The Application of CAD Technology in the Teaching of Ceramic Art Design

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Abstract. With the continuous development of computer hardware equipment, computer-aided design (CAD) technology has been widely used in various fields due to its unique visualization advantages. Ceramic art education is different from the teaching of other disciplines, it needs to show the image characteristics of ceramic art to require students and teachers to understand. However, the traditional book teaching mode is difficult for students to truly understand the content of ceramic art and the characteristics of ceramics. It is also easy for students to lose interest in learning and reduce learning efficiency. If computer-aided design technology is applied in the teaching of ceramic art, it can not only visualize the shape and other intentional features of the ceramic itself, but also improve students' learning efficiency and deepen their understanding of ceramic art. In this study, the ceramic art teaching system was designed and researched by combining computer-aided design system and deep learning algorithm. The research results show that the computer-aided system not only effectively improves the students' acceptance of ceramic art courses, but also the deep learning method is suitable for ceramic art teaching, and the accuracy rate is within 3.3%. The study of this computer-aided design teaching mode is valuable and meaningful for the teaching of ceramic art.

Keywords: Ceramic Art; Computer-Aided Design; Deep Learning; Education System
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1 INTRODUCTION

Ceramic is a kind of porcelain invented by working people in the long-term labor and life. It has a history of tens of thousands of years, and it has also changed the way of life of human beings. With the continuous development of ceramic technology and historical accumulation, it has

gradually become a work of art, it is also a way of people emotional edification. At the same time, China education model has shown diversification, such as music, art and so on. People do not blindly single-minded pursuit of mathematics, Chinese and other disciplines of knowledge, people began to pursue the spiritual sustenance. Ceramic Art is one of the disciplines with historical flavor and art appreciation level. But ceramic art is different from other disciplines of knowledge, so subject art has emotional consciousness, it needs people spiritual experience and the use of professional knowledge to judge. The traditional ceramic teaching mode only relies on the textbook knowledge and the courseware content to carry on the instruction to the students, this kind of teaching mode is tedious and inefficient. For ceramic art teaching, this approach is more difficult for students to accept the potential value of ceramic art compared to other disciplines. Therefore, it is the key of imparting the emotional knowledge and historical information contained in ceramic art to find a method suitable for ceramic art teaching.

CAD technology is a new educational mode which combines computer technology with teaching mode. This educational mode has broken the traditional book teaching mode. This method not only can teach the content to the students by audio-visual way, but also can improve the students' classroom interest and attention [1]. The ceramic art teaching class itself is a relevant class with emotional knowledge and historical information. Vision and hearing are the key to the success of this class, which is different from other disciplines. If CAD technology can be combined with the ceramic art classroom, this teaching mode will not only learn the definition of ceramics and the knowledge related to ceramics through the knowledge of the text. It can also transmit the patterns and historical information contained in ceramics to students through CAD technology [2]. Ceramic technology has been promoted all over the world. Due to its wide application and historical value, more and more students have carried out ceramic art education. Finding a suitable ceramic art teaching method is also the key to imparting knowledge of ceramic art, which can make people have a deep impression on ceramic art. CAD technology will visually display the content of the courseware prepared by teachers with the help of computer equipment and display equipment, and can also display the audio information of ceramic art, which is beneficial to the ceramic art course.

The purpose of this research is not only to use CAD technology to display the courseware of the ceramic art classroom, but also to realize the intelligent education mode of the CAD ceramic art teaching mode designed in this research. The intelligent teaching mode requires CAD technology to interact with students, which further improves students' understanding and interest in ceramic art, because it can automatically match students' performance and the ceramic content of courseware to other information from the Internet. Information on ceramic art. The improvements of computer hardware and the rapid development of deep learning methods have made this research program possible.

2 RELATED STUDIES

The Rhino software has been widely used in the teaching of ceramic art design. Hu et al. [3] studies the application of polymer materials in ceramic artworks. He uses 3D printing technology to refine polymer materials into the injection molding process. He believes that ceramic products that integrate modern styles and polymer materials enrich the connotation and visual tension of ceramic artworks. Li and Alkathir [4] believe that ceramic murals are an art that transcends the dimension of time and space. He uses computer vision technology to study the concept and form of ceramic murals, and at the same time analyzes the design principles of ceramic murals based on computer vision technology. At the same time, the graphics and colors of ceramics are analyzed. He believes that computer vision technology is conducive to the development of ceramic art. Cetinkaya et al. [5] used questionnaires and experimental methods to study the cognitive activities of the elderly in nursing homes for ceramic art products. The content mainly includes simple mental state examination and life satisfaction after owning ceramic art products. The results showed that ceramic art products and art therapy had a positive effect on improving cognitive level and quality of life in older adults. Yates and Szenasi [6] mainly studied the relationship

