





Design of Visual Teaching System for Image Visualization Based on Deep Learning

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Abstract. The education of computer graphics in teaching is mainly to make students have a systematic understanding of the subject, master the necessary theoretical knowledge and learn the commonly used graphics generation method. Computer graphics is not only the theoretical basis for learning other computer technologies. Although some algorithms are demonstrated by animation, learners can only see the pre-made content, and can't learn according to individual requirements, so they lack interactivity. In order to improve the application effect of computer graphics visualization teaching system, this study studies the image feature detection method based on DCNN, and proves the function realization of image processing visualization algorithm through simulation experiments. The test shows that compared with the traditional algorithm, the improved DCNN model in this study shows higher feature detection accuracy and efficiency in image visualization simulation. Visualization of computer images can greatly facilitate users to understand and improve their work efficiency, and greatly promote the rapid development of computer-aided instruction (CAI).

Keywords: Image Visualization; Computer-Aided Instruction; Deep Learning; Feature Detection

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1 INTRODUCTION

Vision is the most important perception of human beings, and the visual system helps people understand what they see around them and even their cognition of the whole world. Humans can get information and understand it through the visual system without the help of external tools. Cho and Kim [1] developed a mobile English teaching application based on a text interface for deep learning. It collects a large amount of English language data, preprocesses and standardizes it for use in deep learning models. This may include steps such as text cleaning, word segmentation, part of speech tagging, and named entity recognition. Select or develop suitable

deep learning models based on the requirements of the application. For Natural Language Processing (NLP) tasks, deep learning techniques such as Convolutional Neural Networks (CNN) and Long Short Term Memory Networks (LSTM) can be used for speech recognition and synthesis. The model is trained using collected and processed data. This may require a significant amount of computing resources and time. Integrate the trained deep learning model into mobile applications. This may involve converting the model into a format that can run on mobile devices, as well as implementing model calls and result feedback in the application. Test the application in a real environment, collect user feedback, and make necessary optimizations and adjustments based on the feedback. Computer display and computer graphics processing technology and methods are the basis of computer graphics. Computer graphics is a subject that studies the generation, processing and display of graphics by computer. Computer graphics, as a comprehensive subject, has developed very rapidly in computer science, and it is also the most widely used subject. Auditory music can be represented through graphical visualization. Graphic visualization is a technology that converts music into visual images, showcasing elements such as rhythm, melody, and harmony by converting audio signals of music into visual signals. Music visualization is an image that converts music into dynamic visual effects. It displays elements such as rhythm, melody, and harmony of music by converting the temporal changes of audio signals into shape, color, and position of dynamic images. Danchenko [2] uses these graphic visualization techniques to help people more intuitively understand the elements and structure of music. At the same time, it can also better appreciate and enjoy the beauty of music. This course is one of the important courses for computer and related majors, and its importance is reflected in the increasing demand for a harmonious human-computer interaction environment. Gresse et al. [3] used the "Ten Year System Map" to provide students and teachers with an intuitive view of the various components of machine learning, including data, features, models, training, and evaluation. This tool also provides rich interactive functions, allowing users to explore different machine learning algorithms and concepts by clicking and dragging. In addition, the "Ten Year System Map" also provides a series of teaching resources, including courses, tutorials, case studies, and practical activities, to help teachers better utilize this tool for teaching. Overall, 'Ten Year System Map' is an excellent K-12 machine learning teaching visualization tool that not only provides a comprehensive visual experience, but also provides rich teaching resources to help students better understand and apply the concepts of machine learning. The purpose of the course is to enable students to systematically acquire the necessary basic theories and commonly used graphic generation methods of the subject through learning. And master the relevant international standards of graphics software, so as to lay a solid foundation for studying other related courses and engaging in development work in the future. The visualization of its image processing can not only change the simple communication mode that people can only communicate by numbers and sounds in the past, but also realize the visualization and visualization of the communication process between people, thus making the communication between people more vivid, reducing barriers and improving the efficiency of communication.

3D printing technology enables sculptors to quickly and accurately convert designs into actual objects. Through 3D printing, sculptors can create complex shapes and structures that are difficult to complete using traditional methods. In addition, 3D printing technology also makes the production process more environmentally friendly, as most of the manufacturing processes are completed within computers, reducing actual material waste. Computers are also used as a tool for sculpture creation. Some software allows sculptors to create in a virtual environment, which not only saves materials but also makes it easy to modify and adjust designs. In addition, some advanced algorithms and design strategies can also provide new possibilities for sculpture creation. The application of computer-aided modeling design in the expression technology of sculpture art space has become increasingly widespread. Guo and Wang [4] have improved the efficiency of sculpture creation and provided more ways and possibilities for sculptors to express themselves. Visualization by image processing technology is not only conducive to the rapid development of CAI field, but also to the progress of related marginal disciplines. Therefore, the application and research of image processing visualization has far-reaching significance. The

education of computer graphics in teaching is mainly to make students have a systematic understanding of the subject, grasp the necessary theoretical knowledge and learn the commonly used graphics generation method. Computer graphics is not only the theoretical basis for learning other computer technologies. By realizing the visualization of image processing, the staff can understand the situation and the progress of the project simply and clearly, without complicated calculation, thus greatly improving the work efficiency and providing a better environment for scientific research. Human cognition of visual images is often from shallow to deep, layer by layer, for example, from the intensity of the lowest pixel to the edge, until the whole object is recognized. Inspired by this, the deep learning (DL) model simulates this visual cognitive framework. DL model can learn and extract features layer by layer. At present, the methods to realize convolutional neural network (CNN) need a lot of training data, and different model designs have great influence on the results. A deeper understanding of CNN in theory can reduce the dependence on data-driven design. In this study, the method of image feature detection based on DCNN is studied, which provides support for the construction of visual teaching system of computer graphics.

