www.cad-journal.net Computer-Aided Design AND APPLICATIONS

Design of Digital Visual Transmission System Based on CAD Aided Technology and Deep Learning

Na Li

Department of Art Design, School of Fine Arts, Anyang Normal University, Anyang, Henan 455000, China, 07211@aynu.edu.cn

Corresponding author: Na Li, 07211@aynu.edu.cn

Abstract. During the growth of AI (Artificial intelligence), DL (Deep learning) is a main research direction. This article deeply studies DL, and applies CAD technology and DL to the construction of digital visual transmission system. It constructs a neural network extraction optimization model based on image feature analysis. In the classification of image training models using network methods, deep learning is used to optimize image features. Improve the performance of DL network by optimizing model and parameters. Experimental research shows that the error of this algorithm is low, and the highest accuracy can reach 96.11%. Moreover, in the case of large parallel operation, the stability can reach about 89%, which shows that the system performance is excellent. Compared with the traditional decision tree algorithm, this method is more flexible, efficient, fast and practical. It provides theoretical and technical support for the application of CAD technology in the design of digital visual transmission system.

Keywords: CAD Technology; Deep Learning; Convolutional Neural Network; Visual Transmission
DOI: https://doi.org/10.14733/cadaps.2024.S1.146-160

1 INTRODUCTION

CAD Assistive technology and deep learning play an role in the design of digital vision transmission system. CAD Assistive technology can be used to design hardware and software components of digital vision transmission system, while deep learning can be used to optimize the performance. In the hardware design of digital vision transmission system, CAD Assistive technology can help designers quickly create and modify circuit diagrams, schematic diagrams and layout drawings. These graphics can help designers understand how the various components of the system interact and how to optimize system performance. In software design, CAD Assistive technology can help designers quickly create and modify program codes. These codes can control the various components of the digital visual transmission system and achieve the required visual transmission functions. Deep learning can be used to optimize the performance and efficiency of digital visual transmission systems. Deep learning algorithms can train the system to recognize and classify different visual signals, and optimize the transmission speed and accuracy of the system. These algorithms can also help the system automatically adapt to different environments and conditions, in order to improve the robustness and reliability of the system. Due to the growth of scie & tech, computer can do more and more software processing and image design, far exceeding the manual ordinary image design. The core content of this technology is not the ability to accommodate massive graphics and images, but the powerful graphics and image processing function. Moreover, with the different media, visual transmission forms are also varied. As a form of activity, visual transmission has the initiative and enthusiasm of hard top. Computers can help analyze some very complicated data, greatly reducing the burden on designers. In the use of charts and data, computers show many advantages, and the works designed by computers have a unique style.

Deep learning networks can be used to extract feature vectors of selected images and train them. This usually involves inputting images into a deep learning network, extracting feature vectors from the network, and then using these feature vectors to train another model, such as a classifier or regression model. For image classification tasks, CNN is typically used to extract feature vectors from images. When training CNN, the network adaptively learns features in the image, such as edges, corners, etc. This usually involves inputting images into CNN and obtaining feature vectors from the middle layer of the network. These feature vectors can be used to train another classifier or regression model to complete specific tasks, such as object detection, image generation, etc. In the whole visual transmission process, information interpretation and visual symbol reception are both complicated processes. The essence of CAD is that designers or engineers use information technology or computers to realize engineering or product design. By using this method, the efficiency of image design and visual design can be effectively improved, and it is suitable for all types of graphic images. Compared with traditional image design and visual design technology, it has better applicability. Image characters include various visual information such as pixels, colors, shapes and textures. Therefore, when classifying features of images, different classification information is emphasized, and the selection of image characters is also different, and the final result will be different because of the selection of angles. In the traditional image classification task, the problem of high-dimensional feature space may lead to inefficiency in the learning process. Therefore, the traditional image classification method based on image characters is no longer suitable for the current needs.

With the rapid growth of computer hardware facilities, DL has made a major breakthrough and has excellent performance. The feature of DL-based method is that it can learn feature extraction automatically through the network, without strict algorithm design, and has better performance. DL model can handle large-scale data analysis tasks. Moreover, by influencing the original data, a more complicated analysis is carried out. DL hopes to learn multi-layer feature transformation at the same time, and better high-level features can be obtained through such multi-layer feature transformation. DL has developed from multi-layer unsupervised pre-training initialization to multi-layer direct training of deep convolutional networks. With its application in various fields, it shows DL's powerful feature learning ability for images.

This article elaborates on the design relationship of image computer vision, and applies CAD technology and DL to the construction of digital visual transmission system. It constructs a theoretical guidance technology analysis for computer information transmission based on visual processing. The innovations of the research are as follows:

(1) In this article, CAD technology and DL are applied to the construction of digital visual transmission system, and a computer image character extraction and optimization model based on CNN is proposed.

(2) This method adopts DL network, It constructs a deep learning network training model through network feature vectors. Moreover, the performance of DL network is improved by optimizing the model and parameters. Compared with the traditional decision tree algorithm, this method is more flexible, efficient, fast and practical.

The first section of this article is the introduction, which introduces the background of the design of digital visual transmission system, and puts forward the construction idea of digital visual transmission system; The second section is related work, which discusses the research results of scholars in related fields; The third section analyzes the relationship between computer image design and visual design, and discusses the construction of CAD technology and DL algorithm model. Based on the content of the third section, the fourth section completed the design of the digital system of visual transmission; The fifth section verifies the effectiveness of DL algorithm model and visual transmission digital system through simulation experiments. The fifth section is the conclusion, which expounds the method and contribution of this article, and puts forward the related research prospect.