between ceramic art and children's growth. He believes that ceramic art has a strong cultural and historical connection. The results showed that children's life experience and popular culture were influenced by ceramic art. Wang et al. [7] designed a ceramic online automatic detection and defect detection method combined with computer vision technology. The hardware equipment of computer vision system can obtain ceramic images in real time and carry out intelligent control. This research provides a technical reference for ceramic image acquisition in CAD and ceramic art teaching. Avram et al. [8] combined CAD technology and CAM technology to study the micro angle of ceramics and image acquisition and observation. He obtained that CAD technology can better reflect the image of ceramics. Through the above literature review, we can see that ceramic art has an important impact on all aspects of people's life, but there are few methods to combine CAD technology and ceramic art teaching.

This paper mainly designs a set of intelligent algorithms and teaching modes based on CAD technology and ceramic art teaching courses. First of all, CAD technology will change the traditional ceramic art teaching mode. It will display ceramic art to students in the form of images or videos. At the same time, this system will also realize intelligent art classrooms. This method will improve students understanding of ceramic art and their interest in learning. This paper is mainly divided into five parts. The application of CAD technology in ceramic art teaching classroom will solve the problem that students cannot recognize the emotional information and historical information contained in ceramic art. It will display relevant ceramic information to students in audio-visual mode. The first part mainly explains the defects of ceramic art teaching mode and the application status of CAD technology in ceramic art teaching. The second part mainly introduces the significance and value of CAD technology and intelligent algorithm in ceramic art teaching. The third part explains the system design and intelligent algorithm of the combination of ceramic art teaching and CAD. The fourth part introduces the feasibility and accuracy of the combination of CAD technology and ceramic art teaching and the application of intelligent algorithms in ceramic art courses. The fifth part is the summary part of the article.

3 THE SYSTEM DESIGN AND ALGORITHM INTRODUCTION OF CAD TECHNOLOGY AND INTELLIGENT ALGORITHM COMBINED WITH CERAMIC ART TEACHING

3.1 Artificial Intelligence Method for Facial Expression Recognition

The CAD-assisted ceramic art teaching system designed in this research mainly includes two processes: CAD technology to display ceramic art and intelligent algorithm to realize the interaction of ceramic art classroom. This kind of system can not only change the defects of traditional book teaching mode, but also it can realize the intelligence and interaction of ceramic art classroom. With the development of the uses and types of ceramic technology, ceramics are not only daily necessities [9], but have been derived into a kind of artistic value rich in emotional information and historical charm information. The shape, pattern, material, etc. of ceramics are all concrete manifestations of emotional information and historical information, which cannot be achieved through book knowledge alone in traditional ceramic art courses. CAD technology can reflect the pattern information and historical information contained in ceramics through images, audio, etc., which is more vivid and specific. If it only relies on the combination of CAD technology and ceramic art, it also lacks classroom interaction. This research combines intelligent algorithms with CAD technology and ceramic art to realize the interactive and intelligent teaching of ceramic art [10].

If the interactive nature of ceramic art teaching is to be realized, the hardware equipment of CAD technology is required to accept information such as student behavior information and courseware information in ceramic art teaching, which is the basis for the intelligence of ceramic art teaching practice. The CAD-assisted ceramic art teaching system can be equipped with cameras and recording equipment, which will be used to collect student behavior information and ceramic art courseware content, which is the data basis for intelligent algorithms to match Internet information. The data collected by the CAD-assisted ceramic teaching system will be used for

intelligent processes such as learning and prediction in the computer of the CAD system. This intelligent algorithm can match the relevant ceramic art information needed in real time according to the performance of the students and the content of the ceramic art taught by the teacher, and it will be transmitted to the students and teachers through the CAD auxiliary system.

Figure 1: The design process of CAD-assisted ceramic art teaching system.