The interactive visual teaching of art courses based on intelligent classroom environment is an innovative method that utilizes advanced technological means, with schematic interaction as the core, to achieve visual teaching of art courses. This teaching method emphasizes multidimensional interaction between students and teachers, as well as between students and students, to promote the development of students' art skills and innovation abilities. The interactive visual teaching of art courses based on intelligent classroom environment is an innovative teaching method that can fully utilize the advantages of intelligent classroom environment, achieve multi-dimensional interaction between students and teachers, as well as between students and students, and improve students' art skills and innovative abilities. In the future, with the continuous development of technology, the interactive visual teaching of art courses based on intelligent classroom environments will be more perfect and popular, playing a more important role in cultivating art talents with innovative and practical abilities [5]. Ince [6] analyzed an automated intelligent content visualization system based on deep learning and genetic algorithms. The automatic intelligent content visualization system based on deep learning and genetic algorithm is a system that combines deep learning, genetic algorithm, and visualization technology, mainly used to convert a large amount of complex data into easily understandable visualization images or videos. The system receives raw data as input. These data can be in any form or type, such as text, images, videos, or sensor data. After inputting data, the system will perform necessary preprocessing steps, including data cleaning, standardization, and feature extraction. The system utilizes deep learning technology to train the preprocessed data. The selection of deep learning models varies depending on specific tasks and data types, such as convolutional neural networks (CNN) for image recognition and recurrent neural networks (RNN) for natural language processing. After deep learning model training, the system will generate visual representations such as images or videos. These visual representations can display the inherent relationships and patterns of data, making it easy for people to understand and analyze. Visual teaching is to map the data (information) in the teaching process to graphic representation or dynamic image representation. By giving full play to the functions of computer in image, sound, animation and interaction, the images of knowledge, concepts, rules and principles described in printed materials are intuitively reproduced and simulated. Although some algorithms are demonstrated by animation, learners can only see the pre-made content, and can't learn according to individual requirements, so they lack interactivity. In addition, the actual situation faced by the algorithm is ever-changing, and different input conditions have different output results. It is not convincing to describe the algorithm only with a preset situation. The visualization research of neural network, specifically the visualization research of features extracted from neural network, not only helps to understand the working mechanism of the internal structure of the network, but also has guiding significance for the research of neural network in other applications, avoiding blind parameter adjustment or trial and error. In order to promote the use of CAI in visualization teaching of iconography, this study

studies the application of DCNN in visualization teaching system of computer iconography, and makes the following innovations:

⊖ This study analyzes the design of computer image processing visualization teaching system algorithms, proposes an image feature detection method based on DCNN, and proves the functional implementation of image processing visualization algorithms through simulation experiments.

⊖ Visualization of feature mapping will strengthen the feature mapping corresponding to the convolutional filter of interest, and suppress the feature mapping corresponding to other filters in the same layer. After obtaining the modulation code, a new image is generated through the encoding inversion method, so that the filtering response of the new image in that layer is the same as the modulation code.

⊕ The generated new image has a one-to-one mapping relationship with the filter of interest, which can reflect the feature representation extracted by the filter from the input image.

This study introduces the advantages of visual teaching and implements an image feature visualization algorithm based on an improved DCNN model; The simulation experiment has proven the practicality of this algorithm in the visualization teaching system of computer graphics; Finally, summarize the research results and contributions.

2 RELATED WORK

Data visualization in Introduction to Business Statistics is a very important teaching method that can improve learning outcomes by enhancing students' practical abilities. Jones et al. [7] helped students better understand the concepts and principles of statistics through data visualization. The concepts and principles of statistics are often abstract and difficult for students to understand through words and numbers. Through data visualization, students can intuitively understand the concepts and principles of statistics through images and charts, deepening their understanding of knowledge points. Secondly, data visualization can improve students' practical abilities. Through data visualization, students can better understand the characteristics and distribution of data, thereby enabling better data analysis and processing. At the same time, students can also master some commonly used data analysis tools and techniques through data visualization, such as Excel, Python, etc., to improve their practical abilities. The application of deep learning in the field of visualization, especially in multi view visualization, is constantly developing and innovating. This technology can generate insightful and interpretive views by processing and analyzing large amounts of data, helping users better understand and solve problems. IEEE Visualization and Computer Graphics is an important academic journal dedicated to exploring the latest developments in visualization technology. Li et al. [8] explored the diversity of public users for deep learning multi view visualization. For public users, deep learning based multi view visualization can provide a more intuitive and understandable way to present complex data. In order to meet the diverse needs of public users, deep learning technology needs to be continuously developed to provide richer and more personalized visual recommendations. For example, users may want to choose specific views or interaction methods to explore their data. The IEEE Journal of Visualization and Computer Graphics provides many papers and research reports on the application of deep learning in visualization. These studies cover various topics, including new visualization algorithms, user interaction technologies, and the application of deep learning in various application fields such as healthcare, environment, finance, etc. Liu et al. [9] analyzed the Hlai ethnic village landscape design visualization system based on machine learning. Using computer vision technology, landscape features such as architectural style, vegetation type, terrain, etc. are extracted from the collected data. Using the extracted landscape features, machine learning algorithms are used to train classifiers, such as support vector machines, random forests, etc., to classify and predict different landscape types. Based on machine learning models and extracted landscape features, design a visualization system that can display the landscape of Hlai ethnic villages in real-time, and classify and filter the landscape based on different