2 RELATED WORK

AI technology has made great progress with the update of computer hardware, and the research results of computer vision such as image recognition and target detection based on DL are remarkable. Ashtiani et al. [1] conducted a neural computing extension limitation analysis of optical networks. By directly processing digital nodes on the mapping array, it analyzes the visual processing classification problem in photon image computing, breaking through the limitations of clock frequency and memory access time in network computing. Bajaj et al. [2] conducted a simulation study on the neural network digital pre distortion technology intervention system. By indirectly adjusting the learning architecture, it analyzed the neural network evaluation scheme under high-frequency signal transceivers. After verification, the proposed signal amplitude modulation gain has achieved optimal performance. Due to the fact that deep learning networks are a non-linear structured, multi-layer black box type, their datasets often cannot reflect real-world problems. This may cause errors in the correlation between the analysis and output of the dataset. Buhrmester et al. [3] conducted an analysis of the characteristics of deep learning network mechanisms for computer vision tasks. With the help of CAD neural network, this problem was perfectly solved. Fang et al. [4] conducted spatial feature classification for hyperspectral image data network extraction. The proposed convolutional network has close links at different scales and spatial features. The application training results on different datasets show that the distinguishability of using enhanced spectral features has been greatly improved. Giuffrida et al. [5] conducted hyperspectral classification and demand analysis on resource transmission of images. Through network training on task datasets, edge data training tests were conducted using hyperspectral deep learning methods. The results showed that in cloud detection, the design of data digital visual transmission system has the characteristics of low power consumption and low latency. In order to ensure that the image does not deform and the classification accuracy is not affected when zooming in or out using interpolation, Hashemi [6] proposed a zero-fill method for adjusting the image size. A target for training the feature quantities of internal parameters was constructed using one-dimensional feature vectors learned by CAD machine learning.

Kim and Panda [7] used the biological network's deep learning alternative to carry out the positioning test of the visual network nerve. As an alternative to traditional deep learning, Spiking neural networks can provide a more in-depth explanation of feature analysis in visual technology and provide users with real-time image regions of interest exploration at each time. For a long time, in order to facilitate communication and improvement for people with disabilities, Latif et al. [8] have constructed a deep learning network architecture for sign language recognition system. By changing the architecture parameter design of the convolutional network, it was tested and analyzed using gesture image information from participants of different age groups. The results indicate that the proposed CAD aided design system has high accuracy. Li et al. [9] conducted a deep learning assisted exploration of augmented reality to address complex connector mismatch issues in digital visual transmission systems. The proposed image matching spatial relationship has priority detection on the appearance of the expected layer. The clustering generation algorithm is used to number the polar angles, which improves the mismatch problem in the enhanced matching interface. Compared with traditional methods, it has more competitive value.

Liang [10] used a small dataset to continue the fault detection and classification of reinforced concrete bridge images based on three-level images. Deep learning was used to classify and locate local damage in bridge components using neural networks. After analyzing the convolutional training network of the bridge, it improved the robustness of the three-level deep learning model based on a principled selection method. Lopez et al. [11] analyzed the sensitivity of tuberculosis bacteria based on image diagnosis. It evaluated the results of automatic neural network interpretation of digital images of a culture. His study analyzed the model's ability to generalize and scale using visual cues of drug sensitivity (MODS) observed under a microscope. The results indicate that during the development of digital experimental models, a new training ratio for the experimental model dataset has been obtained. Lu et al. [12] established a grating system transmission model for optical neural networks, achieving advanced computing at low power consumption. The phase parameters were optimized using forward and backward propagation data from the MNIST handwriting database, which analyzed the grating transmittance results at high standards. Ma et al. [13] conducted a dual branch multi attention mechanism network classification for hyperspectral and spatial features Sharma et al. [14] Integrating spatial information and hyperspectral images for classification ensures the extraction of more discriminative spectral and spatial features. Then fuse the features extracted by the attention mechanism of the type. The validation of dataset results shows that the performance of this method is superior to other types of attention mechanisms. Sharma et al. [15] identified the relevant details of non-image sample transformation organization. The necessary information is obtained by using CAD Convolutional neural network samples for feature extraction. For non-image samples, the powerful functions of Convolutional neural network (CNN) can be realized, including the use of GPU.

Wang et al. [16] believe that the neural function of the retina plays an important role in the efficient image propagation process. According to its principle, the adjustable vertical heterostructure grating is operated accordingly. By linking sensor images to configurable reset gratings, the prototype visual sensing value of the sensor was summarized. Wang et al. [17] conducted object state detection and reconstruction of spatial physical virtual models between optical communication systems. Through the integration of digital twin model algorithms, the behavior rules of optical communication virtualization functions were studied. By introducing CAD assisted deep learning, dynamic transmission of hardware configuration models was carried out in digital virtual space to ensure reliability. Zorzi et al. [18] analyzed the point cloud classification problem of radar digital visual transmission in modern neural networks. Solved the time-consuming problem in traditional radar data processing. By preprocessing the full waveform data and mapping the output vector image of the waveform related point coordinates, it performs a data architecture for the spatial position proximity of the point coordinates with graphical pixels.

Combined with previous literature, this article introduces CAD technology and DL into the design of digital system on the basis of comprehensive analysis of CAD technology and DL algorithm model. After comprehensively analyzing the relationship between computer image design and visual design, a digital system of visual transmission is constructed by using DL algorithm model. In order to play a reference role in the research of related fields.

