong_ys@neusoft.edu.cn

Abstract. In the era of digital media, new media art has been perfectly integrated with the film and television industry. Vigorously developing digital media technology synthesis technology will help improve the quality of film and television works, and film and television special effects synthesis technology will bring unprecedented visual shock to film and television production. This research mainly discusses the application prospects of film and television special effects synthesis technology under digital media technology. Through the impact of digital media technology and film and television special effects synthesis technology on film and television reputation, the economic benefits of digital media technology on the film and television industry, and the application of digital media technology and film and television special effects synthesis technology in the process of film and television production, discuss the film and television under digital media technology. Application prospects of special effects synthesis technology. During the production of "Wandering Earth", the proportion of special effects synthesis technology in the early film and television production process is 70%, and the proportion of film digital technology in the post film and television production process is 55%. This research helps to improve the quality of my country's film production.

Keywords: Digital Media Technology, Film Television Special Effects Synthesis Technology, Application Prospects, Film and Television Reputation Digital Media Technology, Film Television Special Effects Synthesis Technology, Application Prospects, Film and Television Reputation

1. Introduction

Digital media is the direction of media development. It has a profound impact on our lives and will continue to expand this impact in future development. Of course, digital media will not replace traditional media, but digitize traditional media and use digital means to serve the media.

The combination of the film and television industry and digital media technology has made the market economy a content that has attracted much attention. The industry can develop products related to film and television dramas according to market demand, promote the formation of the film and television industry chain, and expand the market economy, making online film and television Marketing, as a new growth pole of the cultural industry, combines the value of the market with P dramas to maximize economic benefits.

The film industry has participated in the production of special effects since its inception [1-2]. With the rapid development of digital technology and the development of electronic computer technology, digital special effects synthesis has gradually been widely used in the film industry, which not only promotes the breakthrough development of the traditional film industry, but also opens up a new path for the future development of the film industry and direction [3-4]. Digital technology was first widely used in the production of graphics and images, such as the production of advertisements, and then gradually introduced into the field of film and television. The maturity of digital special effects technology in the film industry can explain the problem. Digital technology has been successfully attempted to produce special effects for movies before this period, and digital technology gradually entered the field of film production during this period. Since then, special effects technology for film has been gradually promoted and applied to the various processes of film production. The control of the film's lens, post-production synthesis, etc. are inseparable from the participation of digital technology [5-6]. At the same time, on the other hand, it is the most important feature of digital media technology, interactivity [7-8]. In traditional movies, the story content, theme, and image style of a movie are basically fixed, reflecting the style of the director or the team, but under the influence of the era of digital media technology, the participation of the audience breaks all of this and makes The creators themselves have become more complicated [9-10].

The film industry has participated in the production of special effects since its inception. With the rapid development of digital technology and the development of electronic computer technology, digital special effects synthesis has gradually been widely used in the film industry, which not only promotes the breakthrough development of the traditional film industry, but also opens up a new path for the future development of the film industry And direction.

2. Film and Television Technology

2.1. Film and Television Special Effects Synthesis Technology

In order to avoid putting the actors in a dangerous performance situation and state during the shooting process and to reduce the production cost of the film during the shooting process, it is more to use film special effects to achieve shooting scenes and movie plots that are impossible to achieve in the actual shooting process. As well as audio-visual effects, film special effects technology will be used to complete the film's picture when filming, making the audio-visual effects of the movie more exciting. In order to better link the relationship between the two in the film creation that combines reality shooting and digital CG, of course, it is inseparable from the camera motion control system.

2.2. Digital Media Technology

Although the media will influence people's way of thinking subtly, the media itself is also in constant evolution. The impact of digital media technology is first in the art of film, that is, it is changing the art of film. It has been more than a hundred years since the appearance of the Lumière brothers. For the definition of its identity, we are different from other arts. Film is an audiovisual art, its most important media attributes are audiovisual and audiovisual, but in the era of digital media technology, the nature of these two identity attributes cannot cover its characteristics, that is, the film in the era of digital media technology: not only an audiovisual art, It also has a variety of sensations such as touch, smell, cold and warm pain, and digital media technology has given many changes to traditional movies. With the development of digital technology, network technology and information technology, the trend of media digitalization has become more and more obvious. Since 2000, the emergence of web2.0 technology and the wide application of web2.0 platform have brought Internet technology to a new level. Under this platform, the interactivity is more prominent, allowing ordinary audiences who were originally in a disadvantaged position in the media communication process to participate more in the creation of Internet content. Web2.0 related technologies include social networking (SNS), P2P, RSS and so on. It is the interactivity provided by 2.0 technologies that provides a technical basis for ordinary users to comment, upload, and share, and also provide a technical basis for the birth and widespread dissemination of micro movies. Most of the special effects synthesis of movies is not placed in the post-production section, but the completed synthesis special effects are stored in the database before shooting. Through the pre-designed 3D photography system for real scene shooting and virtual shooting, the special effects synthesis database data is projected to synchronize with the shooting, which greatly reduces the special effects synthesis work in the later stage of film and television.

3. Experiment on the Development Prospects of Film and Television Special Effects

3.1 Three-Dimensional Special Effects and Film and Television Synthesis Special Effects in Digital Media Technology

The digital media technology of 3D special effects can make some scenes or even a single object be divided several times in the virtual scene, and the final synthesis can also be achieved by inputting 3D data and combining the ordinate. In an interactive three-dimensional special effects synthesis environment, the film can be freely changed angles, scenes, and three-dimensional deformations as needed.

Synthetic special effects are only used in the post-production and synthesis of movies. We can use a variety of special effects to build film and television scenes. The software for film and television post-production special effects synthesis learning includes Premiere, Photoshop, Maya (3DXMAX), Aftereffect, Shake, Difusion, Nuke, Avid, Luster, Boujou, Matchmove. The breakdown of traditional special effects and CG special effects is shown in Table 1.

Table 1. Breakdown of traditional special effects and CG special effects

Category	Ways of presenting	
Traditional special effects	Make-up, set scenes, firework special effects, early film	
CG special effects	Three-dimensional	Modeling, materials, lighting, animation, rendering
	Synthesis	Keying, wiping, coloring, compositing, scene view

3.2 Research Process

By studying the film "Wandering Earth", this research explores the impact of digital media technology and film special effects synthesis technology on film and television reputation, the economic benefits of digital media technology on the film and television industry, and the digital media technology and film special effects synthesis technology in the film and television production process. The application prospects of film and television special effects synthesis technology under digital media technology are discussed in three aspects.

4. Application Prospects of Film and Television Special Effects Synthesis Technology under Digital Media Technology

4.1 Digital Media Technology and Film and Television Special Effects Synthesis Technology on Film Reputation

Digital media technology can bring a visual impact to movies. According to statistics, the output value of China's digital entertainment industry has grown from less than US$10 billion in 2018 to US$80 billion by the end of 2020, of which the film and television industry can account for about one-third. All kinds of online movies, high-end intelligent interactive video movies, smart phone movies, large arcade analog movies and other new forms of entertainment born under the application of a large number of new digital media technologies have profoundly affected our lives. The film "Wandering Earth" has a high proportion of its special effects synthesis technology in the early, mid and late stages, and it ranks first in the Douban movie score. Douban Koubei film reviews are shown in Table 2.

Table 2. Douban's word-of-mouth film reviews

Rank	Douban ratings	Film
Top1	1259355 people	Wandering earth
Top2	1168718 people	I am not a medicine god
Top3	1121268 people	Farewell My Concubine
Top4	920232 people	Let the bullets fly
Top5	825812 people	The Great Sage of Journey to the West Marriage
Top6	685930 people	Operation Red Sea
Top7	681386 people	The richest man in Xihong City
Top8	679671 people	Infernal Affairs
Top9	676977 people	The unknown
Top10	667561 people	Journey to the West: Moonlight Treasure Box

4.2 Digital Media Technology on the Economic Benefits of the Film and Television Industry

Digital media technology has brought huge economic benefits to the film and television industry. For example, the economic benefits of digital media technology in the movie "The Wandering Earth" are very impressive. According to statistics from Sina Yuyitong, between January 15th and 17th, 2019, the release of the first promotion song "You Seed" MV caused the amount of information related to the film to rise rapidly, forming the first peak of public opinion during the monitoring period. As the release of the film approaches, the amount of information is also rising; as of February 2, 2019, the release of the second promotion song MV made its information volume reach another peak during the monitoring period. Netizens made this film work. Attention continues to rise, with the highest peak of the popularity index reaching 90% in the movie release. During January 2019, the amount of information on the entire network reached 3.96 million, and its related Weibo topic # The Wandering Earth # reached 3.222 million discussions and 480 million readings. Figure 1 shows the popularity index of the movie release.

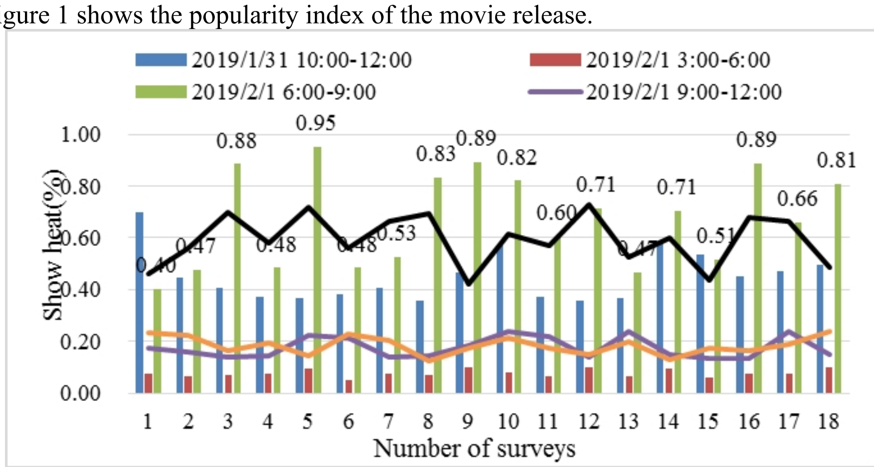

Figure 1. Popularity index in movie releases

4.3 Digital Media Technology on Special Effects Synthesis Technology

Digital media technology and special effect synthesis technology are complementary in film production. Through the three-dimensional modeling method in digital media technology, the special effects of film and television in the film production process can be supplemented. As far as digital media technology and special effect synthesis technology are concerned, the ratio of film digital media technology to special effects synthesis technology in the early, middle and late stages of the film production process of "Wandering Earth" is shown in Figure 2. In the early stage of film and television production, the proportion of special effects synthesis technology is 70%, and a large number of special effects synthesis is for better publicity of film and television works. In the post-production process, the proportion of film digital technology is 55%. In the post-production process, the filmmaker further modifies the film with special effects in order to improve the quality of film production.

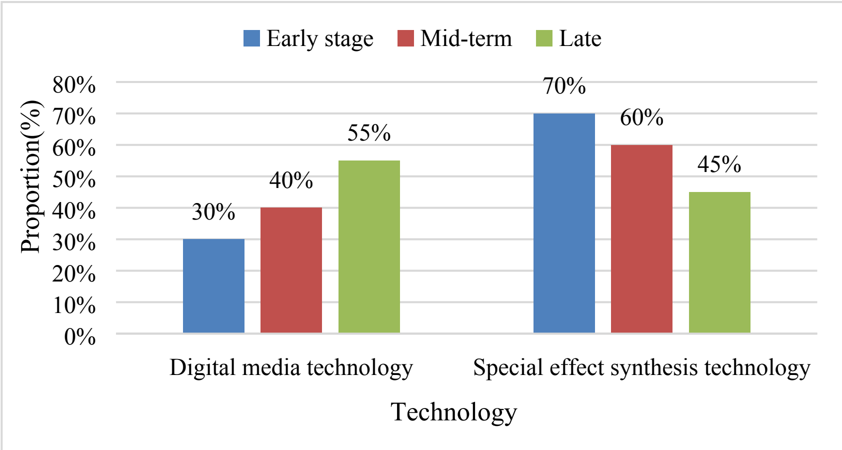

Figure 2. The ratio of film digital media technology to special effects synthesis technology in the early, mid, and late stages of "Wandering Earth" film production

5. Conclusion

This research mainly discusses the application prospects of film and television special effects synthesis technology under digital media technology. Through the impact of digital media technology and film and television special effects synthesis technology on film and television reputation, the economic benefits of digital media technology on the film and television industry, and the application of digital media technology and film and television special effects synthesis technology in the process of film and television production, discuss the film and television under digital media technology. Application prospects of special effects synthesis technology. This research helps to improve the quality of film production in our country.

The rapid development of Chinese film brings opportunities as well as challenges for itself. The application of modern film production technology in the field of film special effects has improved the visual charm of commercial films, and is more convenient for the free expression of film forms. While bringing huge commercial benefits, it also promotes national culture to the world and promotes the international transformation of Chinese films.

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Design of Cricket Control System Based on STM32

Jian Huang(✉)

Xijing University, Xi'an 710123, Shaanxi, China
(✉)Corresponding author: 565200245@qq.com

Abstract. At that time, the 7670 plus warship with atom was used. It proved that it was difficult for warships to complete this topic. On the one hand, the 72m dominant frequency was still slow for image processing. I tested to read and output a frame of QQVGA image, and it took nearly 30 ms after simple binary processing. In addition, the image read out from the FIFO of the 7670 is the image taken at the last time, which determines that the 7670 plus warship of STM32 is not suitable for cricket system.

Keywords: QQVGA, FIFO, STM32

1. Hardware

1.1 MCU

After my practice proved that the warship plus 7670 to do image processing is still very difficult, the completion of the design directly bought Apollo, main frequency 216m, performance leverage drop. Everyone who used it said yes. If you change other cameras, warships can be competent. See below for cameras[1-4].

1.2 Camera

Using 7670, it takes a lot of time to read the image and has a headache in processing. It is not allowed to use the learning board in the competition. In addition, it is very easy for the camera to communicate with DuPont line, even if the atomic brother's camera extension line is used, the interference is also very serious. In general, the atomic camera is not suitable for cricket (personal opinion, if it is not appropriate, please give me some advice). Until the last day of the competition, my classmate found a camera called openmv. According to the seller of a treasure, it is dedicated to 2017 electronic games, and the output frame rate can reach 85 frames per second. I suddenly two eyes shine, but it's the last day, that kind of mood is like you look at hope in front of you humming a ditty slowly away, you can't catch[5-8.]

Opemmv3 uses stm32f7 as the processing core, and the clock frequency can reach 216m. Equipped with 7725, the output frame rate can be as high as 85 frames. In addition, the python interface is provided externally, which can complete a project with only a few lines of code. Finally, a variety of routines are provided, such as finding balls, color blocks, tracking, optical flow and so on.

1.3 Motor

Before the game, a prediction post widely spread on the Internet said that this year's cricket control system is likely to come out, which is very accurate. However, the post recommended a motor - DC putter motor - which really made a lot of people suffer. The unit price is expensive, not to mention there is no feedback. PS: I'm also one of the victims (the key is that the list of components recommended by the organizing committee is also linear motor. I want to cry without tears!). The boss who bought the goods before the game was out of stock. After placing the order, he could receive a call from the boss to apologize that the goods were out of stock. Please return the order after the attempt, the final decision to use the steering gear, steering cycle for 20 ms, simple control, fast response. This time, I use mg946r metal gear steering gear instead of plastic. The metal has high torque and is stable[9-10].