classification results. Users can interactively explore through this system, such as zooming in, zooming out, and rotating, in order to better observe and understand the landscape characteristics and distribution of Hlai ethnic villages. Through this system, designers and planners can have a more comprehensive and intuitive understanding and mastery of the landscape characteristics of Hlai ethnic villages, providing more accurate and reliable data support for design. At the same time, this system can also provide strong technical support for the protection and inheritance of the traditional culture and historical heritage of the Hlai ethnic group. Liu et al. [10] analyzed an open source, cross platform, scientific visualization software for large-scale data. It supports various rendering techniques, including contour lines, transparency, color mapping, and more. In addition, VisIt provides a powerful graphical interface for interactive analysis and visualization of fluid dynamics data. The construction and implementation of a talent cultivation system in universities is a complex system engineering that requires comprehensive consideration of multiple factors. Deep learning and data mining algorithms can provide strong support for this process, providing scientific basis for decision-making by analyzing and mining a large amount of data. Ma and Ding [11] conducted the construction of a talent training system for universities based on deep learning and data mining algorithms. By analyzing various data of candidates, such as college entrance examination scores, comprehensive qualities, subject competitions, social activities, etc., a prediction model is constructed using deep learning algorithms to predict the admission probability of candidates and provide reference for enrollment decision-making. By analyzing various data of students, such as academic performance, attendance rate, social behavior, lifestyle habits, etc., data mining algorithms are used to discover students' characteristics and problems, timely identify and solve students' problems, and provide better services and support for students. Analyze the teaching situation, teaching quality, student evaluation and other data of teachers, use deep learning and data mining algorithms to evaluate their teaching level and work performance, and provide better career development and promotion opportunities for teachers. In summary, deep learning and data mining algorithms can provide comprehensive support and assistance for the construction and implementation of talent cultivation systems in universities, improve the quality and effectiveness of education and teaching, and make greater contributions to the cultivation of high-quality talents. Ma et al. [12] intentionally added disruptive input data using adversarial machine learning to induce erroneous behavior in the machine learning model. This type of attack can lead to serious degradation of model performance and even unpredictable consequences. Therefore, understanding and solving the problem of adversarial machine learning is very important. Visual analysis can provide an effective method to explain the vulnerabilities of adversarial machine learning. By visualizing attack samples, it can be observed how the disruptive inputs added by the attacker affect the model output. It can help us better understand the strategies and techniques of attackers. By visualizing the feature space of the model, the distribution of normal and attack samples in the feature space can be observed. This can help us identify the commonalities and characteristics of attack samples, thereby better understanding the attacker's ideas and methods. By drawing error thermal maps, we can observe the error distribution of the model in different regions. This can help us identify the weaknesses of the model and take corresponding measures to enhance its robustness. Mao [13] conducted intelligent teaching video analysis based on machine learning and virtual reality technology. Intelligent teaching video analysis based on machine learning and virtual reality technology is a system that integrates machine learning, computer vision, and virtual reality technology, aiming to automatically analyze the content in teaching videos and provide more personalized and accurate teaching services for teachers and students. Using computer vision technology to extract key features from preprocessed videos, such as teacher behavior, student performance, environmental information, etc. At the same time, target detection and recognition are performed on characters, objects, etc. in the video. It uses extracted features and object detection results, constructs classifiers and other prediction models through machine learning algorithms, and automatically analyzes and recognizes the content in teaching videos. Based on virtual reality technology, construct virtual scenes related to teaching videos, visualize the content in the videos, and provide users with a more intuitive and immersive teaching experience. Users can interactively explore