The Figure 1 shows the workflow of CAD combined with ceramic art teaching classroom and intelligent algorithm. First of all, the camera equipment and recording equipment carried by the CAD auxiliary system will collect the behavior information of the students in the ceramic art class and the courseware of the ceramic art course, and then the collected data will be processed into the intelligent algorithm processing stage, and finally the ceramic art courseware and interactive ceramic art courseware will be displayed. The unique ceramic art courseware will be displayed to students and teachers through computer CAD technology. From Figure 1, it can be clearly seen that in order to realize this set of ceramic art teaching mode, the realization of intelligent algorithm is the key. Because CAD technology is already a relatively mature hardware device, the feasibility and accuracy of intelligent algorithms are the keys to affecting this ceramic art system. Therefore, this research focuses on the intelligent algorithm of CAD-assisted ceramic art course.

3.2 The Introduction to Intelligent Algorithm of CAD-assisted Ceramic Art Teaching Method

The CAD technology has been used in the teaching field of many subjects, and it has achieved good results, both students' interest in learning and learning efficiency have been improved. However, the realization of the systematic intelligent algorithm of the CAD-assisted ceramic art teaching course designed in this research is a key step. Since the information collected by CAD technology mainly includes student behavior information and ceramic art courseware information, thia information have obvious spatial and temporal characteristics. In one course, the patterns, audio-visual techniques, etc. displayed in ceramic art are closely related to time. And there is a clear time relationship between students' behavior information and time. Therefore, this paper chooses the ConvLSTM algorithm as an intelligent algorithm for CAD technology-assisted ceramic art teaching. The camera equipment and recording equipment of the CAD-assisted ceramic art teaching course are the hardware equipment required for the ConLSTM algorithm to collect data.

The convolutional neural network method has been widely used in the field of image recognition, but its advantage lies in the efficient extraction of spatial features. Long short-term memory neural network technology has been widely used in the field of speech recognition, but it only has obvious advantages in processing temporal features. The advantage of the ConLSTM algorithm is that it converts the dot product operation of the long short-term memory recurrent neural network into a convolution operation. It can not only deal with the temporal characteristics of ceramic art courses, but also can well deal with the spatial characteristics of ceramic art teaching courses, such as Ceramic artwork shapes, patterns, student behavior information, etc.

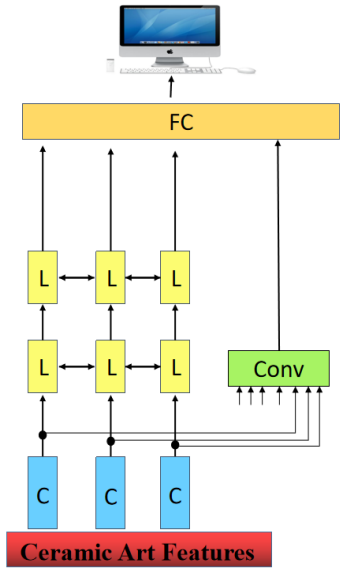

Figure 2: The Intelligent Algorithm of CAD-assisted Ceramic Art Teaching Method.

The Figure 2 shows the intelligent algorithm required by CAD technology to assist the ceramic art course, through which it can be seen intuitively that the intelligent algorithm will process the spatial and temporal characteristics of ceramic art information at the same time. The main body of ConLSTM uses the time processing capability of the long-short-term memory neural network, the difference is that the dot product operation is converted into a convolution operation. The main spatial information collected by the CAD technology-assisted ceramic art teaching system mainly includes the pattern and shape of ceramic products, and it will pass the convolution operation and nonlinear operation of the intelligent algorithm. The student behavior information collected by the CAD-assisted system and the temporal characteristics contained in the ceramic products will be processed by the memory unit. The ultimate purpose of this algorithm is to automatically match the ceramic art features with the ceramic art information from the Internet, so as to complete the interaction and intelligence in the ceramic art teaching. This ceramic art information will eventually be displayed to the students and teachers through the CAD auxiliary system. The existence of intelligent algorithms can not only display ceramic art to students through CAD technology, but also display ceramic information related to ceramic art courses to students in real time.