1.4 Little Ball

The ball is very important. Table tennis is too light and the center of gravity is not in the center of the ball. When we can't find a suitable ball, we can only use a kind of wooden ball similar to camphor ball to drive insects. (now Mr. Bi Shiyi bought a steel ball. By contrast, the steel ball is the most suitable choice, almost unaffected by the wind. But the steel ball is difficult to color, using the camera color block capture is not enough, can only use gray capture. Gray capture so play part of the fourth question do not know how to play, if you use color block capture, play part of the fourth question can use laser guidance, where to go. I use ordinary steel ball, and I want to draw a circle, but the effect is very poor, so I didn't do it. There is only one colored steel ball on a treasure, but it doesn't retail, so I can only ha ha.

1.5 Flat

It is suggested that you use acrylic plate, light and flat, glass is too thick. Acrylic board has colorless and white options. It depends on my personal preference. I take a transparent acrylic board, tear off the paper and dye the paper black with ink. In this way, I can track the ball by adjusting the gray threshold.

2. Mechanical Structure

Machinery is very important! Mechanical structure is very important! Mechanical structure is very important! How many teams are in the mechanical structure of the National Award. Firstly, the mechanical structure must be stable, and secondly, it must be flexible

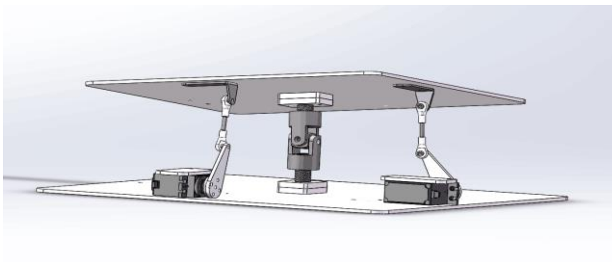

Figure 1. Mechanical structure diagram

It's right to use a universal joint in the middle of this structure. I used it in the competition, and bisher uses it now. What I want to emphasize is the structure of connecting the two steering gears with plates. In this way, the connecting plates can only have one moving direction in this direction. As long as the moving plates of the two steering gears are deformed. If you change to three universal joints, you can link three. But the universal joint and acrylic are not well connected.

Part of the drill is inserted into a hollow wire or a screw. The fixed part is cut acrylic board and glued with acrylic glue. The viscosity of acrylic glue is awesome. In this way, when the board moves up and down, the board will not deform. My board area is not in line with the requirements of the topic, the surface did not draw circles in accordance with the requirements of the topic, this is mainly due to the small size, easy to move, big board is not interesting, in addition to occupying space!

3. Software

The software part is two PID parameter correction, here is the servo system, basically cannot use the micro component. PD is also very easy to find. I'm afraid this is the simplest control problem in the electric games in recent years. As long as we can set the ball in the middle, the basic part can be completed. Just change the setting position, and the play part 1 and 3 are no problem. It's interesting to ask the second question of the play part. Let's give you a detailed introduction to the second question of the play part. The second question is an automatic routing algorithm. My idea is to add four buffers to the nine areas required by the topic to accomplish the task.

When the serial port reads the camera output, the serial port assistant is used to observe the received data. If the camera finds multiple targets, the coordinate positions will be transmitted through, and the external bracket and bracket are used. The data length of each frame is inconsistent, so I compared the gray block found on the basis of the original code, and only the one with the largest area was sent. In addition, if the center coordinate of the color block is one or three digits, only one byte of the number will be sent in the jasson data string, so that the length of the received data will change when the serial port sees. I didn't understand how to use Jason decoding, but I just downloaded its keil codec library, which is in the attachment. I set up the area of interest to be 10-99.

```
int main(void)
{
	u8 key,i,buff[10];
	u8 *str=0;
	Stm32_Clock_Init(432,25,2,9);
	LED_Init();
	MPU_Memory_Protection();
	SDRAM_Init();
	LCD_Init();
	Remote_Init();
	LSS(30,50,200,16,16,"Apollo STM32F4/F7");
	LSS(30,70,200,16,16,"HaiNan university");
	LSS(30,90,200,16,16,"Cricket control system");
```

```
        LSS(30,110,200,16,16,"Writer:Liu Yifan");
        LSS(30,130,200,16,16,"Guide teacher:Yi Jafu");
    LSS(30,150,200,16,16,"KEYCNT:");
    LSS(30,170,200,16,16,"SYMBOL:");
        LSS(30,190,200,16,16,"Current Mode:");
        LSS(30,210,200,16,16,"Program State: ");
        LSS(30,230,200,16,16,"Current Rol position:");
        LSS(30,250,200,16,16,"Current Pit position:");
        LSS(30,270,200,16,16,"Set Rol position:");
        LSS(30,290,200,16,16,"Set Pit position:");
        LSS(30,310,200,16,16,"FPS:");
        for(i=0;i<10;i++)
switch(mode)
                {
                        case 0:      mode_0(); break;
                        case 1: mode_1(); break;
                        case 2: mode_2(); break;
                        case 3: mode_3(); break;
                        case 4: mode_4(); break;
                        case 5: mode_5(); break;
                        case 6: mode_6(); break;
                        case 7: mode_7(); break;
                        case 8: mode_8(); break;
                        default:break;
                }

                LSC(168,270,(u32)rol_setpos/10+0x30,16,0);
                LSC(176,270,(u32)rol_setpos%10+0x30,16,0);
        //              LSC(168,290,(u32)pit_setpos/10+0x30,16,0);
                LSC(176,290,(u32)pit_setpos%10+0x30,16,0);                //
                if(PASSBY_TIME >= 30)
                {
                        LSS(30,330,200,16,16,"OK!");
                }
                else
                {
                        LSS(30,330,200,16,16,"NO!");
                }
                LSC(30,350,PASSBY_TIME/1000+0x30,16,0);
                LSC(38,350,PASSBY_TIME/100+0x30,16,0);
                LSC(46,350,PASSBY_TIME/10+0x30,16,0);
                LSC(54,350,PASSBY_TIME%10+0x30,16,0);
}
```

4. Conclusion

After the analysis above, I think this question is no longer difficult for you? I hope that the small partners who are preparing for the electric games can achieve the ideal results. If a small partner wants to practice setting PID parameters with this problem, it is not recommended by individuals. PID parameters of this topic are very easy to set, as long as you understand the meaning of each parameter can be set out. To hone the ability of self-tuning PID parameters, it is suggested to do wind swing (15-year national race), inverted pendulum (13 years national race), flat pendulum (11 year national race). All of these topics are very good.

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Use of Social Audit Network Intelligent System to Promote High-Quality Economic Development in the Era of Big Data

Bige Li(✉)

Fuzhou University of International Studies and Trade, Fuzhou 350202, Fujian, China
(✉)Corresponding author: 15179191296@163.com

Abstract. The audit system is an important part of the national supervision system. Promoting high-quality economic development is an important task put forward for audit work, and it is also a requirement for the positioning of audit work functions and audit business from the height of the new development concept. In the context of the era of big data, promoting and ensuring high-quality economic development is a major duty and mission of auditing. On the one hand, social audit should adapt to the requirements of the new situation and rely on big data technology to consciously serve the high-quality development of the economy. On the other hand, social auditing should also change ideological concepts, innovate auditing models, actively integrate into the country's modern governance system and governance capacity building, and act as a "consultant" for economic development in order to better provide information and basis for economic decision-making. In the context of the era of big data, this article analyzes the role of social auditing on high-quality economic development and provides corresponding countermeasures.

Keywords: Social Auditing, High-Quality Economic Development, Big Data

1. Introduction

The high-quality development of the service economy is the responsibility and mission of auditing as an important part of the national supervision system, and it is also the need for auditing to adapt to the economic development of the new era [1]. China's audit supervision and management system includes national audit, social audit, and internal audit. These three have an inseparable connection, and each plays an important and irreplaceable role. Giving full play to the power of social auditing is an indispensable means to promote economic norms and orderly development [2]. In the context of economic globalization, the high-quality development of China's economy has put forward higher requirements on the depth, scope, specialization, and quality of auditing in my country. With limited human resources, information resources, and technical resources, the state gives full play to the power of social auditing to effectively integrate and maximize audit resources. This is also a trend in the development of the entire audit career [3]. Social auditing has the advantages of independence, objectivity, and impartiality. It can reveal problems in the process of high-quality economic development, analyze factors affecting high-quality economic development, and evaluate the effectiveness of economic transformation, thereby boosting high-quality economic development. At present, my country's economy has entered a stage of high-quality development. The quality, efficiency, and power changes of economic development require high-quality economic information as a basis for decision-making [4]. In addition to relying on government supervision for the high-quality development of the economy, it also needs to play the role of service supervision of social auditing to make up for the lack of power of the national auditing agency, thereby expanding the coverage of auditing. Compared with national audit institutions, social audit has its own advantages and characteristics: social audit is not subject to establishment restrictions, has great development potential, has extensive social relations, and can mobilize and organize many professionals to participate in professional audits; The rapid economic development has also brought about a large number of intricate relationships. Global economic integration, international capital flows, various economic vertical and horizontal integrations, and the "One Belt One Road Strategy" have promoted the internationalization of accounting information. These factors make various information users have higher and higher requirements for the objectivity and fairness of accounting information. Social auditing has obvious advantages in this respect, and these are inseparable from social auditing in accordance with relevant domestic regulations, international practices, or with reference to the laws and regulations of the country where the company is located or the third country [5-6].

2. The Theoretical and Practical Significance of Big Data Technology for Social Auditing

In the context of the transformation of government functions and the high-quality economic development, the state must give full play to the role of certified public accountants and play the role of social audit as a bridge and link between the government and the economy. Lay a good foundation for improving economic efficiency, deepening reforms, and maintaining healthy and orderly economic development. Supervising economic activities through the intermediary function of social auditing can effectively achieve national macro-control [7]. Auditing practice has proved that social auditing has played an important role in promoting the development of multiple economic components and multiple business methods, straightening out the intricate economic relations between the state, enterprises, and individuals, and coordinating the normal operation of economic activities.

At the 2016 BRICS Conference, the top leaders of audit institutions clearly put forward suggestions on using big data technology to improve audit efficiency; in 2018, General Secretary Xi Jinping put forward suggestions on further enhancing audit informatization at the Central Audit Committee meeting. In the era of big data, audit institutions can provide more useful information for the operation and management of enterprises, investors, creditors and other relevant stakeholders through the classified collection and in-depth mining of big data, and then multi-angle processing and comprehensive analysis of relevant data. In the era of big data, the industrial chain of social audit institutions should be improved from the micro level of serving enterprises to the macro level of serving society and the country. In addition, social audit should enhance the sense of mission and responsibility of the audit industry, and establish a closer alliance with social and economic development. Social auditing uses data to guide enterprise production and operation activities, which can provide decision-making reference for national economic decision-making, thereby improving the status and voice of the social auditing industry;

In the era of big data, audit objects are showing diversified and informatized development, and traditional auditing models have been unable to adapt to the large amount of complex data information of enterprise development. In this context, audit work must change the audit mode and audit thinking, improve the audit risk management system, and use big data technology to organically integrate each process of the audit work, so as to better serve the high-quality economic development [8]. With the use of big data technology, auditors can continuously collect data from the audited unit and complete a large number of repetitive and tedious tasks in the audit work. Using big data analysis tools for analysis, the impact of big data and big data technology on audit work is shown in Table 1:

Table 1. The impact of big data and big data technology on audit work

Audit mode	Audit characteristics	Audit process	Audit evidence collection method	Audit scope
Traditional audit model	Static data	Judge selection based on audit experience	Request information and sampling from relevant responsible persons	Independent audit and key audit of each project
Information Technology Audit Model	Dynamic data	Use data platform to contact analysis	Multi-dimensional correlation analysis using data platform	Comprehensive and continuous auditing using big data

3. Specific Suggestions for Playing the Role of Social Auditing to Promote High-Quality Economic Development

3.1. Improving Awareness of the Overall Situation

In the new era and new situation, social auditing must look at problems from a new height, be aware of the overall situation, and establish a concept of serving economic macro-control; understand the country's new development concept, and give full play to the three immune system functions of prevention, disclosure and resistance In the allocation of economic resources, strengthen its role in high-quality economic development; understand the important role of auditing in the national supervision system and economic operation, and find the best entry point for audit supervision services and high-quality economic development, so as to better provide counsel and basis for the formulation of national policies; Social auditing should also change its thinking in accordance with the needs of the development of the situation, have the consciousness of serving the interests of the whole society and economic activities, and assume the responsibility of social and economic services and supervision. At the same time, pay close attention to national and regional economic dynamics, improve the initiative to serve macroeconomic decision-making, summarize universality, tendencies and social concerns, and develop high-level information so that the audit results can be used by decision-makers [9].

3.2. Strengthening the Construction of Ideological Style

The state needs to strengthen ideological work and work style construction in the social audit industry. First, adhere to the audit in accordance with the law, strictly abide by the professional ethics of auditing, and establish a good image of auditors; secondly, strengthen the education of audit staff's integrity and dedication to improve the political quality and awareness of social auditors; third, strengthen party building in the social audit industry, carry out education on the theme of “not forgetting the original intention and keeping in mind the mission” in the social audit industry, and actively promote the experience and practice of effective integration of party building and business; finally, strengthen the industry’s recognition of the professional spirit of integrity, adhere to honesty and integrity, and enhance social credibility, leading social audit institutions to be practitioners and guardians of integrity [10]. Audit institutions should face the society with high quality and credibility, and serve the society through strong legal status and effective practical actions, so as to truly maintain economic order and promote healthy economic development.

3.3. Innovativing Audit Ideas

Audit institutions must establish the awareness of advancing with the times, actively and timely change their thinking mode, adapt to the needs of the development of the big data era, rely on big data technology to form a proactive, professional, and overall view of auditing, and give full play to the interests of the country and society. The role of a defender of interests and promote high-quality economic development. At the same time, we must cultivate dialectical thinking, be good at looking at the essence through the phenomenon, looking at the macro through the micro, and making scientific analysis and judgment. It is necessary to cultivate innovative thinking, carry out work creatively, become a master at checking and analyzing problems, and explore new methods in practice; it is necessary to expand the breadth and depth of auditing, to lead by audit quality, and to highlight the orientation of audit results [11].

3.4. Strengthening the Construction of the Audit Team

In the era of big data, the scope of audit and supervision services is becoming wider and wider, and the subject of audit is becoming more and more complex. Therefore, the field of audit needs more high-level and compound audit talents to meet new demands and challenges. Social auditing must adapt to the requirements of economic development in the new era, build a professional and professional audit team that is proficient in business, and train auditors on advanced professional technologies such as intelligence, big data, Internet of Things, cloud computing, etc., in order to better adapt to the changes in science, technology, and markets [12]. Familiar with national laws, regulations and policies, study economic development plans and policies, earnestly understand the spiritual essence and rich connotations of the central reform decision-making arrangements, and take national economic development and the interests of the people at heart. Well versed in business, based on projects, fully researched, closely integrated with the characteristics and status quo of the region, industry, field, etc., study new situations and new problems in economic development, enhance the self-consciousness and initiative of audit work, and improve the service economy ability and quality.