through virtual reality scenes, such as roaming, scaling, rotating, and other operations, in order to better observe and evaluate the quality and effectiveness of teaching videos. Through this system, teachers can have a more comprehensive and accurate understanding of students' learning status and needs, and provide more personalized and accurate teaching services for students. At the same time, the system can also provide strong technical support for optimizing the allocation of educational resources and improving educational quality. Pelliccia et al. [14] analyzed the applicability of 3D factory simulation software in computer-aided participatory design of industrial workplaces and processes. It was found that 3D simulation software can be used to train employees and familiarize them with new workplaces and processes. By simulating the real operation process, employees can familiarize themselves with the operating steps before actual operation, improving work efficiency and safety. 3D simulation software can help analyze and optimize the efficiency of industrial workplaces and processes. By simulating different operating conditions and parameters, the optimal operating mode and parameter settings can be found, thereby improving production efficiency and reducing costs. 3D simulation software can be used for safety assessment, identifying potential safety hazards, and taking corresponding measures. By simulating unexpected events and fault situations, potential safety issues can be predicted and handled, reducing the probability of accidents occurring. This simulation software can promote team collaboration and communication. By sharing virtual models and simulation results, different departments and teams can better understand and collaborate, jointly solve problems, and improve work efficiency. Probability theory is an important mathematical course, and for students in many disciplines, mastering the knowledge of probability theory is essential. However, due to the abstraction and complexity of probability theory, many students may find it difficult to understand and master. In probability theory teaching, an interactive learning environment that supports visualization can help students learn and understand the concepts of probability theory. Stanislav and Tadeá [15] provide easy-to-use visualization tools that enable students to easily create and manipulate probability distribution maps and probability simulations. It uses the matplotlib library in Python or other visual tools to create probability distribution maps and simulations. For example, interactive e-books or online tutorials can respond to students' actions and feedback, providing personalized guidance and explanations. Provide personalized guidance and assistance based on students' learning situation and feedback. For example, when a student completes an exercise question, the system can automatically evaluate the student's answer and provide corresponding explanations and guidance. Discrimination is an important issue in machine learning. Discrimination refers to the bias or discrimination of machine learning models towards specific groups during the classification or prediction process. This may lead to unfair results or adverse consequences. Therefore, visual analysis plays an important role in machine learning, which can help us identify and solve discrimination problems. In the IEEE Journal of Visualization and Computer Graphics, there are many papers and research reports exploring how to use visualization techniques to analyze and detect discrimination issues in machine learning. Wang et al. [16] introduced a new visualization method for detecting and solving discrimination problems in machine learning. This method uses visualization of classification boundaries to help people understand how the model makes decisions, and uses thermal maps to visualize the error rates of the model on different features. It introduces a new visualization method for detecting and solving unfairness issues in machine learning. This method uses a box chart to visualize the performance of different groups in the classification process, and uses a heat map to visualize the spatial distribution of unfairness indicators. Convolutional Neural Networks (CNN) is a deep learning model widely used in the fields of image recognition and computer vision. Understanding the working principles of CNN is crucial for learning and applying this powerful tool. Interactive visualization is an effective method that can help people better understand and master the concepts and principles of CNN. Wang et al. [17] proposed a new interactive visualization method that explains the internal working principles of CNN through rendering and animation techniques. This method can help users better understand the key operations of CNN, such as convolution, pooling, and activation. This paper proposes a comprehensive visualization method for interpreting and visualizing the decision-making process of CNN. This method helps users better understand and

trust the output results of CNN by providing detailed views and explanations within the network. These studies and papers demonstrate the important role of interactive visualization in CNN learning and understanding. By using visualization technology and interactive methods, people can gain a deeper understanding of the internal workings of CNN, thereby improving their skills and knowledge in the fields of image recognition and computer vision. Wexler et al. [18] conducted interactive exploration of machine learning models. Interactive exploration of machine learning models is an important method for non-professionals to understand complex machine learning algorithms. IEEE Visualization and Computer Graphics Trading is an important academic journal that focuses on the latest research in graphics and visualization. There are many studies on interactive exploration machine learning models in this transaction. A commonly used interactive exploration method is to use interpretive visualization. Explanatory visualization can help users understand the reasons why machine learning models make decisions, thereby better controlling and adjusting the model. For example, some visualization tools can visualize the decision boundaries of image classifiers, enabling users to better understand how the model works. Another commonly used interactive exploration method is to use interpretable machine learning models. These models use techniques to make them more interpretable, such as using simple model structures such as decision trees and rule lists to approximate complex machine learning models. Ergonomics is a key factor in cabin design, which can be optimized by establishing a human body model to simulate the behavior of passengers inside the cabin, in order to optimize cabin layout, seat design, aisle width, etc. In addition, intelligent algorithms can also be used to automatically recommend cabin layouts and seat designs that meet ergonomic requirements. Yuan and Niu [19] can use computer simulation technology to simulate the cabin environment and evaluate the performance of the cabin under different conditions. For example, fluid dynamics simulation technology can be used to predict the air flow and temperature distribution inside the cabin; Use optical simulation technology to predict the lighting effect and visual comfort inside the cabin. It utilizes advanced computer-aided design tools such as 3D modeling software and virtual reality technology to complete cabin design more quickly and accurately. For example, 3D modeling software can be used to view the 3D effects of cabin design in real-time, in order to make timely adjustments. By utilizing artificial intelligence technology, cabin design can be automated. For example, machine learning algorithms can be used to automatically generate cabin layouts and seat designs that comply with design rules based on historical design data; Through deep learning algorithms, potential problems in cabin design can be automatically identified and optimization suggestions can be proposed.

