# Colour Matching Algorithm in Artificial Intelligence-based Chinese Painting Teaching

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**Abstract.** This article seeks to investigate the utilization of computer-aided AI (Artificial Intelligence) in teaching Chinese painting colour matching, aiming to enhance teaching efficiency, innovate methodologies, and perpetuate the art of Chinese painting. To accomplish this objective, the article develops a colour-matching model leveraging DL (Deep Learning) and integrates it into a computer-aided Chinese painting teaching platform. In the process of analyzing the colour characteristics of Chinese painting in the model, the compilation of colour features and personalized feature analysis of the model was designed and executed. In the process of quantitatively analyzing the benefits of colour learning, both learning progress and work quality have improved. Meanwhile, in the process of comparing algorithms, the colour-matching algorithm used in this article is clearly more innovative. In the process of analyzing the effectiveness of student diversity, diverse works highlight the practical value and artistic form of Chinese painting art.

**Keywords:** Chinese Painting; Colour Matching; Deep Learning; Computer Assisted Instruction
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## 1 INTRODUCTION

With the continuous development of printing technology, computer-direct plate making, computer-direct printing, and digital proofing have emerged and been put into use. After explaining why colour matching is necessary, why colour gamut matching is necessary, and the importance of colour matching. When a colour image is copied from one medium to another, it is necessary to find a matching method between them because each medium has a different colour gamut. Finally, a specific comparative study was conducted on some existing colour gamut matching algorithms, analyzing their advantages and disadvantages and selecting the colour gamut matching algorithm with relatively better accuracy and matching stability [1]. This makes colour-matching issues increasingly prominent, and colour gamut matching, as a fundamental functional part, is essential. In addition, with the popularity of digital cameras and the increasing prevalence of colour reproduction methods, more and more amateur enthusiasts are also getting involved in or exposed to colour reproduction. It introduced the basic principles and workflow of colour matching, followed by a certain introduction to the content related to colour gamut matching. The brightness compression method has been improved to enhance its matching accuracy, and the superiority of the improved algorithm has been verified through experiments. If such a colour gamut matching algorithm can be applied to automatic colour reproduction systems, it is considered to have a certain degree of stability [2].

Especially based on the recognition and application of traditional Chinese colours, while incorporating considerations of colour visual aesthetics. Integrating interactive genetic algorithms into the algorithm, through continuous iterative optimization, improves the accuracy and innovation of colour matching. By analyzing the interval fitness values through grayscale analysis, key information during the population evolution process is extracted to guide the direction of algorithm evolution. Based on the collected colour preference data, factor analysis techniques are used to extract key factors that affect colour selection in Chinese painting, such as "harmony", "contrast", "saturation", etc [3]. In algorithm design, a fitness function combining subjective image evaluation and objective visual aesthetic analysis is introduced. The subjective evaluation uses interval numbers to represent learners' preferences and uncertainties, while objective analysis is based on quantitative indicators of colour visual aesthetics. Based on the above analysis, develop an artificial intelligence-based colour-matching algorithm. This algorithm can automatically analyze user input Chinese painting sketches or theme requirements, and generate colour-matching schemes that conform to traditional Chinese aesthetics and learners' preferences based on colour factor analysis and visual aesthetic quantification results [4].