3.5. Strengthening the Self-Construction of Audit Institutions

In the era of big data, promote the establishment of an audit big data platform, develop audit software and audit analysis models that match cloud audit, and use big data technology as an important auxiliary means for audit work. It is necessary to collect audit evidence from various aspects and establish a big data platform integrating financial operation data of the audited entity, audit result data of audit institutions, and third-party information data. These measures can make the collection, analysis, processing, and update of audit data more timely and accurate. With the development of networks and terminal equipment, mobile office can be supported; to strengthen the maintenance of audit data security, authorization restrictions should be imposed on personnel contacting the data, and the data storage method and encryption level should be strict [13].Social audit institutions should also establish the concept of quality first. On the one hand, strengthen the awareness of risk responsibility and put quality control in a prominent position; on the other hand, strengthen the internal business and technical management, personnel management, information construction, and collaborative management of the headquarters and branches. At the same time, according to the needs of the development of the market economy, bold reforms in personnel management, salary distribution, quality management, financial management, etc. have made social auditing full of vitality.

3.6. Increasing Data Disclosure through Legislation

Judging from the current open data, the sharing degree is limited, the structure is incomplete, and the overall quality is low. Neither the government, enterprises nor individuals have fully realized the effect of data on their own work and business activities. Increasing the publicity of these data will generate great value and will trigger huge changes in social, economic, cultural and other aspects. At present, there are not many platforms for government public data, and they are not widely involved. They focus on education, culture and sports, medical care, and the environment. The total amount of public data is low and the quality is not high. Enhance the data awareness of the whole society, develop a data culture, make the government, enterprises, and individuals fully aware of the role of data in their own work and production and business activities, and integrate big data awareness into everyone's daily work and life;

Big data, as data involving public interest, will have security problems in multiple links such as collection, processing, analysis, processing, storage, etc., so it needs to be regulated by legislation; currently there is no unified law and regulation to protect the development and use of big data, foreign countries such as the United Kingdom and the United States have established protective laws and regulations on data development and sharing; China should combine its own national conditions and absorb successful foreign experience, promulgate relevant laws and regulations as soon as possible, establish relevant laws and regulations on data disclosure, and clarify data disclosure and scope of use, to ensure the rights and obligations of governments, enterprises, individuals, etc. in the use and protection of data; improve the quality standards for publicizing various types of data. Since there is no data quality standard, the quality of data varies, and there is even a lot of redundancy data, only the high quality of all kinds of data publicly disclosed by the society can increase the value and effectiveness of data use [14].

3.7. Improving Relevant Laws and Regulations

The government should increase the practice quality inspections of social audit institutions, improve relevant laws and regulations, accounting standards and auditing standards, etc., block fraud loopholes in regulations and provide more operational guidelines for auditing practices; integrate administrative law enforcement with justice and introduce civil compensation, increase penalties for violations of laws and disciplines; increase the rectification of the industry order, and reverse the market phenomenon of "bad money driving out good money". Industry associations should guide social audit institutions to strengthen self-discipline management and optimize the practice environment; expand the scope of data collection allowed, formulate corresponding measures to stipulate the form and scope of data collection by audit institutions; revise relevant audit standards and supplement relevant regulations on big data audits. At present, big data auditing has been applied to a certain extent in social auditing, but there is no provision for big data auditing in the relevant auditing standards, so relevant content should be revised and supplemented.

3.8. Strengthening the Guidance of Social Auditing

The new concept of promoting high-quality economic development is an important mission of the audit supervision system. Therefore, it is necessary to construct an audit supervision that is compatible with the new development concept and can effectively coordinate the audit forces of all parties from the perspective of political responsibility and audit business capabilities, so as to resolve various contradictions in the process of high-quality economic development and coordinate the interests of all parties. The national government should strengthen the attention, guidance and support of social auditing, fully delegate powers and coordinate relations, help develop new businesses, strengthen the information publicity of social audit work, and increase the social influence of social auditing so that it can better serve the market economy; guide social auditors to actively participate in economic decision-making, participate in government economic work conferences, and listen to their opinions and suggestions; social audits must be bold in pioneering, self-reliant, self-disciplined, and win social recognition and support with good reputation and quality services [15].

4. Conclusions

In the era of big data, multiple economic components still coexist, competition in domestic and international markets has become more intense, and business operations have become more complex and informatized. National audit institutions and the government should give full play to the role of social audit, guide and publicize its advantages, so that it can better serve the healthy development of the economy. In the context of big data, audit work is more closely related to high-quality economic development. As an important part of the national audit and supervision system, social audit must adapt to the development of the new era and have a deep understanding of the new characteristics, new missions, and new requirements of the new era. Social audit institutions should seize the opportunity to find integration points in the complex market environment, dare to undertake various businesses that are conducive to economic development, and give full play to the role of audit's immune system; at the same time, they should constantly change their thinking and concepts, establish scientific audit concepts, and constantly promote the integration of big data technology and audit work, change the audit model, innovate audit technical means, and improve audit effectiveness and efficiency. Through auditing methods, it is possible to reveal the difficulties and pain points in economic construction, improve the ability to audit and supervise guarantees in accordance with the law, the ability to advise and provide suggestions, and the ability to serve development, so as to promote the high-quality, sustained and healthy development of various economic undertakings.

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Upgrading Tourism Experience of Tourists by Using AR Technology

Zhen Gong[1], Danhong Chen[1(✉)], Zhaoxia Wen[1], Tianyu Yi[2] and Shiyu Zhang[1]

[1]College of Economy and Management, Shenyang Aerospace University, Shenyang, Liaoning Province, China
[2]Department of Investment and Financing, Shenyang DaSanHao Investment Co., LTD., Shenyang, Liaoning Province, China
(✉)Corresponding author: chendanhong@stu.sau.edu.cn

Abstract. Augmented reality (Augmented Reality, referred to as AR),) is a technology that calculates the position and angle of the camera image in real time and adds the corresponding image. The goal of this technology is to set the virtual world in the real world and interact with each other on the screen. This technology was first proposed in 1990. With the improvement of the computing power of portable electronic products, augmented reality is more and more widely used. This paper will share and study the AR technology to enhance the tourist experience, and strive to do relevant technical support and reserve for upgrading the tourist experience.

Keywords: Augmented Reality (AR), Tourist Experience, Image Technology

1. Introduction

This is a new technology - enhances reality (AR), which can seamlessly integrate real-world information and virtual world information, and establish a related connection. It applies virtual information to the real world, through our well-known computers and other science and technology [1].

The reality is superimposed with virtual simulations so that virtual information can be perceived by human senses of real world. In order to transcend the realistic experience. In 2018, the number of investments in China's VR/AR industry was 109, and the investment amount was 10.977 billion yuan. From 2015 to 2016, China's VR industry "exploded", and the VR market once "let a hundred flowers blossom". In 2016, the number of VR/AR industry investment reached 299, which is the highest in history. However, from 2017 to 2018, the capital market gradually returned to rationality, and both the number and amount of investment in the industry declined. From the end of 2018 to 2019, with the approach of the 5G era, China's VR/AR industry capital market showed signs of recovery. From January to September 2019, the number of financing in China's VR/AR industry was 49, with the financing amount reaching 9.921 billion yuan [2-5].

According to online data and predictions by relevant agencies such as tourism agencies, the number of world tourists will grow at an annual rate of 3.8 percent from 2020, and it is estimated that by 2030, the number of world tourists will reach a staggering 1.8 billion. In addition, according to the data obtained by the World Tourism Association, In 2010, the number of global tourists and tourism revenue will grow at an annual rate of 4.3 percent, higher than the annual growth of world wealth (3 percent) in the same year. By 2020, the income of the tourism manufacturing will reach 16 trillion US dollars, countertype to 10% of the world's GDP; 300 million jobs will be provided, explaining for 9.2% of the world's total profession, further confirming the important position of the tourism manufacturing in the global thrift. However, there are few researches on AR technology in China [6].

In recent years, the use of AR technology in the tourism industry is also numerous, such as tourist path navigation, enhanced appreciation of AR scenic spots and other features, this paper will systematically analyze the related technologies [7].

2. Basic Principles of Augmented Reality

2.1. Augmented Reality

Early mobile augmented reality systems were based on the idea of adding images, sound, and other sensory enhancements to a real-world environment. For example, television networks use images to send messages around the world. Right? But all TV networks do is show still images, which cannot be adjusted as the camera moves, which is also one of its partial points. The augmented reality that this article is talking about is far more advanced than anything you see on TV, unlike traditional technologies like television. Because these systems can only display images that can be seen from one Angle. What VR is going to do is make the next generation of augmented reality systems capable of displaying images that everyone in the audience can see [8].

In all kinds of universities and high-tech corporations, augmented reality is still in the premier stage of research and development. Eventually, perhaps by the end of the decade, we will see the first augmented reality setups that have been put on the market in large quantities. One researcher called it "the Walkman of the 21st century". What augmented reality strives to achieve is not only to enhance images to the real environment in real time, but also to change these images to adapt to the rotation of the user's head and eyes, so that the image is always within the user's point of view [9].

2.2. Principle of AR Model

Assuming that u(n), x(n)is a stationary random signal, u(n) is white noise and the differentiation is Ó2, it is hoped that the correlation between the parameters of the AR model and the autocorrelation ak function of the x(n) can be established.

$$x(n) = -\sum_{k=\mathrm{c}}^{D} \mathrm{c}_k x(n-k) + u(n) \tag{1}$$

$$H(z) = \frac{1}{A(z)} = \frac{1}{1 + \sum_{k=1}^{b} \mathrm{c}_k z^{-k}} \tag{2}$$

$$P_x\left(e^{/c}\right)=\frac{\sigma^2}{11+\sum_{k=c}^{y}c_k e^{-/\omega k}\Bigg|^2}$$

(3)

Multiply both sides of the above equation (1) by x(n+m) at the same time, and find the mean, there are:

$$r_{1z}(m)=E\left\{x(n)^* x(n+m)\right\}=E\left\{\left[-\sum_{k=1}^{0}c_k x(n+m-k)+u(n+m)\right]x(n)\right\}$$

(4)

So there are:

$$r_x(m)=-\sum_{k=\alpha}^{0}c_k E\{x(n+m-k)x(n)\}+E\{x(n+m)x(n)\}$$

(5)

So there are:

$$r_{1z}(m)=-\sum_{k=1}^{n}c_k r_{1z}(m-k)+r'_{1=c}(m)$$

(6)

There are:

$$r_{1z}(m)=E\{u(n+m)x(n)\}=E\left\{u(n+m)\sum_{k=0}^{\infty}h(k)u(n-k)\right\}$$

(7)

$$r_{1z}(m)=\begin{cases}-\sum_{k=c}^{0}c_k r_{1x}(m-k)(\text{ if }:m\geq 1)\\ -\sum_{k=c}^{0}c_k r_{1x}(k)+\sigma^2(\text{ if }:m=0)\end{cases}$$

(8)

In the above derivation, the even symmetry of the autocorrelation function is applied, that is,so $r'_{1z}(m)=r_{1z}(-m)$, The above can be written as a matrix as follows:

$$\begin{bmatrix} r_{1x1}(0) & r_{1x}(1) & r_{1x}(2) & \cdots & r_{1x}(p)\\ r_{1x}(1) & r_{1x}(0) & r_{1x}(1) & \cdots & r_{1x}(p-1)\\ r_{1x}(2) & r_{1x}(1) & r_{1x}(0) & \cdots & r_{1x}(p-2)\\ \vdots & \vdots & \vdots & \vdots & \vdots\\ r_{1x}(p) & r_{1x}(p\cdot 1) & r_{1x}(p-2) & \cdots & r_{1x}(0)\end{bmatrix}\begin{bmatrix}1\\ a_1\\ a_2\\ \vdots\\ a_p\end{bmatrix}=\begin{bmatrix}\sigma^2\\ 0\\ 0\\ \vdots\\ 0\end{bmatrix}$$

(9)

3. AR Composition of Augmented Reality Technology

A set of closely connected real-time work hardware components and some related software systems constitute an enhanced reality system, which typically includes the following three forms [10].

3.1. Monitor-Based

In the AR implementation displayed by the computer display, first, by the captured actual image and enter the virtual scene generated by the computer, then generate the virtual scene generated in the computer graphics system database, finally output to the screen, display it to the screen.

The fulfillment of the monitor based augmented reality institution is shown in the following figure.

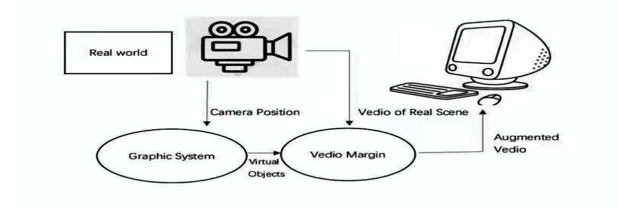

Figure 1. Monitor-Based Schematic diagram

3.2 Optical Perspective

The method of displaying the wearable helmet is widely used in a virtual reality system, and the purpose is to enhance the user's visual imitation. According to the specific implementation principles, it has two forms: one is based on optical principles to penetrate HMD. The completion scheme of optical clairvoyant augmented reality system is shown in the following figure.

Simply, high-resolution and non-visual deviations are three advantages, high positioning accuracy, difficult delay matching, relatively narrow vision and high prices, etc., are the disadvantages of it.

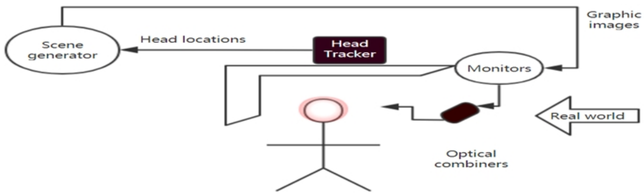

Figure 2. Optical perspective schematic diagram

3.3 Video Perspective

Video perspective augmented reality system adopts penetrating HMD (Video See-through HMD) based on video synthesis technology, and the implementation scheme is shown in the figure.

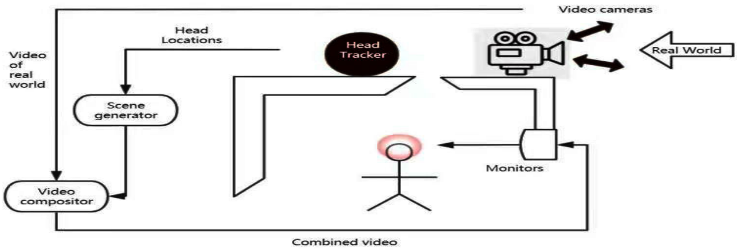

Figure 3. Video perspective schematic diagram

4. Conclusion

The content of VR tourism will continue to increase with the pace of the times, which will also lead to continuous decline in investment and output equipment prices. Video display quality will gradually improve, and the practical application of software will become more powerful and easy to use. The application of AR technology will bring revolutionary changes to many fields. As an industry that uses this technology, tourism will inevitably have more possible development than other industries.

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Legal Issues in the Development of Rural E-commerce in Chinese the Information Age

Qiuping Zhang[1(✉)] and Leilei Li[2]

[1]Heilongjiang Academy of Agricultural Sciences Postdoctoral Programme, Harbin 150086, Heilongjiang, China
[2]Harbin University of Commerce, School of Economics, Harbin 150028, Heilongjiang, China
(✉)Corresponding author: 369407890@qq.com

Abstract. The online sales of agricultural products are one of the important models in rural E-commerce, and it is also an important way to increase farmers' income and revitalize rural areas in China. However, there are many legal issues in the current E-commerce of online sales of agricultural products. These problems make it impossible to guarantee the various links in agricultural products. This article discusses relevant legal issues encountered in the process of online sales of agricultural products and on this basis, there are many suggestions for farmers to trade agricultural products on some trading platforms with effective laws and regulations. The purpose is to provide a certain reference for the smooth development of agricultural products in rural E-commerce.