3.3 The Preprocessing Process of Ceramic Art Information Data

The ceramic art teaching course mainly studies and analyzes the emotional information and historical information of ceramics according to the shape, pattern and material of ceramics. However, these data of ceramic art products will not be directly input into the intelligent algorithm

through the CAD system, because there are obvious differences in characteristics and large differences in magnitude between these data. This will affect the weight distribution and prediction accuracy of the intelligent algorithm, which requires preprocessing of the ceramic-related data collected by these CAD technologies. The preprocessing method of the data of these ceramic art products can not only improve the accuracy of prediction, but also it can facilitate the distribution of intelligent algorithm weights to accelerate the convergence speed. The Figure 3 shows the method of data preprocessing in detail. The methods of data preprocessing include standardization processing method, normalization processing method and maximization processing method. According to the characteristics of the ceramic art product data itself, the standardized processing method is selected to process the ceramic pattern and shape information in this paper. It processes these data into data in the same interval and data in the same distribution. If the data of ceramic art products are directly input into the intelligent algorithm, it will produce the phenomenon of uneven weight distribution. The direct result of this situation is that only the feature prediction for one type of ceramic is more accurate, and other features will produce larger errors.

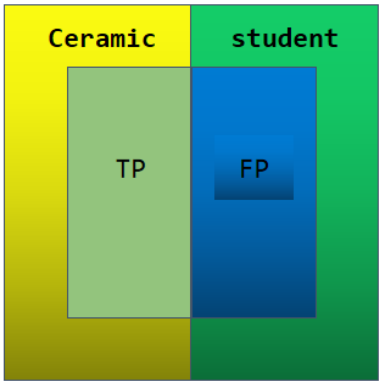

Figure 3: The method of data preprocessing.

4 RESULTS AND DISCUSSION

4.1 The Feasibility and Accuracy Analysis of Intelligent Algorithms

The CAD-assisted ceramic art teaching system mainly includes two workflows. First of all, this paper analyzes the data of ceramic art data and student behavior information collected by cameras and recording equipment equipped with CAD technology.

The Figure 4 shows the distribution of data information collected by CAD technology through hardware equipment. It can be seen that the proportion of four different ceramics and student behavior information is relatively uniform. The largest proportion of data is 27.2%. This part of the data comes from the material characteristics of ceramics, which is easier to collect than other data. The smallest proportion of data has also reached 22.1%, and the proportion of this part of the data is also smaller than the characteristics of other ceramics. Such a data proportion distribution is conducive to the uniform distribution of the weights of the intelligent algorithm. The good distribution of data collected in the first part of the CAD-assisted ceramic art teaching system will also ensure subsequent intelligence.

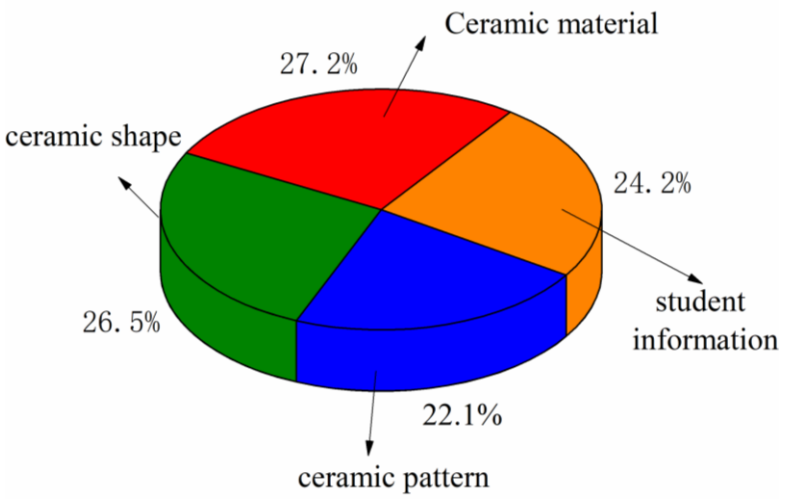

Figure 4: The data distribution of CAD-assisted ceramic art collection.

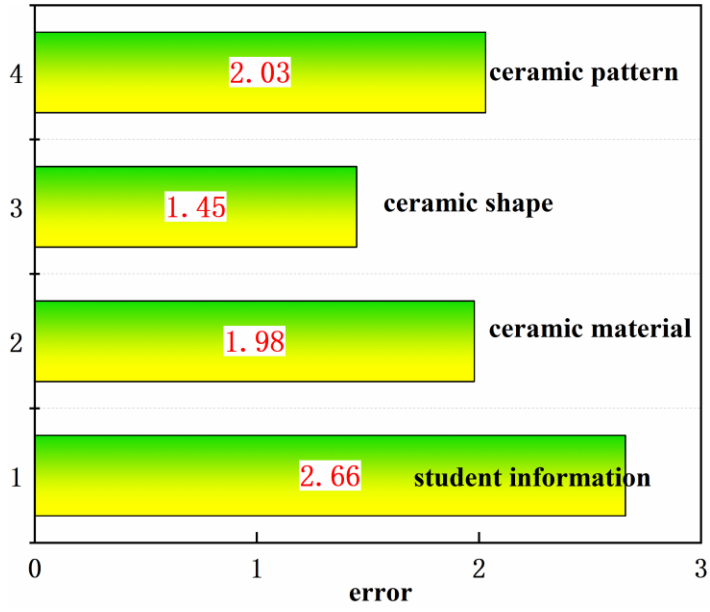

Figure 5: The prediction error of intelligent algorithm in CAD-assisted ceramic art teaching.