3 METHODOLOGY

3.1 The Advantages of Visual Teaching

In fact, computer graphics is how to use computers to represent graphics, and use computers to complete graphics calculation and processing, and the realization of this process needs the support of related algorithms. Visual teaching is a new teaching mode based on modern CAI or network teaching. It can make the abstract ideas that students get in the classroom sublimate through the visual teaching process, thus enlightening and deepening students' creative thinking ability. Because the graphics algorithm is abstract, difficult to understand and boring, it is difficult for learners to imagine the dynamic changes of graphics data structure from the static code executed, thus losing their enthusiasm for learning this course. The purpose of learning computer graphics is to use computer technology to present people with both aesthetic feeling and real graphics.

In order to achieve this goal, it is needed to create a suitable scene according to the requirements of graphics, and do a good job in lighting effects design under the action of some lighting models. In this process, computer graphics needs to be able to cooperate with other computer technologies. Visual teaching method can make teachers have more time to contact with each student, and also have more time to consider other issues such as curriculum design. Computer graphics involves a relatively wide range, including not only graphic hardware design,

but also animation production, virtual reality and other parts. As an important supplement to teaching, visualization teaching is a tool to extend teaching content, learning means and thinking space. Teaching is a complex two-way activity involving teachers and students. No matter what modern teaching methods are adopted, it must follow the inevitable law of cognition. Visual teaching is a new teaching mode based on modern CAI or network teaching. It can sublimate the abstract ideas that students get in the classroom through the visual teaching process, thus enlightening and deepening students' creative thinking ability.

3.2 Image Feature Detection Algorithm

In this study, an improved extraction network model is constructed by reasonably using depth separable convolution and reverse residual network to ensure the network depth and reduce the computational complexity. Combined with the three-branch network training method, the triple loss function based on exponential function and the negative sample mining strategy based on cosine distance matrix are used to train the network, so as to obtain a depth descriptor extraction method with both accuracy and time-consuming. The DCNN model of image feature detection is shown in Figure 1.

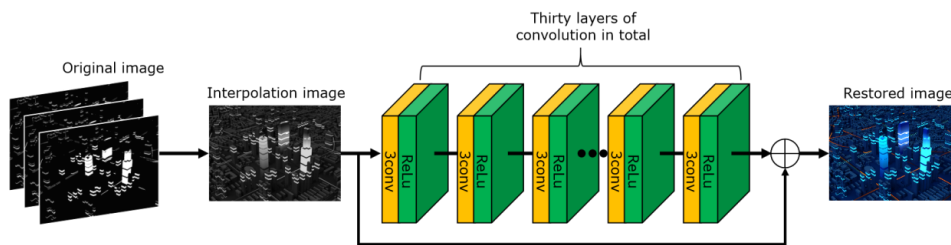


Figure 1: DCNN model of image feature detection.

In digital image processing, this is a concept of abstract representation of images. It refers to the application of computer to abstract graphic images and extract digital matrices that can represent the graphic attributes of images. The image visualization process based on computer vision is shown in Figure 2.

The function of DCNN is essentially the same as that of automatic encoder, which is to extract the features of high-dimensional data. In the automatic encoder model, the difficulty of parameter training increases with the deepening of network layers. The automatic encoder network hopes that the input will be encoded in the hidden layer and decoded in the output layer, and the output will remain the same as the input as much as possible. Usually, the size of the hidden layer is smaller than that of the input layer. After coding transformation, the high-dimensional input is mapped into a lower-dimensional hidden layer, which is the transformed eigenvalue. The automatic encoder can extract data features through this dimension reduction compression mechanism, and it is found that the correlation in the input data will be difficult to be transmitted to the front layer network due to the increase of the number of layers, which greatly reduces the training speed, and the local optimal solution of the final convergence is often closely related to the selection of initial parameters.

In addition to the direct display method, the current depth visualization methods mainly use gradient descent method and back propagation algorithm to iteratively optimize the generated image to visualize the features represented by the structure in the depth neural network, and the only difference is the visualization target and the prior information of the generated image. Given

a representation function $\Phi : R^{H \times W \times D} \rightarrow R^d$ and a target code $\phi_o \in R^d$, the depth visualization method aims to find an image $X \in R^{H \times W \times D}$:

$$\min_{X \in R^{H \times W \times D}} R_{\alpha}(X) + R_{TV\beta}(X) + Cl(\Phi(X), \Phi_o) \quad (1)$$

The loss function l represents the difference between the target coding and the coding of the generated image, and the regularization term $R_{\alpha} + R_{TV\beta} : R^{H \times W \times D} \rightarrow R_{+}$ represents the prior information of the natural image. C represents the relative weight of natural prior and target loss.

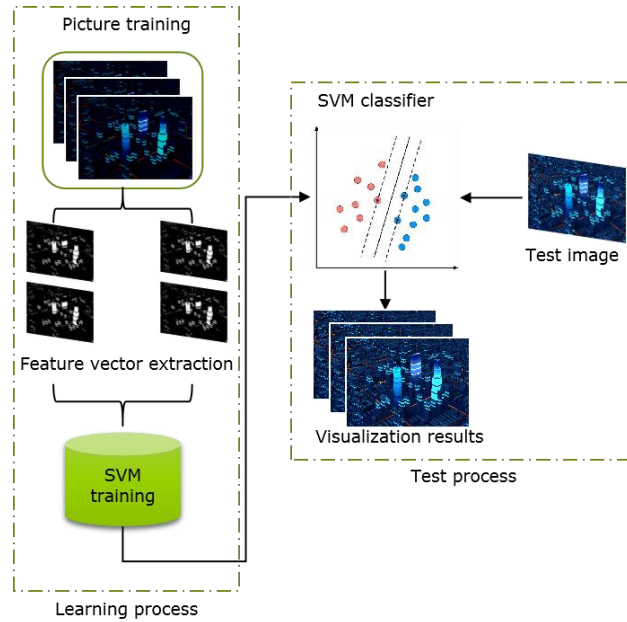


Figure 2: Image visualization process based on computer vision.