Keywords: Rural E-commerce, Online Sales of Agricultural Products, Legal Issues

China's rural E-commerce has development rapidly like mushrooms after a spring rain. Two main forms of rural E-commerce have emerged in China: one is entry of industrial products that provide more convenience in rural areas, and the other one is the online sales of agricultural products that provide farmers with more opportunities to increase income. In the process of online sales of agricultural products relying on E-commerce, E-commerce companies with farmers as the main E-commerce operators encountered many legal problems. Therefore, it is meaningful to analyze the legal problems encountered in the process of online sales of agricultural products, such can promote the development of rural E-commerce.

1. Legal Issues Encountered in the Online Sales of Agricultural Products

1.1 The Legal Awareness of Rural E-commerce Operators is Weak

The main business entities of rural E-commerce are family-based farmers, rural cooperatives composed of farmers and rural enterprises[1]. Among them, farmers and rural cooperatives are different from rural enterprises in the operation of rural E-commerce. Because the farmers and rural cooperatives are not registered in the industrial and commercial department, and they lack legal awareness in the operation process, so they cannot use effective legal tools to maintain their own legitimate rights and interests. When legal disputes occur during the transactions, they cannot be reasonably resolved through legal methods. At the same time, since farmers and rural cooperatives do not have legal personality, it is also difficult for the industrial and commercial departments to effectively supervise them to ensure orderly operation of rural E-commerce[2].

1.2 Agricultural Products Lack Legal Protection

In rural E-commerce, some agricultural products traded are fresh, fruits and vegetables. These products are based on their small garden and cannot be effectively certified for quality. At the same time, due to the weak legal consciousness of some farmers, the phenomenon of "shitty good" and no trace-ability will appear in the process of agricultural products trading[3]. In addition, transaction products by E-commerce are surplus products from farmers'. These products do not have a unified price and a unified brand and so on. As a result, some farmers do not follow the market rules and it is easy to lead to chaos in agricultural product E-commerce platform transactions. Moreover, the relevant departments cannot effectively protect it.

1.3 The Agricultural Product Trading Platform has Legal Risks

Compared with traditional agricultural products transactions, the use of E-commerce for transactions breaks the time and space restrictions between agricultural product sellers and consumers[4]. Therefore, in the process of rural E-commerce transaction process, in addition to the traditional thirty-party trading platforms such as Taobao, Pinduoduo, many proprietary trading platforms have begun to emerge. Meanwhile some other software applications also carry out online trading functions. However, the uneven quality of these trading platforms has caused some legal problems in the agricultural product E-commerce trading platform during the transaction. For example, If the platform is not compliant, it will not be able to effectively protect the rights and interests of both consumers and farmers[5]; there are too many malicious competitions among trading platforms; the payment methods used by various trading platforms are different, making the interests of some merchants unable to be protected; regarding the after-sales service after the transaction is completed, some platforms cannot provide effective services, such as delayed delivery, which has caused some legal disputes.

1.4 There is Few Laws Related to Rural E-commerce

The online sales of agricultural products in rural E-commerce is different from traditional E-commerce[6]. Because agricultural products have obvious characteristics, they are not included in the specific regulations in the "E-Commerce Law". For example: how to deal with the deterioration of agricultural products during transportation, how to conduct quarantine and inspection for agricultural and sideline products of poultry, and how to conduct quality control for the initial processing of some agricultural products[7]. However, some farmers and rural cooperatives mainly carry out quality control through non-standard forms such as word of mouth and trace-ability. In fact, the form cannot be unified. At the same time, there are a wide variety of agricultural products and the quality of agricultural products will be affected by many factors such as climate, soil, and water quality. This makes it more difficult to implement uniform laws and regulations for unified supervision.

2. Suggestions on Improving the Legal Protection of Agricultural Products

2.1 Improving the Legal Literacy of Rural E-commerce Employees

At this stage, most of the trading models adopted of the online sales of agricultural products in rural E-commerce are mainly sales farmer-based sales entities, enterprise-based trading platforms, and consumers urban residents-based consumers, that is, a C2C-based model. In this model, in addition to standardized E-commerce companies, neither farmers nor urban residents have the interpretation and understanding of the laws related to E-commerce in the process of E-commerce transactions. Coupled with the special nature of agricultural products, this kind of C2C model will encounter more legal disputes in actual operation. Therefore, it is imperative to improve the legal literacy of rural E-commerce personnel. In other words, farmers continue to increase their legal knowledge in the process of engaging in E-commerce[8], so as to effectively regulate their behaviors, standards, and procedures for engaging in rural E-commerce products. Continuously improve the legal awareness of urban resident when they purchase products through E-commerce to effectively protect their legal rights. And continuously enhance the standardization of the trading platforms through legal means to maintain the order of rural E-commerce[9].

2.2 Increasing the Legal Certification Method of Agricultural Products

For agricultural product quality certification methods, the traditional word-of-mouth certification should be discarded. Especially there is fierce competition brought by a large number of the current E-commerce platforms**.** In addition, due to the differences in agricultural products caused by the regions, climates and varieties, it is more necessary to standardize the certification methods of agricultural products[10]. Although there are certain difficulties, the certification of agricultural products can be completed through many methods such as the certification of farmer qualification, the certification of soil quality, and the trace-ability of the entire planting of agricultural products; the certification methods for the same types of agricultural products should be unified. Make the certification content and process transparent by formulating relevant regulations and rules. Only in this way, we can make the similar agricultural products comparable. Therefore, increasing the legal certification method for agricultural products is a key move to improve the online sales of agricultural products in rural E-commerce.

2.3 Regulate the Trading Platform through Laws

Although different types of trading platforms have their own trading orders and rules, it is still necessary to regulate the qualifications of E-commerce farmers on each platform by laws. This can prevent shoddy farmers from entering the platform. In order to avoid malicious competition on the same platform, standardized regulations can be used to regulate the marketing model of merchants. Regulate the dispute settlement of merchants and consumers through relevant standards to improve consumer confidence. At the same time, self-operated E-commerce platforms and social media-based sales models should also strengthen legal regulations, so that the rights and interests of both farmers and consumers are protected.

2.4 Promulgating Relevant Laws and Regulations on Rural E-commerce

Different regions and departments should formulate laws or regulations related to rural E-commerce according to the characteristics of agricultural products in each region, and even refine them to different types of products. This standardized management can ensure product quality, expand sales, and reduce disputes. At the same time, relevant departments should also issue relevant laws and regulations on the online sales of agricultural products based on the type of platform. The ultimate goal is to protect the interests of farmers, increase their confidence in rural E-commerce, and truly achieve the purpose of increasing income through E-commerce.

3. Conclusions

In order to ensure that the online sales of agricultural products become an important magic way for farmers' income increase and rural revitalization, it is necessary to recognize the legal issues in the operation of rural E-commerce. Only the contents of farmers, trading platforms and agricultural products are regulated through legal methods, we can truly achieve the vigorous development of agricultural products upward model in rural E-commerce. Therefore, the current important measures to ensure the smooth development of the online sales of agricultural products are the introduction of relevant laws and regulations on rural E-commerce, improving the legal literacy of rural E-commerce employees, increasing legal certification methods for agricultural products, and standardizing trading platforms.

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Self-deduction Training Method Based on Deep Reinforcement Learning and Monte Carlo Tree Search

Tongfei Shang[1(✉)], Weian Kong[1] and Bo Yang[2]

[1]College of Information and Communication, National University of Defense Technology, Xi'an, Shaanxi, China
[2]31008 Troops, PLA, Beijing, China
(✉)Corresponding author: 340445698@qq.com

Abstract. Aiming at the problem of how to construct the strategy and value function in reinforcement learning through deep neural network, this article first constructs the value function and strategy function under the framework of reinforcement learning through deep neural network, and improves the design of residual block to improve model performance The feature extraction ability, and finally the Monte Carlo tree search method is introduced, and the decision model is intensively trained on the basis of supervised learning to improve its deduction ability. Simulation analysis proves the effectiveness of this method.

Keywords: Deep Reinforcement Learning, Monte Carlo Tree Search, Self-Deduction Training

1. Introduction

The decision space of wargaming is complicated and different from traditional expert systems. Taking into account the problem of position information description, through semantic segmentation modeling, the feature information and historical action information of the position in the position are integrated into the "image" tensor to compare and analyze the wargame position and Different Go positions, improve the residual network structure to improve the learning performance of the model, use the output of the deep neural network as the strategy and value function, introduce the Monte Carlo tree search method to design the model structure for training through self-deduction, in order to achieve Complete the exploration of the strategy space without relying on human deduction data. [1-3]

2. Deep Reinforcement Learning

By semantically segmenting the operator information in the wargame deduction and enabling it to express the deduction process, the segmentation result can be used as the input of the neural network and has certain scalability. In order to enable the semantically segmented operator information to express the entire deduction process, the characteristic parameters of the operator are first fully mined, and then all the operator information at a certain moment is put into a matrix, which is used as an approximate image as a neural network. [4-6]

The deep learning model constructed in this paper takes strategy and value as output, and aims to match the decision-making process of reinforcement learning, which includes two parts: strategy network and value network. Assuming x represents an input; the task of a mapping relationship $H(x)=x$ composed of a two-layer network is to fit a potential identity mapping function. This is difficult for deep networks, mainly because of the superposition of multiple non-linear layers. But if the network is designed as $H(x)=F(x)+x$, this will transform the problem into fitting a residual function $F(x)=H(x)-x$. If $F(x)=0$, then it constitutes an identity mapping, and it can be seen that it is relatively easier to fit the residuals [7,8]. The idea of residual error is to remove the same main part x and highlight small changes $F(x)$, so that the output becomes more obvious, the weight is easier to adjust, and the training effect is more ideal. The residual learning is integrated into the network layer. The two network layers are assumed to be two convolutional layers, and the residual structure is shown in formula (1).

$$y=F(x,\{W_i\})+x \tag{1}$$

$$\frac{\partial loss}{\partial x}=\frac{\partial loss}{\partial y}\frac{\partial y}{\partial x}=\frac{\partial loss}{\partial y}\left(1+\frac{\partial}{\partial x}F(x,\{W_i\})\right) \tag{2}$$

Where x, y represents the input and output of the network, the function $F=W_2\sigma(W_1x)$ represents the residual mapping relationship, σ represents the activation function Relu, and the operation of $F+x$ is completed by "short-circuit chain" and element addition.

After passing through the Reproduce layer, Inception+ is a multi-scale and multi-channel structure block based on the improvement of GoogLeNet. The specific structure of Inception+ is shown in Figure 1. First, after channel segmentation is performed on the output of the previous layer, two parallel twin convolutional layers are passed in, and the size of the convolution kernel is. The role of the twin convolutional layer and the Reproduce layer here is different, and no copy operation is performed. After the parallel convolution, the width of the network is expanded again by fusion, and the features of different levels are further mined. The result of the fusion is put into 3 asymmetric parallel convolutional networks as Fig 1.

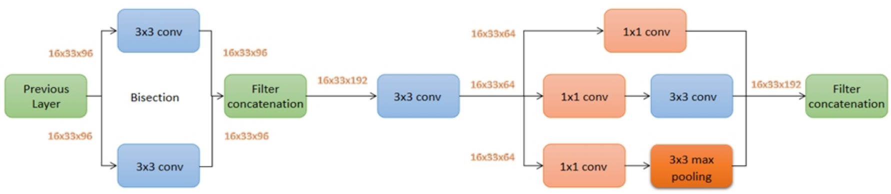

Fig 1. Inception+ internal structure diagram

3. Self-deduction Model Based on MCTS

Wargame deduction is a turn-based game process, and the branch nodes of the game tree represent various situation states generated during the deduction process. Simulation based search is a common method to solve game decision problems. The simulation process is based on the reinforcement learning model for sampling to obtain sample data, but these data do not have a real effect on the environment; the search process uses the simulated sample results to guide the model to choose appropriate actions to maximize long-term benefits. The game tree is a top-down forward process, which expands all possible actions of a certain state node S_t. A subtree with the root node S_t can be constructed. This subtree can be regarded as an MDP. Solving the most valuable actions is the problem to be solved by forward search. [9, 10]

Due to the large space of actions in wargaming, simple forward search takes a lot of time to complete, which is difficult to solve the requirement of decision-making time during wargaming. The Monte Carlo search method is based on a reinforcement learning model M_v and a simulation strategy π. For each possible sampled action $a \in A$, where A represents the action space, round sampling is performed to obtain the group K state sequence (episode) corresponding to the action, as shown in formula (3):

$$\left\{S_t, a, R_{t+1}^k, S_{t+1}^k, a_{t+1}^k, ...S_T^k\right\}_{k=1}^K \sim M_v, \pi \tag{3}$$

In the formula, R represents the reward in reinforcement learning. For each (S_t, a), the value function of its action and the choice of the optimal action are shown in formulas (4, 5):

$$Q(S_t, a) = \frac{1}{K}\sum_{k=1}^{K} G_t \tag{4}$$

$$a_t = \arg\max_{a \in A} Q(S_t, a) \tag{5}$$

In MCTS, the corresponding state sequence is shown in formula (6):

$$\left\{S_t, a_t^k, R_{t+1}^k, S_{t+1}^k, a_{t+1}^k, ...S_T^k\right\}_{k=1}^K \sim M_v, \pi \tag{6}$$

After sampling, a search tree of MCTS is constructed based on the sampling results, and the corresponding actions of and the maximum $Q(s_t, a)$ are calculated $Q(s_t, a)$ approximately, as shown in formulas (7, 8):

$$Q(S_t,a)=\frac{1}{K}\sum_{k=1}^{K}\sum_{u=t}^{T}1(S_{uk}=S_t,A_{uk}=a)G_u \tag{7}$$

$$a_t=\arg\max_{a\in A} Q(S_t,a) \tag{8}$$

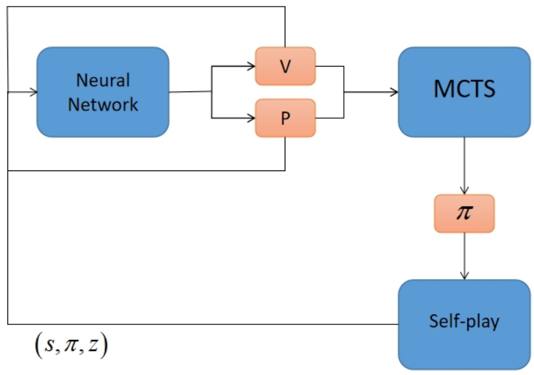

Fig. 2 Self-deduction structure diagram

After MCTS repeats the above search process N times, it selects the action branch of the root node, as shown in formula (9):

$$\pi(a\,|\,s)=\frac{N(s,a)^{1/\tau}}{\sum_b N(s,b)^{1/\tau}} \tag{9}$$

The input of the neural network is the description s of the current situation, and the output is the probability p of each feasible action in the current situation and the winning rate v of the current situation. What is used to train the strategy value network is a series of data (s,π,z) collected in the self-play process. According to the neural network training process in Fig.2, the goal of model training is to make the action probability p output by the neural network closer to the output probability π by the MCTS, so that the position winning rate output v by the network can more accurately predict the real game result z .