3 CAD AIDED TECHNOLOGY AND DL ALGORITHM MODEL CONSTRUCTION

3.1 The Relationship Between Computer Image Design and Visual Design

Computer graphics image design focuses on technical realization, and uses computer technology to create artworks. Visual communication focuses on information transmission, and conveys the design content to the audience through visual and auditory means. Computer graphics image design mainly uses computer technology and software tools for creation. Designers need to master relevant technologies and tools to create artworks through technology. This design method has multiple advantages such as efficiency, convenience, aesthetics, and precision, making the teaching form more flexible and vivid, and achieving effective exploration of creative potential. Visual communication refers to the design of transmitting information by means of vision and hearing. It can not only be conveyed through the audience's senses, but also utilize specific psychological effects to enhance communication effectiveness. Designers need to achieve communication effects through individual group or group based on specific content. The ultimate purpose of Visual communication is to express certain ideas, which is widely used in commercial design, printing art design and other fields. To sum up, the emphasis of computer image design and Visual communication is different. Computer graphics image design focuses on technical realization, while Visual communication focuses on information transmission. Computer graphics image design focuses on the design and display of products, while Visual communication focuses more on the transmission and expression of information. Therefore, Computer graphics image design is often used in product design, advertising, multimedia and other fields, while Visual communication is more common in poster, logo, trademark and other graphic design fields. They have different emphases in practical applications. The appropriate design method needs to be selected based on specific goals, audiences, and communication methods.

Visual transmission design is to convey the designer's ingenious creativity or unique design concept through visual transmission, bringing different feelings to viewers. With the combination of computer and Internet, visual transmission has entered a new height. People began to use the image design function of the computer. It can promote the upgrading of information industry, effectively realize the retrieval and visualization of graphic image information, effectively identify hidden graphic images, and effectively improve the efficiency of mining graphic images. The traditional visual transmission digital system can't realize the dynamic and multidimensional image, and the communication effect is poor. Compared with traditional design, CAD technology can bring more contents and elements, and more images can be designed. The design concept it can express is more in line with the creator's intention and will not cause the situation of unsatisfactory words. Designers can carry out complex design through CAD technology, and add various ideas on the basis of graphic manuscripts, so that designers have more choices and greatly increase the fault tolerance rate. In the practical application of computer image design and visual design technology, not only a certain algorithm is used, but different algorithms are combined to use their respective advantages to complete the work of image design and visual design.

3.2 Computer Image Character Extraction and Optimization Model Based on CNN

The application of DL-based feature extraction in image retrieval has developed so far. Although it has surpassed the traditional image character extraction algorithm in recognition rate and robustness, there is still much room for improvement. Especially in the retrieval efficiency, we can improve the retrieval efficiency by adopting different retrieval strategies. In this article, cross entropy is used as the loss function. The formula of cross entropy is:

$$H(p,q) = -\sum_{x} p(x) \log q(x) \tag{1}$$

The structure of residual function module is shown in Figure 1.

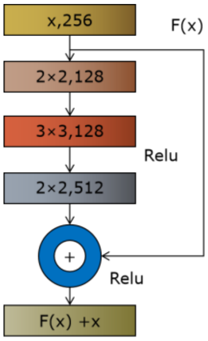

Figure 1: Structure diagram of residual function module.

In CNN, the first convolution layer will input preprocessed images, and each convolution operation only processes a small piece of images. When the image is convolved in the current layer, it is further transmitted to the following network, and each time the filter will extract the most effective features from the data. A plurality of convolution kernels in the convolution layer slide on the input image matrix according to a fixed step size, and perform convolution operation with the corresponding image data to extract the pixel-level features of the image and obtain the feature map of the whole image. Figure 2 shows the convolution stage of CNN.

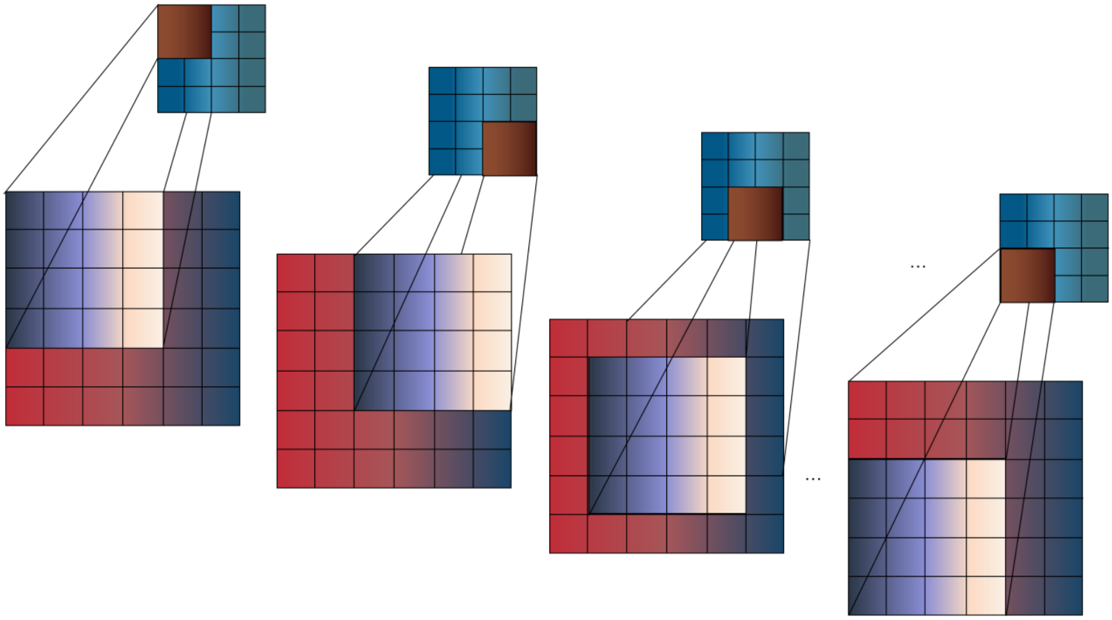

Figure 2: Convolution stage diagram of CNN.