The stage of generating an image by maximum activation is like searching the area of activating the target neuron on the map by neural network, and then updating the area by optimization method to strengthen the activation degree of the target neuron, and so on until the generated image converges. The loss function is:

$$l(\Phi(X), \Phi_o) = -\frac{1}{Z} \langle \Phi(X), \Gamma(\Phi_o) \rangle \quad (2)$$

AA represents the selection and editing of the maximum active visual object of the target code. When BB indicates that only the value of one of the meridian elements is retained and the other meridian elements are 0, the gradient of the generated image mainly comes from the target neuron. The loss function of coding inversion is:

$\Gamma(\Phi_o)$ represents the selection and editing of the maximum active visual object of the target code. When $\Gamma(\Phi_o) = e_i$ indicates that only the value of one of the meridian elements is retained and the other meridian elements are 0, the gradient of the generated image mainly comes from the target neuron. The loss function of coding inversion is:

$$l(\Phi(X), \Phi_o) = |\Phi(X) - \Phi_o| \quad (3)$$

Φ_o is the feature map $\Phi(X_o)$ obtained by the target image through network mapping. If it is needed to highlight the information of the target image represented by a certain area of the visual target code Φ_o , add a mask M to the target code. The mask M can keep the region of interest of the target code Φ_o and suppress other regions. Then the loss function becomes:

$$l(\Phi(X), \Phi_o) = \frac{\|(\Phi(X) - \Phi_o) \Theta M\|}{\Phi_o \Theta M} \quad (4)$$

By limiting the pre-training parameters of Boltzmann machine and finally fine-tuning, the number of network layers of DCNN can be much larger than that of the automatic encoder network composed of classical neural networks. When there are more neurons in the hidden layer than in the output layer, by adding some regular terms to the error function of the network, such as introducing sparse structure to limit the activation degree of neurons, better feature transformation can also be obtained.

3.3 Computer Image Visualization

Visualization teaching is to fully mobilize students' audio-visual organs, so as to obtain the best cognitive effect. Visual teaching process can also be regarded as information and information carrier, that is, teaching content and teaching media. Teachers transmit information to students through the media, while students receive information through the teaching media. This system establishes a virtual grid and simulates pixels invisible to human eyes with visible points. It uses visualization technology to simulate the realization stage of the basic algorithm, difficult knowledge points and abstract concepts in animation form, and pays attention to the application of interactive control technology. When the compilation is completed, click the link to run, and you can see the drawn straight line in the client area. This example can make students who are new to graphics find that drawing straight lines is so simple. DL's PointNet network structure is shown in figure 3.

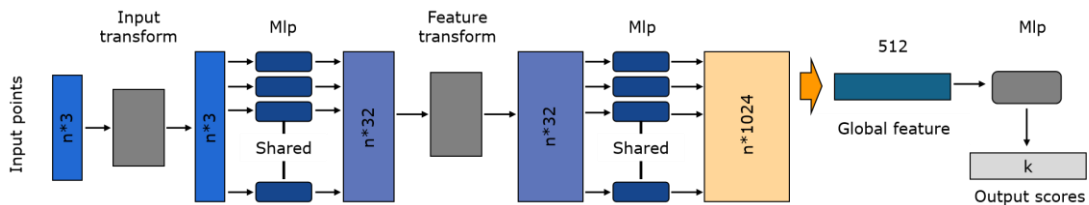


Figure 3: PointNet network structure.

In the back propagation algorithm of convolution layer, the algorithm uses the same convolution operation, but uses the convolution kernel of space inversion. In the forward propagation algorithm of pooling layer, it is needed to keep some intermediate results to avoid repeated calculation later. Generally, the fully connected feedforward neural network will be connected at the end of CNN, so it is needed to combine the back propagation algorithm of fully connected network, first calculate the error map of convolution layer or pool layer, and then iteratively update the parameters by the above algorithm until the whole network converges or reaches a certain number of iterations.

The automatic encoder network can be used to pre-train the convolution kernel in CNN. On the other hand, it can also be directly used for feature detection after slightly modifying its structure, and the features can be connected to the classifier to complete the classification task. After the training of the automatic encoder network, only the input layer and the hidden layer are kept in the network, that is, only the feature detection part is kept, the symmetrical part of the restored

input is removed from the structure, and the hidden layer is directly used as the feature as the input of the classifier. Select the following exponential loss function during training:

$$L(y, f) = e^{-yf(x)} \quad (5)$$

In which $y \in \{-1, 1\}$; f is the output value of the classifier.