4. Simulation Analysis

In order to verify the effectiveness of the improved residual network proposed in this article, select 200 rounds of deduction data from human players (the top 32 in the competition) in the "Urban Residential Area 8vs8" scenario, with a total of 64,000 position states, and train the improved network and Resnet respectively. The basic learning rate is set to 0.001, the maximum number of iterations is 80,000 times, the Batch size is set to 128, and the learning rate is attenuated by 0.1 times at each iteration of 15000 times. As is shown in Fig. 3, the parameters are updated by the gradient descent method, and the training of the two models is set according to the above hyperparameters.

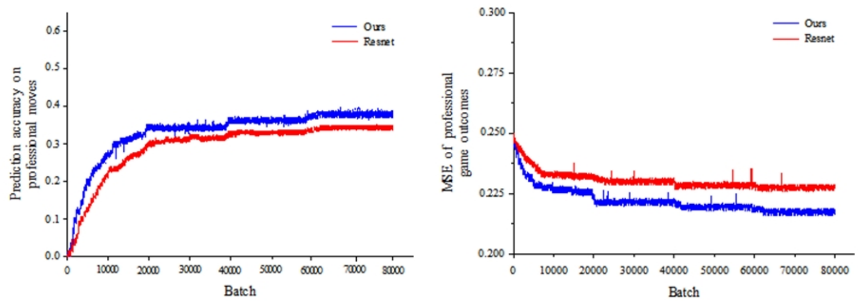

Fig. 3 Improved networks and Resnet training effect comparison diagram

Use the collected deduction data of 1027 rounds of "Urban Residential Area 8vs8" as a sample set to supervise and train the improved model. The training samples are the deduction data of the top 32 contestants in training and competition, and 100 rounds of data are randomly selected as the test Set, the training time is set to 7 days, and the learning rate is decayed every two days. At the same time, another network model with the same structure was trained through self-deduction, network parameters were initialized, and training was ensured from scratch. MCTS performed 500 simulations at each step, and 7 days of self-deduction produced 3125 rounds of deduction data. During the training process, the change of the loss function is shown in Fig. 4.

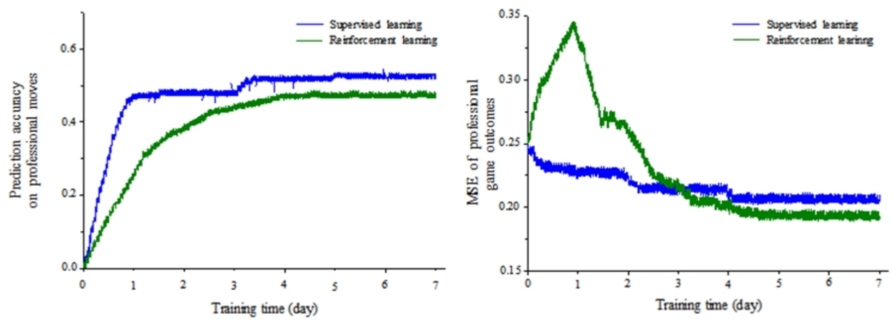

Fig. 4 Comparison of the effects of supervised learning and self-deduction training

5. Conclusion

In complex game problems, under the framework of reinforcement learning, DNN are used to construct strategies and value functions, and MCTS is used as the main reasoning process. The improved residual network is suitable for the learning of wargame situation information and the exploration of strategy space, can reduce the time overhead of simulation search, and has a certain auxiliary effect on the improvement of decision-making level.

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Application of Artificial Intelligence Technology in Big Data Mining

Xueyun Zhou[1] and Haiyan Wu[2](✉)

[1]Department of Computer Science and Engineering, Guangzhou College of Technology and Busines, Guangzhou, Guangdong, China
[2]Management School, South China Business College Guangdong University of Foreign Studies, Guangzhou, Guangdong, China
(✉)Corresponding author: 103392283@qq.com

Abstract. Data mining is the process of expressing knowledge through data collection and processing. This is an important technique for efficiently extracting batch data. Artificial intelligence is a simulation technology of the human brain. It makes full use of computer technology and other subject technologies for intelligent learning and machine control. Both are advanced data management technologies, and both have broad application prospects. This article mainly introduces the clustering algorithm and TextRank algorithm. This paper uses artificial intelligence technology to conduct research and application in big data mining, and establishes a mathematical model of the underlying TextRank algorithm. The model is solved by the TextRank algorithm, andthe status of research and application of artificial intelligence technology in big data mining is assessed, and the model is revised using historical data to improve the accuracy of research and assessment of the application of artificial intelligence technology in big data mining. The experimental results of this paper show that the TextRank algorithm increases the research and application of intelligent technology built into big data data by 55%, and reduces the false alarm rate and false alarm rate. Finally, by comparing the research and application analysis of artificial intelligence technology in big data storage, artificial intelligence technology can be fully utilized.

Keywords: Artificial Intelligence Technology, Big Data Mining, Textrank Algorithm, Clustering Algorithm

1. Introduction

1.1 Background and Significance

The emergence of information civilization has created the rapid progress of human society [1]. It is not only the result of continuous innovation in human cognition, but also an important manifestation of the realization of human intelligence as information civilization [2]. The concentrated expression of computer algorithms, the Internet, and artificial intelligence. Intelligent science and technology will inevitably become the research core with the most attention and exploration potential [3]. The theoretical research and practical application of artificial intelligence have made great progress. With the development of information technology cannot be attributed to this fact in the hands of, and information technology, the two technologies that hath done for thee these things not a little to the progress achieved in the technology artificial intelligence[4].Therefore, it is important to conduct in-depth research on the use of data mining in artificial intelligence. With the rapid development of Internet technology, the amount of information that people can access in daily life is also rapidly increasing, because it makes it easier for us to obtain the information we need in daily life [5]. The effective combination of big data technology and artificial intelligence is the main technical guarantee to help us obtain information [6, 7].

1.2 Related Work

Li S provides a method that can evaluate participatory stakeholder innovation in a complex multi-stakeholder environment to solve essential problems [12]. Based on the principle of common value creation, he proposed an evaluation framework that illustrates the process of social interaction, during which stakeholders integrate their resources and capabilities to develop innovative products and services [8, 9]. In order to evaluate this evaluation framework, a number of data were collected in the study. This case represents a multi-stakeholder environment related to the research and application of artificial intelligence technology in big data mining [10, 11]. But because the message collection process is too complicated, the data result is not very accurate [12].

1.3 Main Content

The innovation of this work is in the proposed clustering algorithm and TextRank algorithm. Based on the research and application of artificial intelligence technologies in big data mining, evaluating the research and application of artificial intelligence technologies in big data mining. Create a calculation method for the TextRank algorithm in combination with a clustering algorithm to provide guidance for researching and using artificial intelligence technology in large data mining.

2. Research and Application Methods of Artificial Intelligence Technology in Big Data Mining

2.1 Clustering Algorithm

In data mining technology, clustering algorithm can be regarded as a very practical algorithm. Well-deserved cluster analysis is widely used in most applications, such as image processing, model recognition, data processing and market research. As a large piece of data mining technology clustering algorithm, it divides instances into natural groups, and then distinguishes the hidden classes in the data instead of using predicted instance classes.

The clustering algorithm can be used as an independent tool to obtain the approximate distribution of data, and analyze each collection of data that combines similar properties. These collections can also be called clusters. Clustering analysis can map out some of the operating mechanisms of some instances in certain fields, and create different connections and different relationships between instances.

The problem of clustering analysis is also included in the problem of data classification. Its classification model has the attribute of unknownness. If it is not clear how to classify, the data can be re-analyzed by clustering algorithm according to the difference in the intrinsic attributes of the data Appropriate grouping and classification, and finally get the generated objects. For each cluster type, the similarity of the internal data is relatively high. On the contrary, for the cluster type and the cluster type, the data is basically not connected.

2.2 TextRank Algorithm

The TextRank algorithm is mainly used to generate text and abstract keywords, and the page ranking algorithm is used to calculate the importance of web pages. If the entire network is regarded as an LED graph, each web page is a node in the LED graph, and there is a link between each web page, and the link can be expressed from one web page to another web page in the corner. Several directed edges constitute a complete network. Then the importance of web pages can be calculated by formula (1):

$$A(\mathrm{N}_i) = (1-d) + d^* \sum_{je\ln(N_i)} 1 \big/ Out(N_j) s(N_j) \quad (1)$$

Among them, is the frequency of words appearing in the text, S is the total number of texts, and N is the number of texts where the word i appears.

$$E = B_j \log\left(\frac{\mathrm{n}}{m_i}\right) \quad (2)$$

The calculation of the TextRank algorithm fully considers the independence of a single word from the overall document, but in actual situations, if a word appears more frequently in the text, then the word should well reflect the text characteristics and should be given a higher weight, this also leads to the lack of TextRank algorithm.

3. Research and Application Experiment of Artificial Intelligence Technology in Big Data Mining

3.1 State Design of Artificial Intelligence Technology Applied to Bg Data Mining

It can be seen development data processing and technical analysis involves integration, network and complexity. Integration mainly the continuous integration of many technical tools with open interdisciplinary and interdisciplinary phenomena. The network gives full play to the main role of the network, which can expand the processing capacity of terminal equipment indefinitely and form powerful management and control capabilities. In many ways, complexity means that different technical solutions are not limited to the computer field, but can also be effectively used in business models, industry control and financial decision-making. Big data design is perfectly driven. Literally, it is based on data as a design reference and foundation. Before data-driven design, you need to understand two different types of data. For data research, researchers can analyze data through various research methods. Producers' motivations and behaviors to study their hidden needs, and then check the results of data analysis and provide appropriate solutions as soon as possible. Research data should start with qualitative data and quantitative data.

3.2 Artificial Intelligence Technology Applied to Data Collection in Big Data Mining

Today, data mining technology has been applied to many fields such as banking, telecommunications, insurance and data mining, and can solve many common business problems. The steps to process the above information using artificial intelligence are as follows. Firstly process the original data, fill in the remaining, eliminate abnormal data, etc., then use algorithms to summarize and abstract the original data, and finally use data mining. The basic content is artificial intelligence technology applied to big data mining data. The data is shown in the Table1.

Table 1. Data Table of artificial intelligence technology applied to big data mining

Artificial intelligence	Mean standard	deviation	variance value	error rate
Data collection	97	24	12	40%
Data mining	87	48	22	38%
Data Classification	95	25	5	29%

From Table 1, we can get the relationship between data mining and artificial intelligence. Knowledge representation generally refers to a description of knowledge by a computer, and is a description structure of data that can be accepted by a computer. Although there are still many problems in the construction of data knowledge system, there are still some specific knowledge representation methods in the process of researching artificial intelligence: symbolic representation and connection mechanism representation. These two representation methods use data mining technology to varying degrees. As far as artificial intelligence technology itself is concerned, its development should also be combined with people's realities in life, and then continue to improve existing technologies. As a kind of big data technology, data mining technology has certain limitations, but it can still provide the necessary impetus for the current artificial intelligence development.

4. Research and Application Artificial Intelligence Technology in Big Data Mining

4.1 Artificial Intelligence Technology in Big Data Mining

AI sample recognition means using computers to replace people or make people feel like patterns. This is a simulation of people's perception of the outside world. Research is a computer pattern recognition system, which is a technology that forces a computer system to imitate people to receive external information and recognize and understand the environment through perception. The first major achievement of artificial intelligence was the development of chess programs that could solve problems.

Technology has made some progress in this field, including machine learning, neural networks, computational consciousness and evolutionary computational data.

Intelligent learning is the basic way for computers to become intelligent. Starting from the study of the problems related to the robot arm, and then reaching the best planning technology to obtain the best sequence of robot motion as the goal, and finally successfully creating artificial life. In the future, the successful development of intelligent artificial intelligence life will surely be a sign of breakthroughs in artificial intelligence technology.

The data mining in this article forms a new data Table, and further collects the data according to the name, area, etc., so that the data in the original database is reorganized according to the target demand, which is more conducive to decision-making analysis. You can see the inner relationship between the data more clearly, and the analysis results are shown in Figure 1:

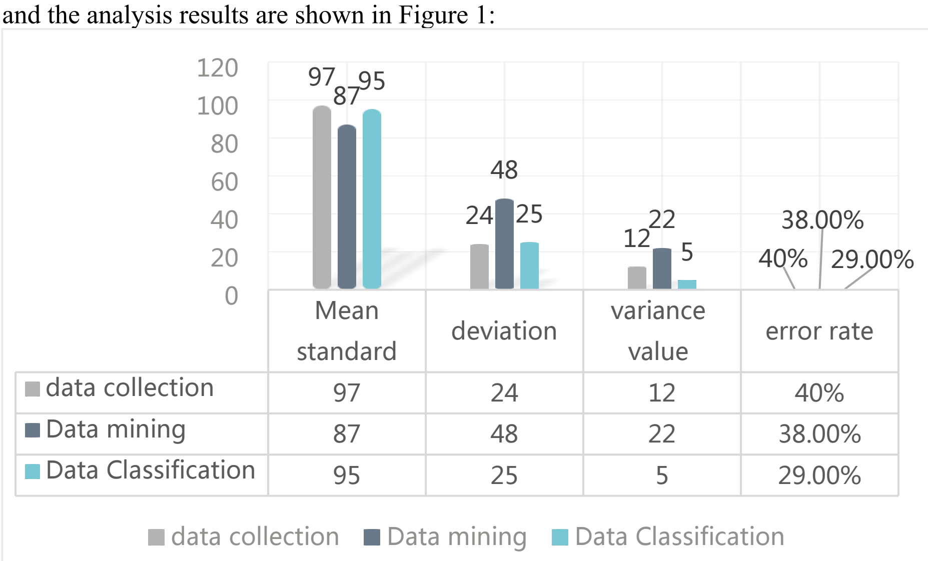

Fig 1. The inner relationship between the data more clearly and the analysis results

From the above Figure, the continuous increase in the number of nodes in the cluster will lead to a linear increase in the speedup of the algorithm. Use data to compare the performance of data collection, data mining, and data classification. Set the support degree to 0.23, and use data collection, data mining and data classification to mine frequent item sets respectively. Since the test set is smaller than the usual normal value, this article defines the data block of the imported function as 9, so the test set is divided into 4 blocks on average and sent to each node of the cluster for execution.