The weight sharing structure of CNN can greatly reduce the parameters of NN, prevent the over-fitting of the network and reduce the complexity of the network. In order to meet the characteristics of decentralized execution, each neuron's movement strategy can only rely entirely on its own local information. Therefore, neurons need to learn to extract relevant features from some observations, plan their own path in the environment reasonably, find the most valuable image information, and solve the classification problem reliably. For all m samples, the activation values of all neurons were calculated by forward propagation algorithm. For the L layer network, calculate:

$$\delta^{(L)} = \begin{bmatrix} \delta_{(1)}^{(4)} \\ \delta_{(2)}^{(4)} \\ \cdots \\ \delta_{(m)}^{(4)} \end{bmatrix} = \begin{bmatrix} -(y_1 - \hat{y}_1)\sigma'\left(z_{0(1)}^{(4)}\right) \\ -(y_2 - \hat{y}_2)\sigma'\left(z_{0(2)}^{(4)}\right) \\ \cdots \\ -(y_m - \hat{y}_m)\sigma'\left(z_{0(m)}^{(4)}\right) \end{bmatrix} \tag{2}$$

l decreases from layer $L-1$ to 2, and is calculated in turn:

$$\delta^{(l)} = \delta^{(l+1)}\left(W^{(l)}\right)^T \sigma'\left(z^{(l)}\right) \tag{3}$$

Calculate the partial derivative of the error function for each layer of network parameters:

$$\frac{\partial Cost}{\partial w^{(l)}} = \left(a^{(l)}\right)^T \delta^{(l+1)}, l = 1, \ldots, L-1 \tag{4}$$

Using the gradient descent number method, perform:

$$W^{(l)} = W^{(l)} - \alpha \frac{\partial Cost}{\partial w^{(l)}}, l = 1, \ldots, L-1 \tag{5}$$

According to its own action value, the algorithm adopts greedy strategy to select the action with the greatest value. In the training stage, the model does not directly select the optimal action, but randomly selects the action with a probability that changes adaptively with time. This method can increase the exploration ability of the algorithm. Which combines the deep feature images extracted by Darknet-53 module with the small-scale output features after up-sampling to form a medium-scale feature output, and then generates a large-scale feature output. Entering different question language texts directly affects the image characters extracted by CNN, which makes the same image have different visual features under different question conditions, thus improving the performance of visual question answering of the whole model. Convolution operation is linear operation, but most images are not linearly separable, so the activation function is applied to CNN to enhance the classification performance of the network. In this article, the saturated nonlinear Sigmoid activation function is used. This function can map the output value of NN to 0-1. Then the K nearest neighbor classification algorithm is used to classify the fusion features and the optimal fusion features obtained by the algorithm search are classified:

$$d(x_i, y_i) = \sqrt{\sum_{l=1}^{n} (x_i, y_j)^2} \tag{6}$$

The model adopts Darknet-53 feature extraction module with full convolution network as the main body, integrates the network model with reference to residual structure, and realizes down-sampling by convolution kernel with step size of 2 instead of maximum pooling in Darknet-19. If the distance values obtained are the most, it can be determined that the feature samples of the image to be measured belong to one of the efficient classifications. On the basis of the original tags, higher-level semantic tags are obtained, and then these high-level semantic tags are used to modify and supplement the target classification, so as to enhance the model training effect, thus solving the problem that large-scale visual relationship recognition cannot be carried out by using rough tags.

4 DESIGN OF DIGITAL SYSTEM FOR VISUAL TRANSMISSION

Based on the computer image character extraction and optimization model constructed in the previous section, this section adopts CAD technology to highlight the structural information of the image and make the visual transmission have better stereoscopic and dynamic special effects. Moreover, the hardware and software environment is designed. When designers use the digital visual transmission system to design, the works are generally dynamic three-dimensional and convey the author's ideas in a unique way. The hardware of digital visual transmission system based on CAD and DL consists of four parts: image acquisition and processing module.

View and voxel can represent the original information of the model. This article takes them as the input of DL model, which will extract complete and effective features from the original information of 3D model. The data processing stage of the algorithm model is shown in Figure 3.

The feature extraction part is composed of a series of convolution layers, which is a layer-by-layer abstraction process. The classification and regression part gets a classifier or regression according to the specific task training. The feature extraction part can be used as an image character extractor independently and applied to other tasks.