When the CAD auxiliary system collects the characteristics of ceramics and students course performance through camera equipment and recording equipment, these data will be input to the intelligent algorithm on the CAD side for learning and prediction. The Figure 5 shows the prediction error of the intelligent algorithm of the CAD-assisted ceramic art teaching system. It can be clearly seen that the prediction error is all within 3%. These errors are sufficient for the teaching of ceramic art. The largest prediction error is 2.66%. These errors come from the behavioral performance of the students in the ceramic art class. Although this study adopts an intelligent algorithm with processing time characteristics, the error is still relatively high for the characteristics with strong time characteristics such as behavioral information. Large, but this error is still acceptable for ceramic art teaching. The smallest error is only 1.45%, which shows that this

intelligent algorithm is trustworthy enough to predict ceramic art teaching. For the prediction of ceramic shape and ceramic pattern, the error is about 2%. This is because the material of ceramics and the shape of ceramics change relatively little, and the emotional information and historical information displayed by ceramics through patterns and shapes are relatively fixed. Therefore, this part of the error is relatively small relative to the student behavior information. The material change of ceramics is smaller, which leads to the smallest prediction error. If we want to improve this part of the error, we need to increase the proportion of data on student behavior information.

4.2 The Statistical Parameters Predicted by CAD-aided Ceramic Art Teaching System

The research on ceramic art teaching is mainly about the pattern and shape of ceramics, because the pattern of ceramic products can often reflect more emotional sustenance and historical information, and the shape of ceramics can reflect ceramic products of different eras. Figure 6 shows the prediction error distribution of ceramic patterns and ceramic shapes, it can be clearly seen that the prediction errors are within 3%, and most of them are also distributed within the range of 1.5%. It is more intuitively illustrates the feasibility of intelligent algorithms in CAD-assisted ceramic art teaching. The prediction error distribution range of the shape of the ceramic is relatively small compared to the pattern of the ceramic, which shows that the prediction of the pattern of the ceramic is more difficult, because the types of the pattern of the ceramic are various, which also affects Predictions for the teaching of ceramic art. The predicted distribution range of ceramic patterns is large, which may be caused by the uneven distribution of ceramic pattern data collected by the CAD-assisted ceramic art teaching system, but this error is also within an acceptable range.

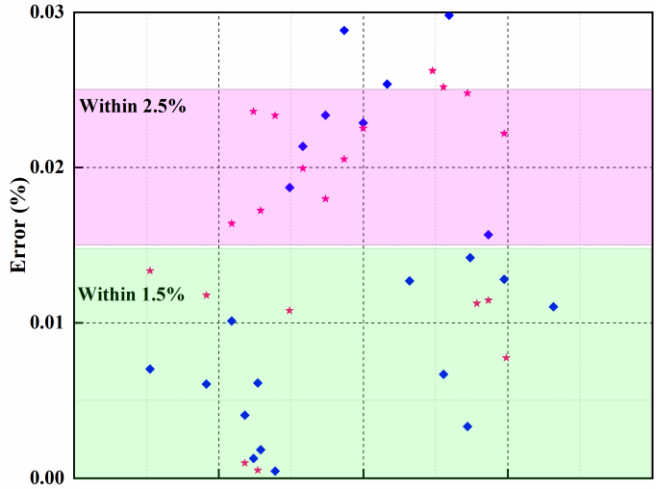

Figure 6: The prediction error distribution of ceramic pattern and shape part data.

The ceramic patterns will be taken out separately for prediction accuracy analysis, which can more intuitively see the prediction accuracy of each ceramic pattern. Figure 7 shows the distribution of predicted values for ceramic patterns versus actual ceramic pattern data. Although the error of the ceramic pattern is large, the difference between the predicted value and the actual data value is relatively small. In this paper, 30 groups of ceramic pattern information are selected for comparative analysis, and the trends among them are also in good agreement. The intelligent algorithm of the CAD ceramic art teaching system can generally meet the prediction of ceramic patterns, but its top 10 groups have relatively large differences, which may be due to the relatively rare ceramic patterns, which leads to the CAD hardware system. Less pattern data is collected, which can solve this part of the larger error by collecting more ceramic patterns.