4.2 Experimental Data Artificial Intelligence Technology in Big Data Mining

Data mining is closely related to artificial intelligence technology, and even many key technologies are consistent with each other. In particular, there is a high degree of consistency between reasoning and data exploration. Whether it is traditional reasoning, non-logical reasoning, internal reasoning or model reasoning, it has high value. The basic principle is the accuracy of reasoning. The efficiency and processing of manual data is of great significance. Search engines are fully reflected in the data mining process. It will continuously search for existing paths according to the needs of users, and set up a process for calculating cheaper conclusions. The efficiency of data retrieval directly determines the speed of data retrieval. It can be seen that there are many connections between data production technology and artificial intelligence technology, especially at the intersection of technology. Therefore, experiments are conducted on big data mining. The experimental data are shown in Table 2:

Table 2. Experimental data Table of artificial intelligence technology in big data mining

experimental project	Average percentage	Ratio of standard deviation	Proportion of variance value	Error rate
Knowledge representation	99%	88%	76%	12%
Search technology	87%	55%	78%	10%
Compressed image	76%	66%	89%	9%

Through the analysis of Table 2, the data mining in this paper forms a new data Table, and the data is based on the development of teaching reform,

Leaders' emphasis and hardware facilities are used for further data collection, so that the data in the original database is reorganized according to the target requirements, which is more conducive to decision-making analysis, and can more clearly see the internal relationship between the data. The analysis result is shown in Figure 2:

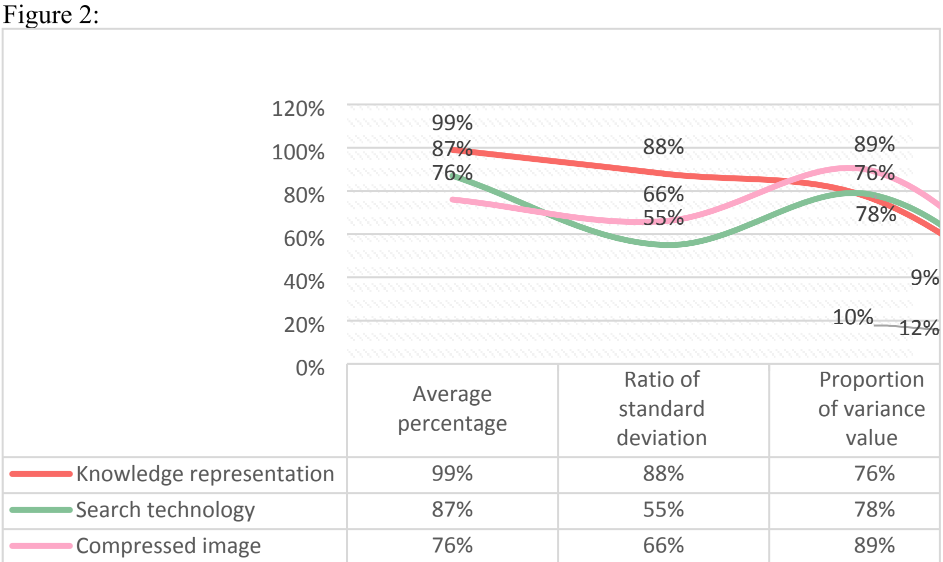

Figure 2. Experimental data diagram of artificial intelligence technology in big data mining

The Figure shows that big data has high security, stability and transferability. The Knowledge representation, search technology and compressed image used in the logistics blockchain of the Internet of Things provide decentralized and non-deceptive requirements, and use the powerful functions of artificial intelligence and distributed storage functions to solve problems in data mining.

Through the analysis of data mining and artificial intelligence technology, it can be seen that its future development direction is towards integration, networking and complexity. Integration mainly refers to the continuous integration of several technical means. The phenomenon of interdisciplinary and interdisciplinary is very obvious. Networking can make full use of the core role of the network, unlimitedly expand the processing capabilities of terminal equipment, and form powerful management and control capabilities. Complexity usually means that different technical solutions are not limited to the computer field, but can also be effectively used in business design, industrial management and financial decision-making.

5. Conclusions

Although this paper has made certain research results on the clustering algorithm and TextRank algorithm. The research and application methods of artificial intelligence technology in big data mining still have a lot of in-depth content worthy of study. There are many steps in the decision-making process that have not been involved due to reasons such as space and personal ability. In addition, the actual application effect of the improved algorithm can only from the level of theory and simulation.

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Development Trend of Electrical Automation in the Era of Big Data

Yiru Zhang

School of Mechanical and Electrical Engineering, Liaoning Jianzhu Vocational College, Liaoyang, Liaoning, China
zhangyiru@fgkhb999.onexmail.com

Abstract. Power supply system and power facilities are the basic lifeline of people's livelihood in China. Power is an important component of infrastructure and an important link of national grid construction project. The construction of electrical automation system can not only improve the management level of power equipment, but also carry out flexible load management and power distribution for different loads. In the power system market value-added services driven by user demand, electrical automation can also achieve the purpose of power system scheduling optimization, stable operation, convenient maintenance, management optimization, etc., and provide better high-quality power services for the healthy development of regional economy. This paper analyzes and plans the background, significance and feasibility of future development mode of electrical automation in power supply area. Through studying the works of experts and scholars in related fields at home and abroad, the principles, objectives and related planning of electrical automation system are studied in detail. Through the design and development of electrical automation experimental platform, the test results show that the system can meet the requirement of 80% success rate of data transmission. Finally, the future development trend of electrical automation is explored.

Keywords: Electrical Automation, Power System, System Dispatching, Power Service

1. Introduction

In recent years, the state has paid more and more attention to the operation of monopoly industries, and began to strengthen the reform and adjustment of the industry, the most prominent of which is the energy industry. Power enterprises also need to carry out market-oriented reform according to the development law of market economy. For power companies, it is necessary to consider how to reform and adjust in order to adapt to the impact of the market-oriented wave, maintain the stable situation of sustainable development, and truly serve the power customers. The lifeline of the survival and development of power enterprises is to truly take the customer as the center and meet the demand of customers for power supply[1-3]. Electricity and the majority of power customers always maintain a close contact, in the whole process of power transmission, transformation and distribution is the most direct contact with customers, connecting the majority of users and power supply companies, highlighting a more and more important role. In the process of sustainable development of the national economy, people's material demand level is also higher and higher, and the scale of electrical automation has begun to continue to expand with the continuous advancement of the urban process[4-6]. For the electrical network, the rise of emerging energy is a very important factor affecting the development. Whether from the perspective of power supply quality or reliability, it is necessary to improve the electrical automation ability to meet the all-round needs of customers. At the same time, it is also necessary to improve the management ability of distribution network.

Since the 1950s, foreign countries began to pay attention to the construction of electrical automation while carrying out the construction of dispatching automation. After more than 40 years of development, great achievements have been made. In the process of distribution network management, the world's major power companies have invested more financial and material resources to carry out electrical automation construction. Many countries in Asia, Europe and America have typical cases. Among them, we can see the technology and application characteristics of Companies in various countries, as well as the historical imprint of different technical routes in different periods. Although the construction modes of different countries are different and the technology is not necessarily the most advanced, it is common to meet the needs, continuously apply and play a role. From 1999 to 2000, China has also vigorously carried out the promotion of new distribution automation technology, known as the first wave in history, and has accumulated rich experience and profound lessons. Since 2009, driven by the new era of smart grid, the State Grid Corporation of China and the "two grid" companies of China Southern Power Grid Corporation have restarted the construction and application of electrical automation. In recent years, there have been more than 100 pilot and promotion cities of the "two networks", showing new achievements and achievements of electrical automation, including construction management, technical framework, system function, information interaction, communication, operation and maintenance management, etc. It explores the technical route in line with the national conditions and strengthens the development concept of seeking truth from facts. As a "barometer" of national economic development, the power consumption of the whole society in a region often reflects the level of local economic development and people's living standards. Therefore, Premier Li Keqiang has included electricity consumption into the index for evaluating China's GPD growth. At the same time, the power industry is also the "vanguard" in the development and construction. The so-called "army is not moving, food and grass first", the popularity and utilization rate of power disturbance sensitive electrical equipment are also rising, which puts forward higher demand for power quality, and the operation status will have the most direct and significant impact on the power consumption experience of customers[7-10]. At present, there is a certain contradiction between the increasing demand for electricity and the relatively weak distribution network. However, due to the overall development strategy of the state grid which attaches great importance to the construction of transmission network, there is a big gap between the distribution network and the transmission network in terms of equipment progress, operation reliability, and automation management and so on. These gaps lead to the failure of the distribution network to provide better quality and safety the ability of reliable and electric energy is becoming the biggest short board of grass-roots power supply enterprises. With the increasing number of customer complaints and claims, the overall situation of increasing production and operation pressure forces more and more grass-roots power supply enterprises to realize that they need to change the existing distribution network operation and management mode to adapt to the development needs of production and operation situation.

The value of big data is that it can be combined with other data of the enterprise. Enterprises not only use big data itself, but also put it in the internal information platform and data environment to expand and supplement it; therefore, the expansion of data analysis environment brings exponential growth of data discovery. This paper combs the concept and key principles of big data and data analysis, expounds the related concepts of electrical automation, designs and develops the electrical automation experimental platform in line with the development mode, and explores the application mode of electrical automation in the actual operation situation to complete the design scheme.

2. Definition of Related Concepts

2.1 Big Data

There is no standardized definition of how big data is defined. But there are some similarities between several famous views. Changes in different industries also reveal the basic characteristics of some big data: large capacity, fast speed, high complexity, and wide data sources.

2.2 Big Data and Traditional Data

As a new data source, big data is not the collection or storage of traditional data or existing data, but to open up a new way to obtain data and collect data in large amount and detail. The design of big data source is not close to reality, and many large data sources are not friendly, and most traditional data sources take this into consideration in the design big data may not have enough value corresponding to its massive scale. Therefore, although the analysis of big data is very difficult, it does not guarantee that there is income for work.

2.3 Big Data Application

(1) The amount of data is huge and complex. Due to the huge amount of data, the conventional database does not have the ability of collection and storage, and the data types are rich. The data come from various aspects, and the sources are complex, and show different structures and different media forms. It is far from the conventional database management and analysis, but needs a powerful database to mine the potential value of data, in order to realize the role of big data technology in promoting economic development.

(2) The processing speed is fast. Big data requires more and more computer technology, and data changes in many ways. It is very important to process data in time. In addition to collecting data, it is necessary to analyze and mine data, and even analyze the preferences and behavior patterns of information subjects. Therefore, it is necessary to analyze and process the data quickly and continuously to meet the real-

time reference requirements.

(3) Use data analysis to obtain valuable information. The core of big data is not to store and simply process a large amount of data, but to obtain some important information through the specific analysis of these data.

2.4 Electrical Automation Technology

Distribution automation is closely related to distribution network planning and is an important part of distribution network. The distribution network planning has changed from the planning of single primary network structure and equipment to the secondary system based on protection and automatic devices, and then to the mutual cooperation and development of automation, communication and information technology systems. This is the strategic transformation and development of distribution network planning, and the basic requirements and requirements of modern distribution and utilization system.

Distribution automation has command and support function for distribution network emergency repair operation, is an important technical support for distribution network fault repair operation, and is the information basis for field data collection and fault perception of various functional systems of fault repair work.

Distribution automation has strong correlation with distribution network dispatching operation. Distribution automation brings new changes to the operation and maintenance and dispatching operation of traditional distribution network. Distribution automation as one of the most critical technical support system, its importance and urgency is more and more recognized by people, and develops rapidly.

2.5 Related Formula

Polynomials over fields:

$$\mathrm{b}(x) = b_{n-1}x^{n-1} + b_{n-2}x^{n-2} + \ldots + b_2 n^2 + b_1 x + b_0 \tag{1}$$

Alternative encryption:

$$E\text{（m）} = (m + k)\,\mathrm{mod}{*}\,n \tag{2}$$

M is the position number of plaintext letters, and N is the number of letters.

Modulo inverse elements:

$$ed = 1(\mathrm{mod}\,\varphi(n)) \tag{3}$$

$$\mathrm{ed} - k\varphi(n) = 1 \tag{4}$$

The so-called modulo inverse element means that there is an integer d such that the remainder of ED divided by φ (n) is 1.

3. Design of Electrical Automation Experiment Platform in the Era of Big Data

3.1 Practical Objectives

The design and development of electrical automation system under the background of big data can help solve the problem to a certain extent. The standard Ethernet interface is used to realize the data communication with the upper computer and the communication connection with various controllers. In the design of electrical automation experiment platform, the following problems should be considered

(1) Problems of original PLC laboratory equipment;

(2) The original PLC has simple function and poor compatibility;

(3) The design of electrical automation experiment platform should follow the principle of flexible development;

(4) The latest technology should be introduced into the design of experimental platform. The electrical automation technology will be updated rapidly, even the most advanced and mainstream technology will also achieve results in the future. Therefore, in the design of the experimental platform, we need to introduce the most mainstream technology, such as touch screen technology, Ethernet group control and so on.

3.2 Test Procedure

(1) Electrical automation real-time data test record and analysis;

(2) Accident simulation test and analysis;

(3) Data transmission success rate analysis.

4. Test of Electrical Automation Experimental Platform in the Era of Big Data

4.1 Communication Rate

Table 1. Relationship between Communication Rateand BusLength

Communicationrate/(kbit/s)	Longestbuslength/M	Communicationrate/(kbit/s)	Longestbuslength/M
1000	40	500	130
250	270	125	530
100	620	50	1300
20	330	10	6700

According to table 1, this test mainly focuses on the relationship between the test line length and the amount of data transmitted. Through two comparative tests, it is not difficult to find that among the 40-330m cable length and 130-6700 m cable length, the data transmission capacity decreases from 1000 and 500 to 20 and 10kbit / s respectively. Through this test, it can be seen that with the increase of cable length, the amount of data transmission will decrease.

4.2 Data Transmission Success Rate Test

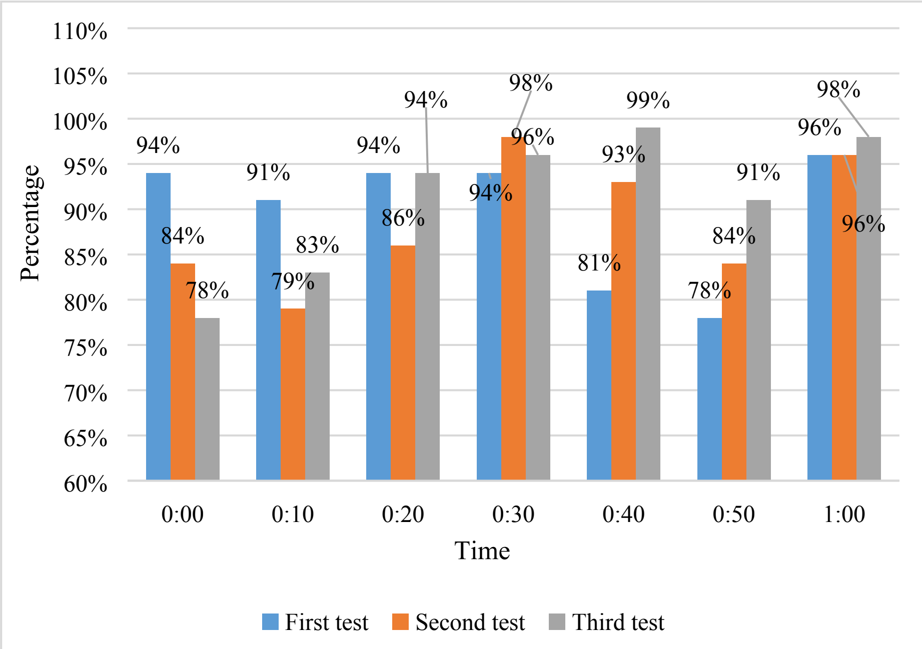

Figure 1. Platform Transmission Success Rate Test

According to figure 1, in the data transmission success rate test project of the platform, after three rounds of tests, each test time is one minute, the transmission success rate basically meets the demand of more than 80%.

4.3 Accident Simulation Test

Table 2. Accident Simulation Test

Timeofaccident	Accidentline	Accidentcontent
12-0117:12:32	ShunwaiRoadLine1	Accidenttotal
12-0219:50:47	No.19,Qingshan	Overcurrent
12-0309:13:41	Xingcheng28generallongline	Overcurrent
12-0417:12:51	Beisin15huapowerline	Quickbreak

According to table 2, the system can well report and feedback the accident, and meet the basic accident alarm requirements of electrical automation system.