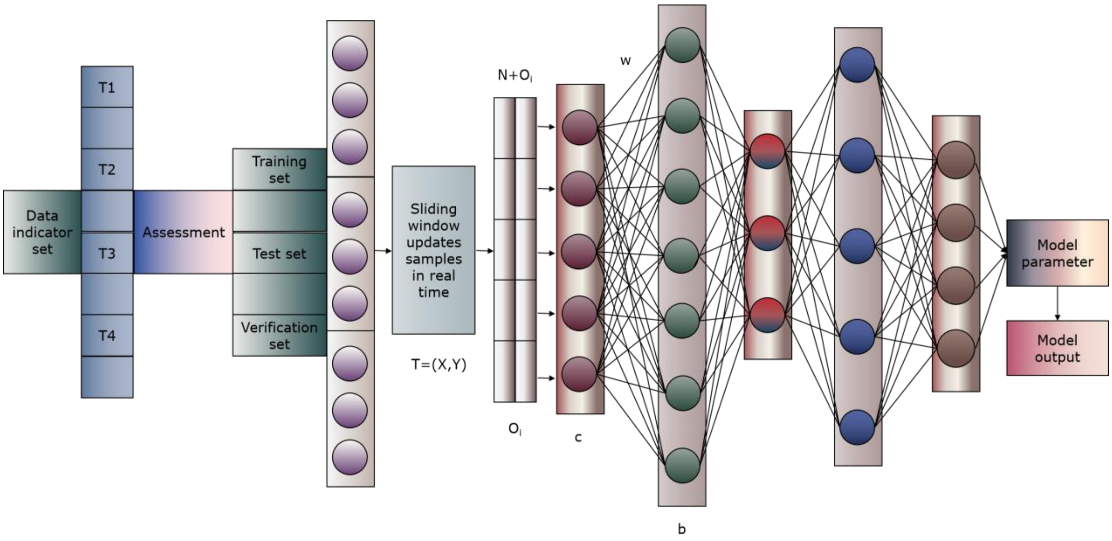

Figure 3: Data processing stage of algorithm model.

In the actual model training, it is difficult for the training samples to satisfy the assumption that all the training samples in the same class meet the same distribution, and the statistical properties of different batches of samples are not exactly the same. This phenomenon is called covariant drift. In order to alleviate the covariant drift phenomenon, batch normalization is to normalize the activation value of the network layer by using the training samples in each batch, so as to improve the learning speed and performance of CNN. In this article, the initial value generation method is adopted, and the method is as follows:

$$x_i^{'}(k)=\frac{x_i(k)}{x_i(1)}, i=0,1,2,3,\ldots,m, k=1,2,3,\ldots,n \tag{7}$$

In the digital visual transmission system based on CAD and DL, the image acquisition and processing module includes camera, microprocessor and sensor. In the image transmission module, infrared sensor is selected as the device for image transmission. The automatic digital system of visual transmission based on CAD technology aims at improving the effect and efficiency of image communication. Using infrared sensor as transmission equipment can reduce the time-consuming of system communication. The network structure proposed in this article contains a unique "space-context-appearance" module. The publishing module is responsible for publishing the dynamic information of the system on the Internet; The user management module is responsible for user registration information and identity verification, and also needs to be responsible for authority management. Each module in the database layer is responsible for storing data information parameters. FIF0 memory is the main storage device in the image storage module of the system. It has abundant data resources, small volume and convenient storage. After the image storage module completes the image storage. The image control module is responsible for controlling operations such as image reading, writing, and updating. The image control module can read image data from the storage device and transmit it to the processing module for processing. The control module can write the processed image data to the storage device for storage and subsequent use. If it is necessary to modify or update the stored images, the image control module can read the original image data, process it, and update it to the storage device. If it is necessary to adjust the size or size of the image, the image control module can perform scaling or cropping operations on the original image and update it to the storage device. The image control module is a key module responsible for controlling and managing stored images. It can read, write, and update image data as needed, and perform format conversion and size adjustment operations on it. Ensure that all graphic image mining can meet the needs, and can also carry out targeted analysis for graphic images with special meanings.

5 SIMULATION EXPERIMENT

This section realizes a virtual simulation image generation method of CAD model through OpenGL graphics library, which can quickly generate easy-to-use lightweight simulation data according to the characteristics of the required design. In order to verify the effect of the model proposed in this article, this article uses decision tree, random forest and this method to carry out comparative experiments in the same environment, and trains the three models until they converge. First, train CNN model. Learning rate is a very important parameter in the stage of training CNN. In the first stage, the initial learning rate is 0.01 and the impulse coefficient is 0.9. With the progress of training, when all the training data are circulated for 10 times, the learning rate will drop to 0.1 of the previous learning rate, and the final learning rate will drop to 0.0001. In this article, the learning rate of 0.001 is used for the second stage of training until it is stable. The basic learning rate of the whole model is 0.001, and the parameters from conv1_1 to conv3_3 will not be updated, and the parameters of the pre-training network will be used directly. The whole experimental framework is implemented on Caffe, and the parameters of the whole model will be optimized by stochastic gradient descent optimizer. In this experiment, the training data is enhanced and the original training set is expanded. The original training picture is randomly cropped and flipped to get an input picture with a size of 24*24, and the contrast and brightness of the picture are adjusted. Data enhancement of the training image is equivalent to adding more data sets, which makes the training model have better classification performance.

In this section, the accuracy, F1 value and running time are selected to verify the performance of the algorithm. Figure 4 provides a comparative accuracy analysis of the algorithm time. Figure 5 shows the comparison results of the algorithms. Figure 6 compares the running time.

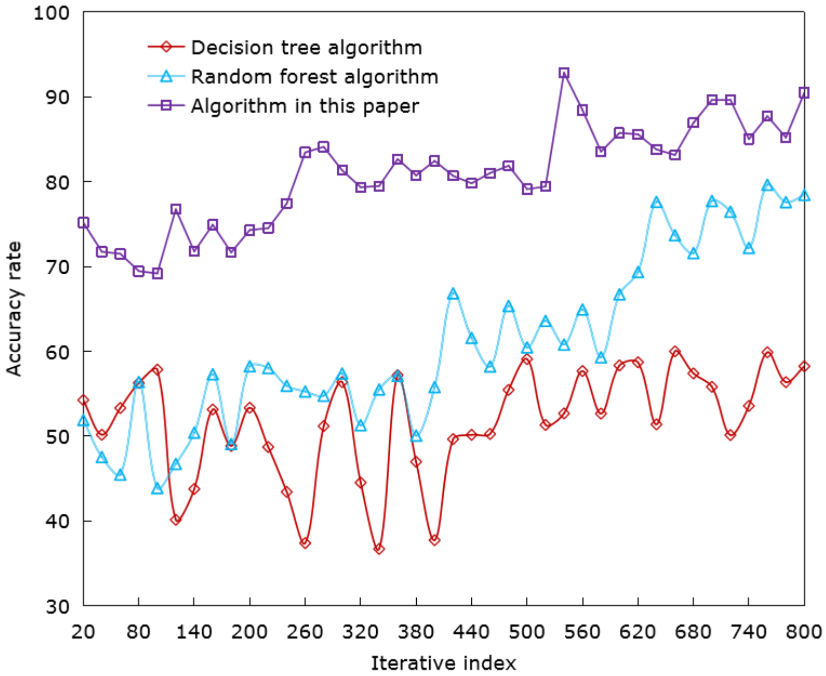

Figure 4: Comparison of accuracy of algorithms.