Introducing a linear truncation activation unit into the first convolution layer TLU of the network;

$$TLU(x) = \begin{cases} -T, & x < -T \\ x, & -T \leq x \leq T \\ T, & x > T \end{cases} \quad (6)$$

After training the first hidden layer, only the feature detection part of the network structure is retained, and then a new hidden layer is added, and the symmetrical structure is restored to form an automatic encoder, keeping the trained parameters unchanged and only training the parameters of the newly added hidden layer. Repeat this step until all hidden layer connection parameters are trained.

It is assumed that all the training sample data can be fitted linearly without error, and the distance from the sample point to the hyperplane is less than or equal to ε as a penalty function. Because the function f is unknown, we can only use the linear regression function $f(x) = w \cdot x + b$ to fit the sample data according to the collected samples, and get:

$$\begin{aligned} y_i - (w \cdot x_i + b) &\leq \varepsilon \\ (w \cdot x_i + b) - y_i &\leq \varepsilon, \quad i = 1, 2, \dots, n \end{aligned} \quad (7)$$

SVM classification algorithm can transform the problem of finding hyperplane solution into a solution:

$$\begin{cases} \min \|w\|^2 / 2 \\ s.t. \quad y_i(w \cdot x + b) \geq 1 \end{cases} \quad (8)$$

The corresponding prediction function is:

$$f(x) = \text{sgn} \left(\sum_{i=1}^n a_i y_i \langle x_i \cdot x \rangle + b \right) \quad (9)$$

Transform the input data into a more compact or abstract representation form by artificially designing features; Then the transformed abstract representation form is sent to the classifier for training. The multi-layer learning architecture can not only learn the required transformation operations directly from the data, but also learn the classifier directly, thus avoiding the complexity of multi-step operations.

4 RESULT ANALYSIS AND DISCUSSION

Visualization goals are methods, processes, concepts and their meanings that we hope to convey by visualization. After determining the visualization goal, it is needed to explain the consistency of the visualization goal between the software designer and the user (learner). If the interpretation of visualization goals is different, it will produce completely different effects in visualization mapping. To complete the image style transfer, we must first train a CNN, extract the content features and style features from the input image to be converted and the style image respectively, and cut the

images to the same size before extracting the features. The specific training loss of the algorithm is shown in Figure 4.

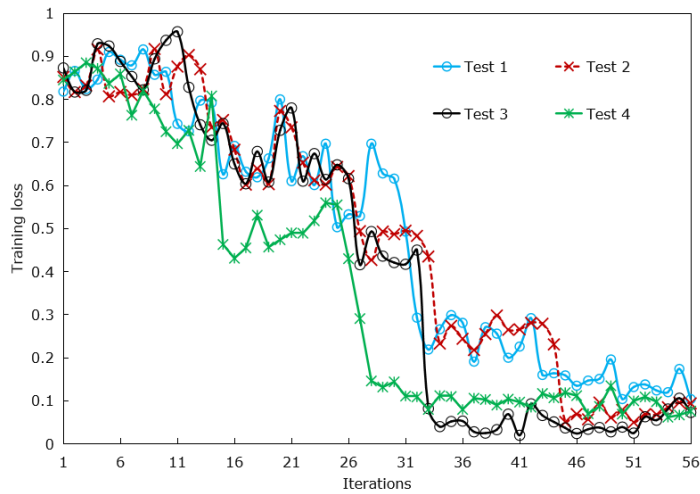


Figure 4: Training loss of algorithm.

When running a visual algorithm program, the algorithm features and program functions can be dynamically displayed on the screen in a graphic way due to the incomprehensible data structure in the program, thus deepening the user's understanding and understanding of the program behavior and accurately understanding and analyzing the logical meaning and function reflected in the program execution process.

For the classification problem, it can be predicted that the output of the last layer of the network is an advanced feature with strong stability and semantics. Therefore, the effects expressed by different layer features are different. The output result of image visualization using traditional SVM algorithm is shown in Figure 5. The output result of image visualization using the improved DCNN algorithm is shown in Figure 6.

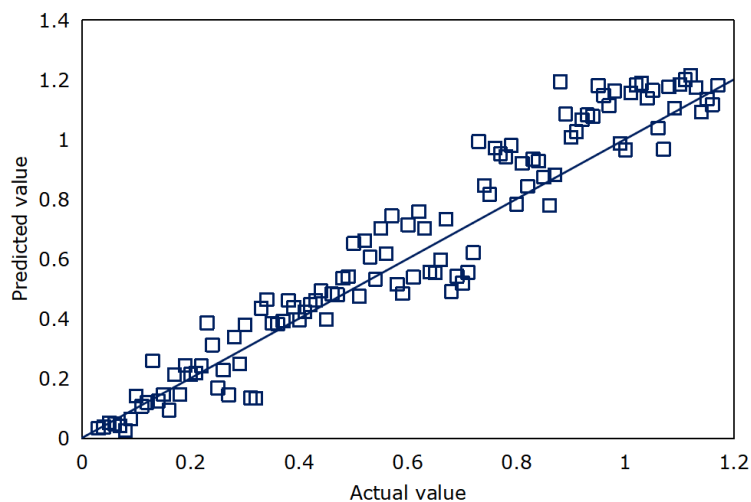


Figure 5: Accuracy test results of traditional SVM algorithm.