4.4 Analysis of Test Results

Most of our common experimental platforms are closed, and the experiments are written step by step according to the experimental report. Most of the equipment interfaces are connected and do not need to be changed. The closed experimental system and fixed experimental steps greatly limit the other functions of the equipment. The electrical automation experimental platform system adopts open design, most of the input and output device interfaces are left blank, which is convenient for students to set up control system flexibly and freely according to their own ideas, and the function of experimental equipment can also be fully reflected.

The hardware equipment involved in the design of electrical automation experimental platform includes programmable logic controller, motion controller, frequency converter and AC motor, intelligent motor starting controller, touch screen, network switch, industrial control computer, servo driver and servo motor, photoelectric switch and temperature transmitter, etc., and the hardware equipment covered is relatively more Yes. Flexible and open platform design can develop many functional applications, such as analog input and output and logic control, multi axis motion control, electronic cam control, inverter AC motor control, servo system control, touch screen control, configuration software communication and monitoring, Ethernet networking and other functions. The design of the experimental platform is completely consistent with the real industrial environment, and the hardware equipment used is also widely used in the real industrial environment.

4.5 Survey Statistics

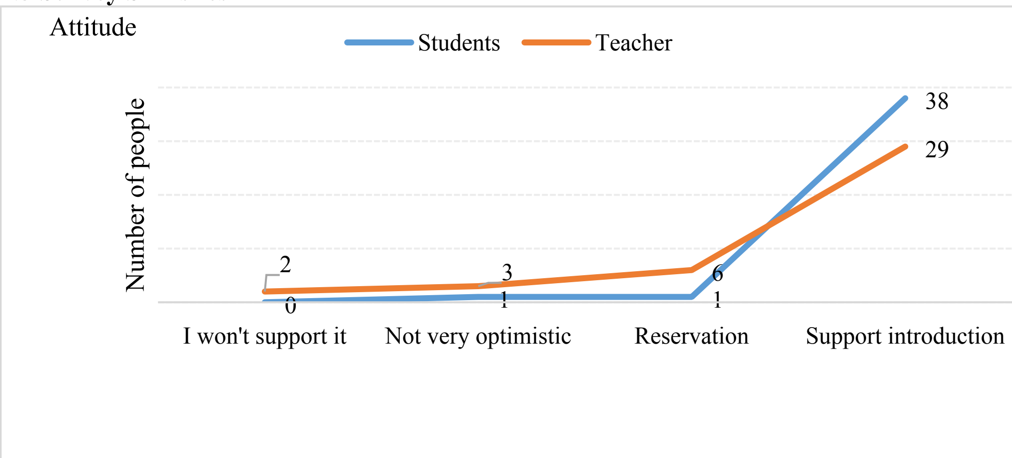

Figure 2. Platform Support Statistics

As shown in Figure 2, the picture is changed to the teaching survey of electrical automation system among automation teachers and students in our school under the background of big data after testing. According to the data statistics, more than 85% of the students agree with the design and implementation of the system, and only 5% of the people do not agree.

5. Conclusion

The importance of electrical automation technology in the field of modern industrial production is very obvious, the demand for talents is also expanding, the establishment of automation experimental platform is very necessary. In this paper, the basic experimental platform of electrical automation as the background, experimental inverter control, at the same time, the comprehensive experimental platform set up a variety of signal conditioning circuits and control circuits, and develop the experimental platform software system, based on the touch screen design of human-computer interaction interface. In the construction of the experimental platform, there is no further analysis of the control of programmable logic controller, frequency converter and motion controller. In the design, more in-depth research on PID analog adjustment and high-speed counting input is needed. After the implementation of the future power supply area electrical automation system, it can realize real-time monitoring of the operation of each switch, and dispatch at any time according to the actual situation, reduce the loss of feeders in the mode of economic operation, complete the optimization and improvement of distribution network construction, improve the utilization rate of distribution network equipment, and reduce the cost of distribution network transformation. In addition, the centralized setting of feeder automation can effectively isolate the fault area, provide guarantee for the normal operation of the non-fault area, control the outage time in the shortest range as far as possible, and make the distribution network operation more reliable.

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Development of Virtual Reality and Computer Technology Application

Lixia Hou(✉)

College of Artificial Intelligence, Nanchang Institute of Science and Technology, Nanchang, Jiangxi, China

(✉)Corresponding author: wanly@ncpu.edu.cn

Abstract. Virtual reality technology, as a cutting-edge media technology, is widely used in various fields to enhance the user's autonomy and selectivity, make the user feel like in the real world, and realize the user's immersive experience. In this paper, through the related definition of virtual reality technology, at the same time, the integration of computer technology and virtual reality technology development research, through the survey, we can see that the number of people who choose to be optimistic is 71, accounting for 81.6% of the total number. The application of virtual reality technology in the development is inseparable from the help and promotion of computer technology, and the better integration of the two can achieve the purpose of common development.

Keywords: Virtual Reality Technology, Computer Technology, Investigation and Analysis, Common Development

1 Introduction

Virtual reality technology is kinds of computer simulation system, which can create and let people, experience the virtual world. It is a high-tech that can use computer simulation to produce three-dimensional virtual world. The technology through the use of computer graphics technology, simulation technology, artificial intelligence and other computer related technologies, with the help of virtual reality wearable devices.

The birth of the world's first head mounted display in 1961 marks the beginning of virtual reality (VR) technology. In the past 50 years, VR technology has experienced the perfection from theory to technology, and finally ushered in the explosive stage of application in this century [1]. In 2014, social media giant Facebook acquired oculus, a VR technology equipment manufacturing company, with a huge sum of US $2 billion, which ignited a new round of virtual reality research and development boom. Google, Samsung, HTC and other technology companies have laid out the VR market one after another, and 2016 is even regarded as the "first year" of VR by the industry. VR technology has the advantage of "immersion" experience. It is famous for improving the sense of scene, participation and interactive experience. It attracts medical, tourism, education, games and other industries to explore the possibility of integrating new technologies. The development speed of computer technology is relatively fast. In the process of continuous progress of science and technology, the research and application of computer technology is more in-depth. A variety of new computers have been developed, and computer technology is also developing in the direction of informatization, intelligence and efficiency. For the traditional computer, its application performance has been unable to meet the current development environment, which requires the innovation of the application principle of computer technology to realize the effective application of a variety of new technologies [2]. In this development environment, virtual reality technology has been further developed. The development and application of a variety of science and technology, virtual reality technology has also been affected. In the process of continuous improvement of computer level, it provides a driving force for the development of virtual reality technology. Compared with the previous computer operation technology, the overall application advantage of this technology is more obvious [3].

To sum up, this paper mainly discusses and investigates the development of virtual reality technology and computer technology application, clarifies the relationship between the two by elaborating the relevant concepts and definitions, investigates the computer professional practitioners through questionnaire survey, and analyzes the development direction of virtual reality technology and computer technology application through research.

2 Definition of Related Concepts

2.1 Virtual Reality Technology

VR Chinese means virtual reality. Virtual reality is not real reality, but the combination of virtual and reality. It is a fictitious computer simulation system created by a series of corresponding computer technologies. Through VR technology, realistic real scenes can be created. In this virtual scene, virtual objects can be materialized through interactive devices, so as to make users feel comfortable. The image is brought into the real environment, the experience of the experience is more intuitive, and the feeling of being in the scene arises spontaneously. VR technology has greatly stimulated the interest of the majority of users. This kind of interactive environment, which is generated by VR technology on the computer and makes users feel more realistic, is called virtual environment [4].

2.2 Characteristics of Virtual Reality Technology

Virtual reality technology perfectly combines computer technology and media technology, brings users a highly realistic virtual experience, and provides an effective means for people to explore things and their development laws [5]. The sensing device and video implementation device are hardware technology, and the system application is software technology. The most important characteristics of virtual reality technology include immersion, interactivity and conceptualization. Specifically, by creating a virtual space which is highly similar to reality, users immerse in it and realize human-computer interaction through relevant hardware operation. Details are as follows:

Immersion: users can immerse themselves in the designed virtual environment when using virtual reality technology. They feel part of the virtual environment and participate in a variety of activities. Immersion is mainly reflected in the user's perception, such as the most basic visual perception, in addition to auditory perception, taste, smell perception and tactile perception [6].

Interactivity: this feature refers to the process in which users can interact with various elements in the virtual world and obtain system feedback after operation. Specifically, users can experience the same feeling as the real world through data helmets, data gloves and feedback devices. The interactivity of virtual reality technology is mainly reflected in two aspects: one is to emphasize the interactive feedback between users and the system in the virtual environment; the other is to emphasize the timeliness of interactive feedback [7].

Conceptual: the content of virtual situation is generated by the design and programming of developers, which mainly reflects the ideas that developers want to express. Therefore, the virtual situation designed in this way shows that a goal is conceptual. For example, the application of virtual reality technology in military, medical, education and other fields is to better solve the existing problems. Developers develop software according to the needs of users. In the field of education, bringing students into the imaginary virtual environment helps students improve their cognitive understanding and develop innovative development on the basis of understanding [8].

2.3 Application of Computer Technology

In view of the rapid development of computer technology, virtual reality technology also has a huge update. In the composition of virtual reality system, the application of 3D computer graphics technology plays an obvious role, which can simulate the real graphics, and people can get more intuitive and three-dimensional visual enjoyment. Moreover, computers produce high-performance and intelligent types, which provide many useful technical support for virtual reality technology. To build a virtual world is to achieve a visual, real-time interactive virtual environment state through computer operation of relevant data. In terms of operation and reality, it is significantly superior to the traditional computer [9].

2.4 Development of Virtual Reality Technology

The emergence and development of virtual reality has a strong inevitability, but also in the development of human society and production life has been a lot of exploration and practice. It is always a goal of human beings to imitate the real world objects and use them for people to achieve a certain purpose. Human's exploration and practice of "virtual reality" have been taking place all the time. The legends of shaman priests and Viking crazy soldiers in ancient times all decorate the animal's head and fur on their bodies in order to expect that they can obtain some ability of the corresponding animals. The paper-cut characters in shadow play and the wooden people in martial arts training are all human beings who achieve the established goal of "virtual reality" through the simple physical simulation of animals and human beings. With the advent of the Internet era and the continuous development of computer technology and its related technologies, human exploration and pursuit of virtual reality (Human-Computer Interaction) has shown explosive growth, reaching a new research level and height. Human beings are not only satisfied with simple physical simulation, but also open a new era of exploration and practice. After the technological revolution, virtual reality is the development of computer high-performance computing, computer graphics and image processing, human-computer interaction, artificial intelligence, communication and transmission technology, so that people's exploration and practice in simulating and fabricating the real world reach the latest level. Virtual reality has experienced several different stages from concept generation, technology practice to industrial development [10]:

2.4.1 Budding stage

Industrial production began to emerge. A large number of physical simulation "virtual reality" are constantly explored and practiced. The concept of virtual reality is in the embryonic stage, and the corresponding concept principles and standards are not put forward. Physical simulation promotes the germination and exploration of virtual reality related concepts.

Taking the development of space technology as an example, before the emergence of simulation technology (the rudiment of Virtual Technology), the proportion of flight accidents caused by human operation errors in all accidents reached an amazing 90%. At the beginning of the 20th century, when the simulation technology was not developed, there was a saying in the aviation industry: "pilots were piled up with gold equal to their weight", which is enough to explain how expensive it was to train a qualified pilot at that time. In order to reduce the flight accident rate and train qualified pilots, a simple flight simulator appeared in Europe in 1920s. This kind of flight trainer has a simple simulated aircraft operating system, but it needs the help of natural wind, so it is not practical. Until 1929, Edwin link used the pneumatic parts of musical instruments to make a flight simulator (similar to today's children's rocking car), which was the earliest flight simulator. Interestingly, at that time, Edwin link sold his aircraft to the amusement park as a game machine, and even added a slot. The aircraft was more like an entertainment tool.

2.4.2 Exploration period

In 1965, Ivan used his rich imagination to describe a kind of technology that can be used to simulate 3D scene by computer. Moreover, users can interact with virtual images as in real life, such as touching, sensing, smelling, controlling and moving virtual images, etc. In the early stage of Ivan Sutherland's research (1968), he developed a 3D display system: Sword of Damocles. This is the earliest augmented reality system, and its invention means opening a new chapter in virtual reality research.

2.4.3 Consumption development period

After the concept and principle of the second period were gradually improved and established, great breakthroughs and achievements were made in military, aerospace and other fields. Virtual reality technology has also ushered in the development stage of all technologies - from the professional field to the field of mass consumption, and finally achieved great breakthrough and success in the fields of film, games and so on. Virtual reality technology has been widely popularized and gradually accepted by ordinary consumers, leading to a large number of capital entering the field of virtual reality, which has brought about the blowout development of the industry, It also brings the industry cold winter of technical bottleneck.

2.4.4 High speed development period

Goldman Sachs Group (a famous investment bank in the United States) pointed out in the comprehensive report on the status of virtual reality industry released in 2016: the total output value of virtual reality industry is showing a rising trend year by year, and showing a huge potential. According to the prediction of Goldman Sachs, the total scale of virtual reality industry will reach 110 billion US dollars in 2025, which will officially surpass the scale of 90 billion US dollars set by the TV market. Thus, the future development potential of virtual reality technology can not be underestimated.

In short, the goal of human exploration of nature and social needs are the driving force of the emergence and development of virtual reality. The eternal pursuit of computer technology and artificial intelligence workers for faster, smarter and more harmonious computer and artificial intelligence system promotes the continuous development of virtual reality technology.

2.5 Related Formulas

Weight calculation:

$$\mathrm{CI} = \sum_{\mathrm{i}=1}^{5} W_{\mathrm{i}} CI_i \tag{1}$$

$$RI = \sum_{i=1}^{5} W_{\mathrm{i}} RI_i \tag{2}$$

$$CR_{\mathrm{all}} = \frac{CI_{\mathrm{all}}}{RI_{\mathrm{all}}} \tag{3}$$

3 Development Survey of Virtual Reality and Computer Technology Application

3.1 Investigation Purpose

In recent years, the virtual reality industry has developed rapidly, whether it is military, medical, real estate, education or entertainment and many other industries are involved. In 2017, Jiangxi Province proposed to support the construction of Nanchang world-class virtual reality center, focusing on the construction of 10 artificial intelligence and intelligent manufacturing industrial bases. It can be seen that the development of virtual reality industry is the general trend. The following will be studied through questionnaire survey to analyze the development direction, problems and solutions of the application of virtual reality and computer technology, so as to pave the way for the future development of the technology.

3.2 Respondents

Through the questionnaire survey on the employees of virtual reality and computer related industries in our city, a total of 87 people were selected, including 67 people in the computer technology industry and 20 people in the virtual reality industry. Through the questionnaire results, the development of the industry and the prospects of the two technologies were analyzed.