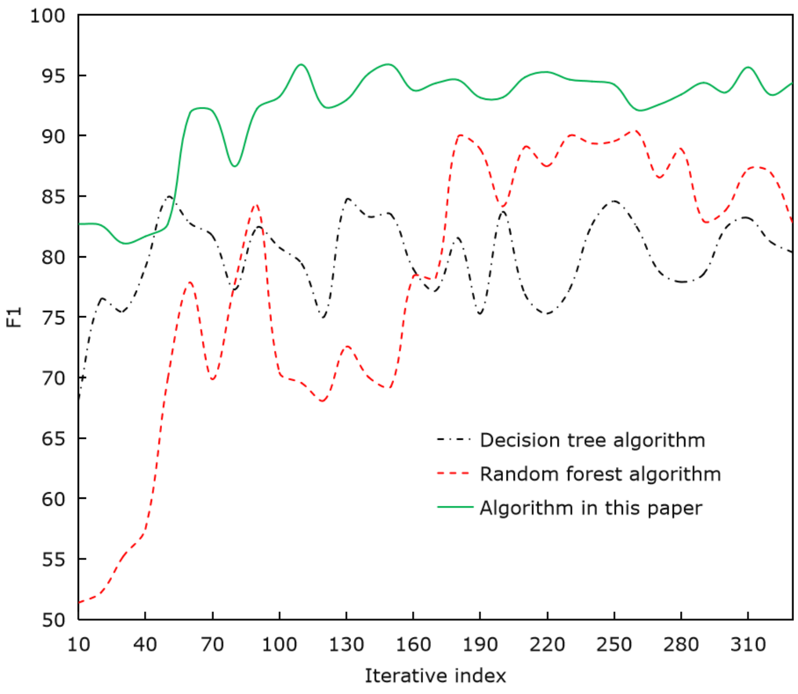

Figure 5: Comparison of F1 values of the algorithm.

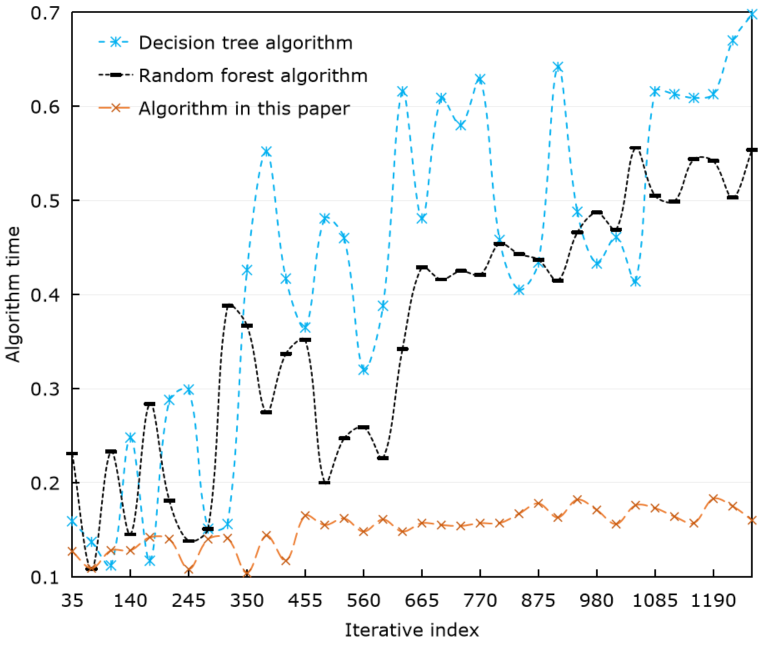

Figure 6: Comparison of running time of algorithms.

It can be concluded from the above figure that compared with decision tree and random forest method, this algorithm has better performance in accuracy, F1 value and running time. This shows that this method can learn better action selection strategies and get more global rewards, thus achieving higher accuracy. The computer image character extraction and optimization model based on CNN shows excellent performance in the stage of image character extraction and classification.

In this experiment, three commonly used model performance assessment indexes are used for assessment. And the definitions of each index are as follows:

$$MSE = \frac{1}{n}\sum_{k=1}^{n}\left(y_k - y'_k\right)^2 \tag{8}$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{k=1}^{n}\left(\left|y_k - y'_k\right|\right)^2} \tag{9}$$

$$MAE = \frac{1}{n}\sum_{k=1}^{n}\left|y_k - y'_k\right| \tag{10}$$

Where y_k is the actual value and y'_k is the model output value. The above indicators express the superiority of the results of the algorithm compared with the simple predictor that uses the tie value of the actual results as the prediction result. This section uses 10% cross-validation, Tables 1 and 2 conducted MAE algorithm testing on this algorithm and constructed the results of MSE.