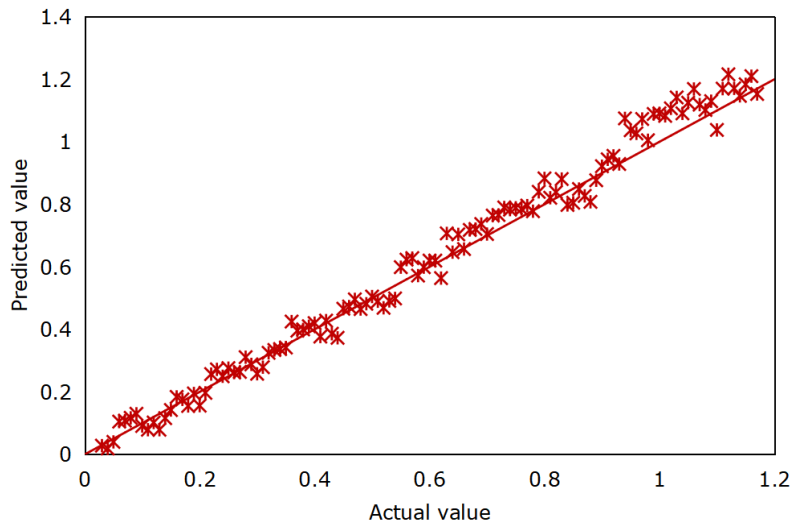


Figure 6: Accuracy test results of improved DCNN algorithm.

The improved DCNN algorithm has more advantages than SVM algorithm in accuracy in image visualization simulation test. There is an important assumption in the realization of image style transfer. If two pictures have the same feature expression, it can be inferred that the two pictures themselves are similar. Therefore, the measurement index of image content can be described by the similarity of feature expression of two pictures.

The design of visual objects also emphasizes interactive control, and users can choose different algorithms, modify the radius and adjust the demonstration speed. Figure 7 shows the running time comparison of the generated countermeasure network, the traditional SVM algorithm and the proposed algorithm.

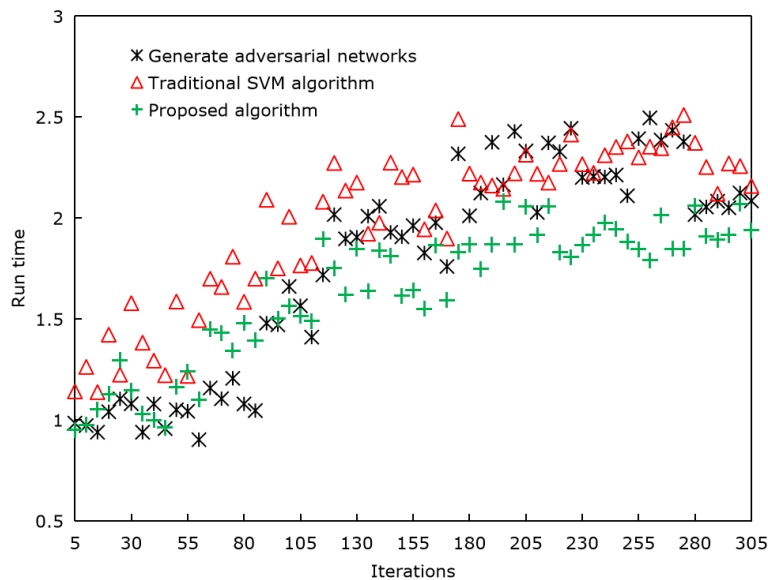


Figure 7: Comparison of running time of algorithms.

Compared with the traditional algorithm, the improved DCNN model in this study shows higher running efficiency in image visualization simulation. Visualization technology is used to simulate the realization process, difficult knowledge points and abstract concepts of iconography algorithm in animation form. With interactive control technology, learners can modify parameters and adjust the demonstration speed for different algorithms. This teaching system is designed to help learners understand the generation principle of graphics in the computer and master the algorithm of graphics generation in the computer. Visual teaching can improve the efficiency and quality of educational information transmission in a limited time, and enable students to obtain various representations by various perceptual means in classroom teaching, thus enriching their imagination, promoting the formation of creativity, improving learning efficiency and teaching effect, and expanding students' information content.

5 CONCLUSIONS

Visualization technology can transform the data and results of scientific calculation stage into geometric figures and image information for display and interactive processing on the screen. Visual teaching is to map the data (information) in the teaching process to graphic representation or dynamic image representation. Visualization by image processing technology is not only conducive to the rapid development of CAI field, but also to the progress of related marginal disciplines. This study studies the application of DCNN in the visualization teaching system of computer graphics, and puts forward a visualization method based on category activation mapping, which provides support for the construction of the visualization teaching system of computer graphics. The test shows that compared with the traditional algorithm, the improved DCNN model in this study shows higher feature detection accuracy and efficiency in image visualization simulation. In the existing visualization framework, the pre-processing of images can also improve the display effect; Segmentation of volume data set can reduce the processing area of reconstruction algorithm; Denoising the image can not only improve the quality of the generated image, but also ensure the quality of the later model.

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