4 Survey Results and Analysis

4.1 Development Prospect Survey

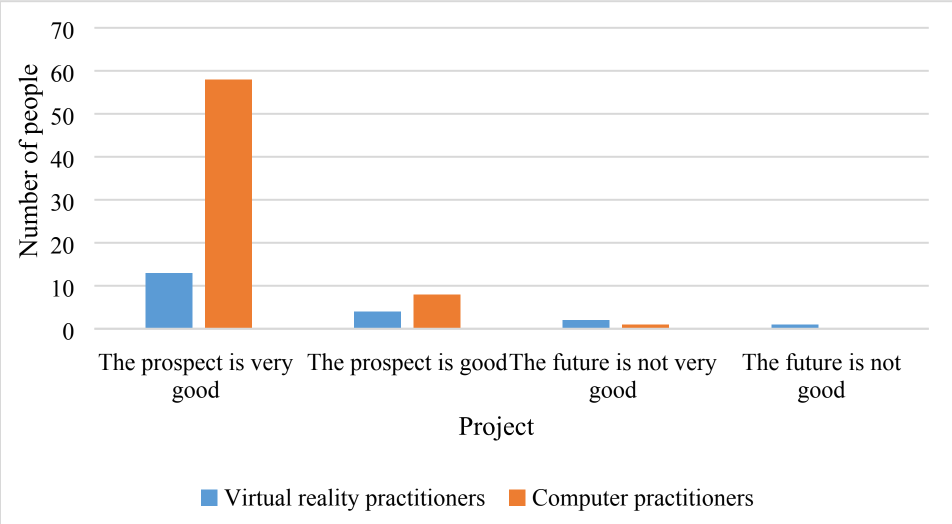

Fig. 1. Survey on the Development Prospects of Virtual Reality and Computer Technology Applications

As shown in Figure 1, through the survey of technology development prospects in the questionnaire survey, it shows that absolutely some employees in relevant industries are optimistic about the technology development prospects, and only a few employees are not optimistic about the development prospects. Basically, the daily work content of employees is related to the technology. They can well understand the development potential of the two technologies and represent the development expectation of the technology to a certain extent. The specific number of people is shown in Table 1.

Table 1. Survey on the Development Prospects of Virtual Reality and Computer Technology Applications

	Virtual reality practitioners	Computer practitioners
The prospect is very good	13	58
The prospect is good	4	8
The future is not very good	2	1
The future is not good	1	0

It can be seen from the table that 71 people choose to be optimistic, accounting for 81.6% of the total number. Among them, 13 are engaged in virtual reality technology, 58 are engaged in computer industry, 12 are optimistic, accounting for 13.8% of the total number, 4 are not optimistic or not optimistic at all, accounting for 4.6%, and only 1 is not optimistic at all, accounting for 1.1%.

4.2 Technology Integration Survey

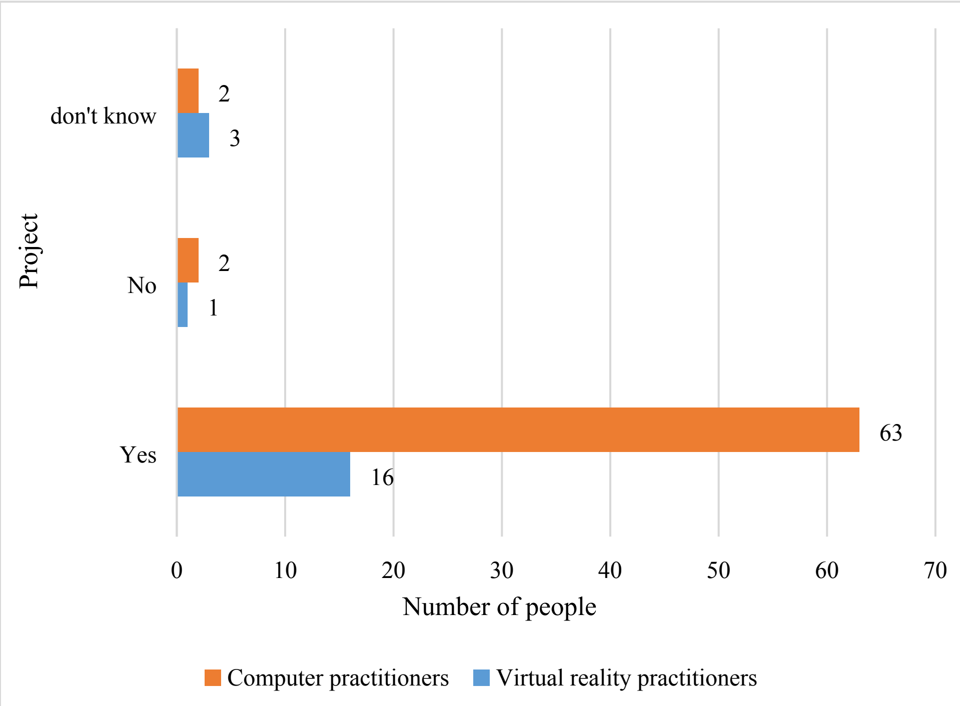

Fig. 2. Findings of the technology integration survey

The application of computer technology in virtual reality technology develops rapidly and gradually tends to mature, but inevitably there are many problems in the development. Therefore, whether the two technologies can be integrated more closely is investigated. As shown in Figure 2, through the survey of technology integration in the questionnaire survey, absolute part of the employees in relevant industries said yes, only a few thought no.

4.3 Development Direction Analysis

The interactive experience of virtual reality technology provides similar services in life for the audience in the process of information release and acquisition. It not only makes the audience feel the intelligent experience, but also has the natural and real feeling. In addition, in order to make users have a better experience, it can also provide massage relaxation leisure activities. At the same time, the audience can browse the virtual reality news, and analyze the authenticity of the information on the basis of the virtual reality environment. Therefore, the interactive development of virtual reality technology is objectively the comprehensive utilization of time and space. Based on human sensory function, through the application of relevant calculation and simulation development, it can achieve stable and normal operation, and bring new experience and feeling to the audience.

5 Conclusion

With the rapid development of information technology, big data, computer technology, virtual reality technology and blockchain technology have been applied in many industries and fields. With the rapid development of foreign VR technology, in order to improve the application of VR technology, China needs to improve the level of relevant technology, strengthen the attention of the government and enterprises to this technology, use the mature computer technology to integrate the two, promote the development and construction of virtual reality technology, and realize common development.

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Ubiquity of Aural Skills Development in Music Rhythm through the Mobile Phone Mechanism

Yu Ting Huang[1], Chi Nung Chu[2]

[1] Department of Music, Shih Chien University,
No.70 Ta-Chih Street, Chung-Shan District,Taipei, Taiwan, R.O.C.
yuting11@mail.usc.edu.tw
[2] Department of Management of Information System, China University of Technology,
No. 56, Sec. 3, Shinglung Rd., Wenshan Chiu, Taipei, Taiwan 116, R.O.C.
nung@cute.edu.tw

Abstract. Music rhythm learning requires a critical ability with the immediate response to music staff reading and keeping up with the speed implied within the music notes. It is a difficulty of music rhythm learning for the learners but can be overcome by repeated practice. With the advent of the e-learning era, learning has transcended the choice of instruction beyond time and space. To this goal, this paper proposed a novel mobile learning system called Aural Skills Development in Music Rhythm through the Mobile Phone Mechanism. The application design is based on the learning theory of behavioral drill strategy to construct the music rhythm practice system. In order to achieve long-term effective practice, mobile devices can be introduced as a learning tool. Learners can use smart phones to practice music rhythms anytime and anywhere according to their personal needs. Learners would no longer be limited to music rhythm learning in traditional classrooms for instructors' correction on-side.

Keywords: smart mobile phone, music rhythm, learning effect

1 Introduction

The aural skills include staff reading, music dictation, sight-singing and music rhythm, which is an extremely important professional foundation for music learning [8, 27]. The well-developed aural skills can create a deeper perception and understanding of music. The quality of aural skills can also affect the level of listening to music, it can enhance people's perception of music and make hearing more acute and enjoyable. With good aural skills, people can more easily understand and appreciate music, enhance their sensitivity to contact music [19, 28, 29].

Establishing the basic aural skills from music rhythm learning is a well beginning [18, 33]. Therefore, in all aspects of music learning, the establishment of music rhythm is critical, and the development of music rhythm needs time to form up [4, 16, 35]. Strengthening the music rhythm ability must extend the learning time. It is a long-term practice in the acquisition of music rhythm sensitivity. Learners can form a truly internalized rhythm, and then learn an advanced domain of music knowledge. The mastery of musical rhythm can effectively assist learners in the acuity of music dictation and the pitch of sight-singing. However, the difficulties in rhythmic learning come from the actual performing the length of music notes which are determined by the tempo of the music. The space symbol of music note is used to identify the pitch and time value of the sound. That is a problem in the transition of vision and hearing for students' difficulty in learning rhythm [22, 26]. Studies showed that rhythm teaching must stabilize learners on the stable tempo [7, 10]. Tradition rhythm exercises seem relatively drab. As the learners encounter rhythm exercises, the immediate reaction is to convert music notes into monotonous pithy formulas often in rhyme. Even the correct recitation or rhythm is confirmed by the instructor, it will limit the learners to develop their sense of rhythm with an instructor who must be on site guide.

With the advent of the digital learning trend, the information technology has been applied to learning-related research and design in recent years, including the technology in development of instruction systems, the platform planning of teaching platform, and the production of instruction contents [3, 13, 36]. The use of IT-assisted instruction including mobile learning has positive effects on the learning achievement [2, 17, 21]. Even for the courses with higher complexity and difficulty, digital learning tools have better learning efficiency than traditional instruction. Studies show that information technology can concretize abstract concepts of instruction contents, and achieve the effect of enhancing learning motivation and promoting self-learning [1, 6].

2 Learning Theory behind the Design of Aural Skills Development in Music Rhythm

Learning theories provide educators with various education aspects for research and thinking on instruction strategies. As the human learning process is still in the exploratory stage, effective instruction strategies have absolute instruction benefits for learning. The design in this paper is based on the mobile learning with information technology and the application of practicing strategies of learning theory by the behaviorism.

2.1 Information Technology Convergence Strategy

With the development of information technology, acceleration in the communication, dissemination, and accumulation with information has been connected. Beyond the main resources of knowledge such as books or classrooms in the past, instead anyone can retrieve knowledge from everywhere as long as they turn on the mobile devices and surf the Internet [9, 12, 31, 34]. The impact of information technology is comprehensive. In education, it has affected teachers' instructions and students' learning methods, and even led to the transformation of traditional education patterns.

The rapid advancement of information technology has had a tremendous impact and influence on the teaching practice in the classroom. The popularization of smart phones, the Internet and the establishment of wireless networks have broken the time and space limitations of traditional classroom activities. Facing the advent of digital era, the world is close at hand with the connection of the Internet, and learning is even more ubiquitous because of the convenience of information technology. The modern learning model is gradually no longer centered on the instructor, but shifted to center on the learner. As a result, learners can not only learn with the aid of information technology, and even the scope of the classroom can also be infinitely extended due to the convenience of the Internet.

The learner-centered transformation and the combination of information technology with learning provide the possibility of exploring and improving instruction effectiveness [5, 14, 32]. As the information technology can integrate the digital media such as image, graphic, audio, text, and animation, various learning subjects can be vividly simulated and abstraction of domain knowledge can be presented concretely. The learning motivation can be greatly enhanced. Especially, information technology has gradually been developed into a new visual tool in art education. This is just the beginning. Information technology is no longer exclusive to the scientific professional field, but can be incorporated into other educational fields.

Therefore, the environment created by information technology is a satisfiable choice for learning needs of learners. It can not only facilitate learners' active operation choices to improve problem-solving and expand thinking skills. What digital learning intends to touch is not to merely adopt information technology for the sake of information technology, but to satisfy individual differences in learning. Therefore, instructors must bring learning to learners; not to bring learners to learn [11, 20, 25]. Information technology could allow learners to learn more actively, lively and interestingly.

2.2 Drill Strategy of Behaviorism

Behaviorism spanned from the field of psychology to the field of education in the early 1960s. The educational environment of the school was conducted to that if the correct stimulation is provided with the instructor then the knowledge would be got by the learners [15, 30]. Behaviorist believes that knowledge can be acquired passively, therefore emphasizing on the use of stimulus and feedback control makes meaning for learning. As one of the multiple spontaneous responses to stimuli makes sense to the learner, the stimulus and the response are connected to strengthen learning effects for the learner. Therefore the instruction strategy implements the most appropriate positive reinforcement to enhance the learner’s need to show good behavior or provides a negative reinforcement to remove the behavior that learner should avoid.

The behaviorist view on learning emphasizes the task of instruction and should successfully guide learners to produce new connections of external behavior. The strategies of instruction design include designing different forms of exercises or questions to induce learners to respond and providing immediate feedback after doing practice questions, quizzes or homework by the learner.

3 System Development Strategy of Aural Skills Development in Music Rhythm

The acquisition of aural skills is a continuing process of practices that requires long-term training and continuous modifications [23, 24]. Time is a key factor in the existence of music forms. The abstract ion with various basic elements of music must be reflected in the course of time.

Learner drills these apps in conscious training to enhance learner's unconscious intuition and increase the effectiveness of music rhythm learning.

3.1 Steady Rhythm Maintenance

The metronome is an instrument for making sounds regularly. It is usually used as an auxiliary tool for practice to help learners maintain a steady rhythm and make sure to reach a precise rhythm during the entire practice. The tempo sign described in the text of Italian words, such as: Allegro, Andante, Moderato, etc. The music note sign is usually expressed in the form of " note = number". The learning interface is shown as Fig.1**.**

Fig. 1. System of Metronome

3.2 Drill in Music Rhythm

Music rhythm is mainly designed to help learners improve the ability of accurate rhythm in music, and its main goal is to provide learners with different types of music score exercises to improve their skills in stable rhythm.

There are two modes for practicing with smart phone: "tapping exercises" and "shaking exercises". The former one provides learners with choice to tap on the phone screen as the practice mode, the latter one provides learner with music rhythm practice by shaking. (Fig.2)

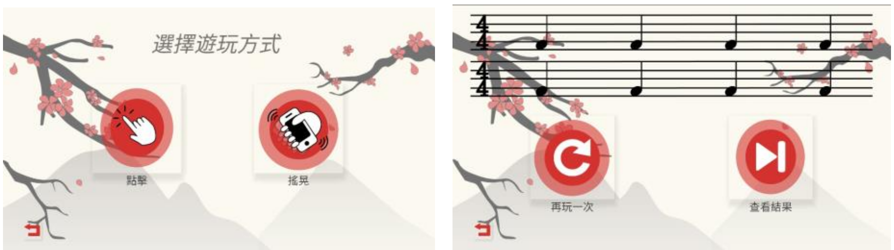

Fig. 2. Functions of Drill Mode Selection and Drill

4 Conclusion

This convenient type of ubiquity of aural skills development in music rhythm through the mobile phone mechanism will "groove" with learners' performance anytime and anywhere. It can detect whether learners have tapped on or shaken with mobile phone in the correct rhythm key, and will respond to the learner until they accomplish the correct rhythm drill before continuing to play the next one. The learners just need to tap or shake to play, put their hands on/with the mobile phone, learners can concentrate on their performance, and they can know whether they are playing correctly through instant feedback — learners no longer need to stay with the tutors and be limited to the tutor's on-site guidance. From then on, there is no interference in the process of practicing music rhythm, only concentration and fluency.

The development of aural skills in music rhythm through the mobile phone mechanism received positive affirmation during the prototype trial test with potential users. This also strengthened further studies to bring this new technology to the majority of users.

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