Training times	*Decision tree model*	*Random forest model*	*This article model*
1	7.36	7.01	4.21
2	7.67	6.26	4.35
3	6.36	6.53	4.06
4	6.24	6.67	4.04
5	6.19	6.25	4.43
6	6.14	6.43	4.47
7	6.13	6.45	4.38
8	5.71	6.5	4.38
9	5.59	6.73	4.92
10	5.91	6.11	4.05
Average value	6.33	6.49	4.33

Table 1: MSE test results of the algorithm.

Training times	*Decision tree model*	*Random forest model*	*This article model*
1	0.656	0.773	0.562
2	0.654	0.621	0.543
3	0.691	0.659	0.515
4	0.635	0.623	0.541
5	0.699	0.671	0.529
6	0.63	0.677	0.515
7	0.607	0.644	0.541
8	0.689	0.674	0.506
9	0.681	0.622	0.503
10	0.605	0.633	0.512
Average value	0.655	0.660	0.527

Table 2: RMSE test results of the algorithm.

Training times	*Decision tree model*	*Random forest model*	*This article model*
1	2.29	2.19	1.32
2	1.92	2.05	1.46
3	2.29	2.26	1.49
4	1.93	2.17	1.23
5	2.04	2.29	1.32
6	1.95	1.99	1.21
7	2.17	2.29	1.46
8	1.92	2.21	1.48
9	2.17	2.22	1.22
10	2.18	2.11	1.27
Average value	2.09	2.18	1.35

Table 3: MAE test results of the algorithm.

The table 3 that the errors of the proposed method are obviously lower, and the performance of the proposed method is superior. It can block the image according to the specific feature points of the complex image, and can achieve better acceleration effect and lower error.

8000 simulated images are virtually sampled as experimental samples, and their resolutions are all 1000*800 pixels. 6000 training images in the sample correspond to their tag file information, and each image contains one object; The remaining 2000 images are taken as test objects, each of which contains one or more targets. The processed image is tested, and the stability of the system is shown in Figure 7.

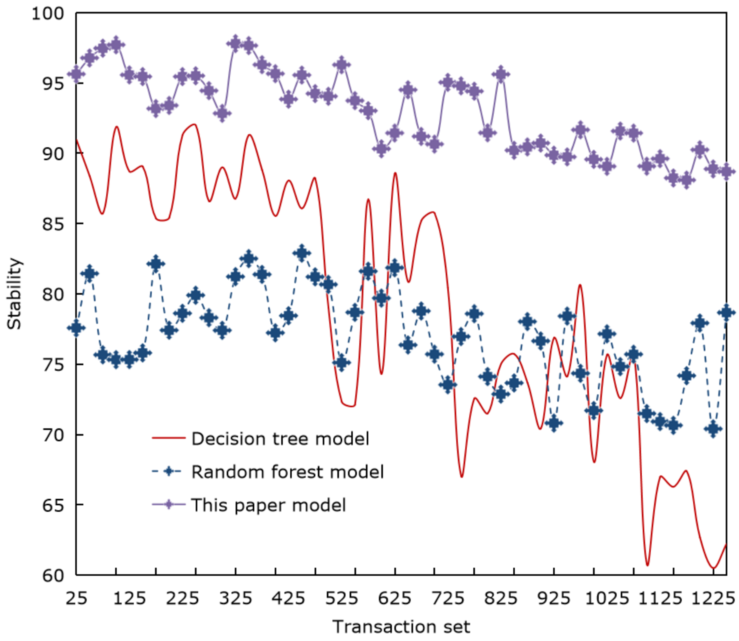

Figure 7: Stability of the system.

The above experimental research shows that the error of this algorithm is low, and the highest accuracy can reach 96.11%. Moreover, the stability can reach about 89% under the condition of large parallel operation, which shows that the system performance is excellent. The simulation data does not need to enter the field to collect images and preprocess, so the collection cost is greatly reduced; And it can be directly input into the network for feature learning, which has high flexibility and can meet the requirements of digital application of visual transmission to a great extent. In addition, the input and output speed of the algorithm model proposed in this article is faster and takes less time, which effectively improves the efficiency.

Deep learning networks can meet the requirements of digital applications in visual transmission, mainly manifested in the following aspects: deep learning networks can digitize images and convert them into digital form for the processing and transmission of digital signals. Deep learning networks can extract high-definition features of images to meet the requirements of high-definition visual transmission, enabling better presentation and transmission of image details and features. Fast transmission: Deep learning networks can quickly transmit and process images, thereby meeting the speed requirements of visual transmission digital applications. Deep learning networks have strong adaptability and can adapt to different environments and scenarios, thus meeting the requirements of different visual transmission digital applications. Deep learning networks have high robustness and can maintain good visual transmission performance even in the presence of a certain degree of noise and interference.

Therefore, deep learning networks can meet the requirements of digital applications in visual transmission and have been widely used in fields such as digital signal processing, image processing, and computer vision.

6 CONCLUSIONS

At present, in the whole DL field, systematic achievements have been made around the study of image character learning and classification methods. However, an effective DL network needs a mass of data in the training process, and data collection and labeling are extremely time-consuming and labor-intensive, which limits the application scope of DL. Based on the basic connotation of DL, this article analyzes the applies CAD technology and DL to the construction of digital visual transmission system, and puts forward a feature extraction and optimization model of computer image based on CNN. In this model, the complex domain Contourlet decomposition is carried out on the feature region of the target image, and the decomposition results are filtered, so that the sub-band coefficient matrix of the target image can be extracted and the relevant features of the coefficient matrix can be obtained. Experimental research shows that the error of the proposed algorithm is low, and the highest accuracy can reach 96.11%. Moreover, the stability can reach about 89% under the condition of large parallel operation, which shows that the system performance is excellent. In this article, the model extracts relevant features from locally observed images and classifies them, so as to reduce data complexity and filter out irrelevant data. Moreover, the improved value function decomposition method is used to train the agent strategy network to solve the reliability distribution problem. This method has more advantages than traditional methods and can meet the needs of digital visual transmission system. It is of great significance to promote the further application of computer image design and visual design technology. In the future research, we can study deeply from many angles, dig and improve the shortcomings of this system.