The Figure 8 shows the box distribution of the predicted value and the actual value of the ceramic pattern, which is to further demonstrate the feasibility of the intelligent algorithm in the CAD-assisted ceramic teaching system. It can be seen from Figure 8 that the distribution of the predicted box of the ceramic pattern is relatively consistent with the box distribution of the actual data, and the distribution and size of the data are also in good agreement. This shows that the intelligent algorithm is reliable in predicting the characteristics of ceramic patterns. However, the predicted value of the ceramic pattern is larger than the actual ceramic pattern data and the average value. In the follow-up research, the CAD-aided system needs to extract more ceramic pattern data.

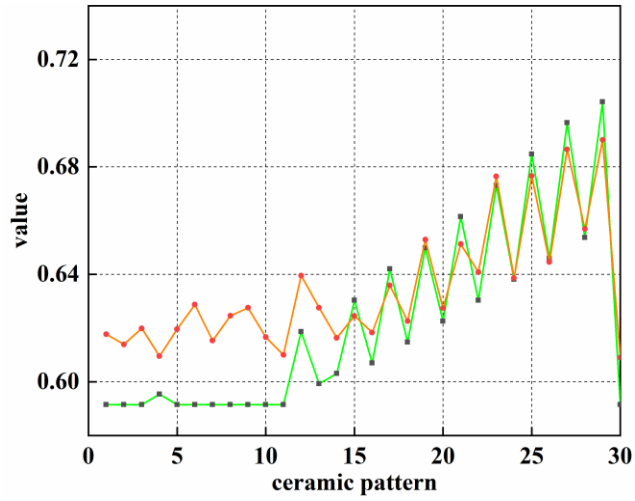

Figure 7: The distribution of predicted data and actual values of ceramic patterns.

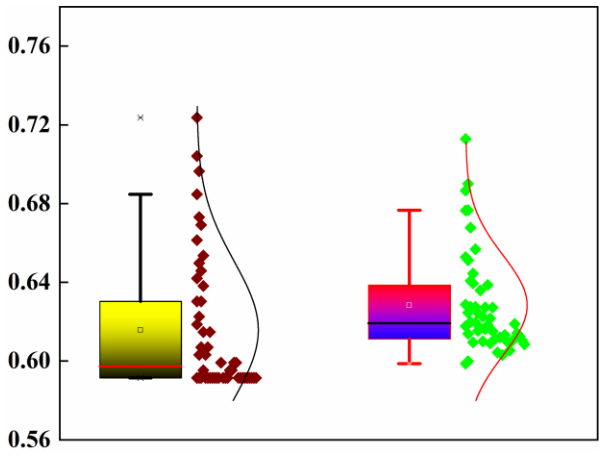

Figure 8: The box plot distribution of predicted and actual values of ceramic patterns.

5 CONCLUSION

Ceramic art teaching is a subject with emotional information and historical information, which is different from the characteristics of subjects such as English and mathematics. The traditional book teaching mode is difficult for students to truly understand and appreciate the emotional and historical information contained in ceramic art. CAD teaching aid system has been widely used in

other disciplines, which is also suitable for ceramic art teaching system. This research mainly designs the system by combining computer-aided design system and ceramic art teaching, and it also introduces an intelligent algorithm to realize the interaction and intelligence in ceramic art teaching. First, the data distribution of ceramic feature information and student behavior information collected by the hardware equipment of the CAD-assisted ceramic art teaching system designed in this study is relatively uniform. The largest proportion has reached 27.2%, and the smallest proportion has also reached 22.1%, which is conducive to the weight distribution of intelligent algorithms. The second step of the CAD-assisted ceramic art teaching system is the intelligent algorithm to predict the ceramic pattern and student information. The prediction error is also within the acceptable range, and the maximum error is only 2.66%. At the same time, the data characteristics of the ceramic pattern and the shape of the ceramic are in good agreement with the actual ceramic pattern information, and its trend is also well predicted. The CAD-assisted ceramic art teaching system designed in this paper can not only realize the collection of ceramic pattern, shape and other information, but also can accurately predict the ceramic pattern.

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