Na Li, https://orcid.org/0009-0000-7263-6823

REFERENCES

[1] Ashtiani, F.; Geers, A.-J.; Aflatouni, F.: An on-chip photonic deep neural network for image classification, Nature, 606(7914), 2022, 501-506. https://doi.org/10.1038/s41586-022-04714-0

[2] Bajaj, V.; Buchali, F.; Chagnon, M.; Wahls, S.; Aref, V.: Deep neural network-based digital pre-distortion for high baudrate optical coherent transmission, Journal of Lightwave Technology, 40(3), 2021, 597-606. http://dx.doi.org/10.1109/JLT.2021.3122161

[3] Buhrmester, V.; Münch, D.; Arens, M.: Analysis of explainers of black box deep neural networks for computer vision: A survey, Machine Learning and Knowledge Extraction, 3(4), 2021, 966-989. https://doi.org/10.3390/make3040048

[4] Fang, B.; Li, Y.; Zhang, H.; Chan, J.-C.-W.: Hyperspectral images classification based on dense convolutional networks with spectral-wise attention mechanism, Remote Sensing, 11(2), 2019, 159. https://doi.org/10.3390/rs11020159

[5] Giuffrida, G.; Diana, L.; Gioia, F.; Benelli, G.; Meoni, G.; Donati, M.; Fanucci, L.: Cloudscout: a deep neural network for on-board cloud detection on hyperspectral images, Remote Sensing, 12(14), 2020, 2205. https://doi.org/10.3390/rs12142205

[6] Hashemi, M.: Enlarging smaller images before inputting into convolutional neural network: zero-padding vs interpolation, Journal of Big Data, 6(1), 2019, 1-13. https://doi.org/10.1186/s40537-019-0263-7

[7] Kim, Y.; Panda, P.: Visual explanations from spiking neural networks using inter-spike intervals, Scientific Reports, 11(1), 2021, 19037. https://doi.org/10.1038/s41598-021-98448-0

[8] Latif, G.; Mohammad, N.; AlKhalaf, R.; AlKhalaf, R.; Alghazo, J.; Khan, M.: An automatic Arabic sign language recognition system based on deep CNN: an assistive system for the deaf and hard of hearing, International Journal of Computing and Digital Systems, 9(4), 2020, 715-724. http://dx.doi.org/10.12785/ijcds/090418

[9] Li, S.; Zheng, P.; Zheng, L.: An AR-assisted deep learning-based approach for automatic inspection of aviation connectors, IEEE Transactions on Industrial Informatics, 17(3), 2020, 1721-1731. http://dx.doi.org/10.1109/TII.2020.3000870

[10] Liang, X.: Image-based post-disaster inspection of reinforced concrete bridge systems using deep learning with Bayesian optimization, Computer - Aided Civil and Infrastructure Engineering, 34(5), 2019, 415-430. https://doi.org/10.1111/mice.12425

[11] Lopez, G.-S.; Sheen, P.; Zimic, M.: Automatic diagnostics of tuberculosis using convolutional neural networks analysis of MODS digital images, PloS One, 14(2), 2019, e0212094. https://doi.org/10.1371/journal.pone.0212094

[12] Lu, L.; Zhu, L.; Zhang, Q.; Zhu, B.; Yao, Q.; Yu, M.; Zeng, Z.: Miniaturized diffraction grating design and processing for deep neural network, IEEE Photonics Technology Letters, 31(24), 2019, 1952-1955. https://doi.org/10.1109/LPT.2019.2948626

[13] Ma, W.; Yang, Q.; Wu, Y.; Zhao, W.; Zhang, X.: Double-branch multi-attention mechanism network for hyperspectral image classification, Remote Sensing, 11(11), 2019, 1307. https://doi.org/10.3390/rs11111307

[14] Sharma, A.; Vans, E.; Shigemizu, D.; Boroevich, K.-A.; Tsunoda, T.: DeepInsight: A methodology to transform a non-image data to an image for convolution neural network architecture, Scientific Reports, 9(1), 2019, 11399. https://doi.org/10.1038/s41598-019-47765-6

[15] Virupakshappa, A.-B.: Computer-aided diagnosis applied to MRI images of brain tumor using cognition based modified level set and optimized ANN classifier, Multimedia Tools and Applications, 79(5-6), 2020, 3571-3599. https://doi.org/10.1007/s11042-018-6176-1

[16] Wang, C. Y.; Liang, S. J.; Wang, S.; Wang, P.; Li, Z.-A.; Wang, Z.; Miao, F.: Gate-tunable van der Waals heterostructure for reconfigurable neural network vision sensor, Science Advances, 6(26), 2020, eaba6173. http://dx.doi.org/10.1126/sciadv.aba6173

[17] Wang, D.; Zhang, Z.; Zhang, M.; Fu, M.; Li, J.; Cai, S.; Chen, X.: The role of digital twin in optical communication: fault management, hardware configuration, and transmission simulation, IEEE Communications Magazine, 59(1), 2021, 133-139. http://dx.doi.org/10.1109/MCOM.001.2000727

[18] Zorzi, S.; Maset, E.; Fusiello, A.; Crosilla, F.: Full-waveform airborne LiDAR data classification using convolutional neural networks, IEEE Transactions on Geoscience and Remote Sensing, 57(10), 2019, 8255-8261. https://doi.org/10.1109/TGRS.2019.2919472