With the rapid development of the times and technology, the position of comprehensive artistic quality in the overall development of individuals is increasingly prominent, becoming an indispensable part of the modern education system. This algorithm can analyze the harmony, contrast, and emotional expression effects of different colour combinations in the picture, providing students with scientific colour-matching suggestions. However, in current Chinese painting teaching, colour matching often relies on the teacher's personal experience and intuition, lacking systematic and scientific guidance [5]. At the same time, algorithms can dynamically adjust colour teaching plans based on students' learning progress and preferences, achieving personalized teaching. Through intelligent cloud service technology, the teaching data of colour-matching algorithms can be collected, transmitted and analyzed in real-time, providing data support for teaching decisions. Given this, the study combines the "colour matching algorithm in computer-aided artificial intelligence Chinese painting teaching" with an intelligent classroom environment and proposes an innovative pattern interactive visual teaching mode, aiming to optimize colour teaching and enhance students' artistic literacy and innovation ability [6]. Firstly, based on traditional Chinese colour theory and modern colour psychology, combined with deep learning technology, a colour-matching algorithm specifically designed for Chinese painting teaching has been developed. Especially in the traditional art field of Chinese painting, the use of colour is not only a technical challenge but also a key factor in artistic expression and emotional transmission. Stereo-matching technology is a necessary step in 3D reconstruction, and its accuracy directly determines the effectiveness of 3D reconstruction. Some scholars have proposed a fast and highly anti-interference step-by-step stereo-matching algorithm. This colour segmentation-based step-by-step matching technique not only obtains high-precision disparity maps but also greatly improves the matching speed [7]. Firstly, the colour segmentation results are used to calculate the matching cost function based on colour segmentation, then the traditional non-parametric transformation process is weighted, and finally, these two matching cost functions are fused to form a joint matching cost function. From the perspective of balancing stereo matching accuracy and speed, and improving matching robustness, the disparity search strategy and similarity measurement function of stereo matching are taken as the center. However, stereo matching technology faces the challenge of balancing accuracy and speed, and the matching accuracy is easily affected by noise and lighting changes, making it difficult to quickly obtain high-precision disparity maps [8]. Therefore, stereo-matching technology is also one of the difficulties in the field of vision and is highly favoured by scholars at home and abroad. Starting from the perspective of stereo matching disparity search strategy, colour segmentation is introduced into stereo matching technology. Some studies have proposed a disparity constraint method based on colour segmentation and a disparity search strategy that matches disparity in a certain range step by step [9]. Based on studying various stereo matching, colour segmentation and non-parametric transformation are introduced into region-based matching algorithms. Firstly, the mean shift algorithm is used to segment the image, and initial matching is performed using segmentation regions of any size and shape as support windows to form disparity constraints. Lastly, the research is summarized, emphasizing its contribution to computer-aided art and education, and future research directions are outlined [10].

The novelty of this article lies in several aspects: firstly, applying DL technology to Chinese painting colour-matching teaching, realizing the fusion of traditional art and modern science and technology; secondly, constructing a personalized colour-matching model that offers customized teaching suggestions based on students' characteristics and needs; and finally, validating the model's effectiveness through practical teaching applications, providing novel ideas and methods for computer-aided art education.

## 2 RELATED WORK

Artificial intelligence, as an emerging interdisciplinary field, has made significant progress in recent years. Among them, deep learning technology has made breakthrough progress in fields such as image recognition and natural language processing with its powerful data modelling and feature learning capabilities. DL has achieved automatic extraction and efficient processing of complex data by simulating the structure and function of human brain neural networks, providing new possibilities for computer-aided education and artistic creation. CAI, as a new educational model, has gradually penetrated into various disciplines. Yang et al. [11] have brought innovation to traditional teaching by utilizing computer technologies such as data processing, interactivity, and personalization. In Chinese painting teaching, CAI can provide students with richer learning resources and more flexible learning methods, which can help improve students' interest and effectiveness in learning. AGIS Net separates the representation of content and style and uses a collaborative decoder to simultaneously generate glyph images and texture images. This idea also applies to colour teaching in Chinese painting. In Chinese painting, the texture of colour and ink, as well as the shape of lines, are inseparable and together form the unique style and artistic conception of the work. To verify the effectiveness of the above model, a large-scale dataset specifically designed for teaching Chinese painting colours can be constructed. This dataset should include various colour styles, stroke characteristics, and different themes of Chinese painting works, covering traditional and modern, realistic and freehand art styles. We can learn from the model structure of AGIS Net and design a model that can simultaneously consider colour matching and stroke texture generation. The local texture refinement loss in AGIS Net is crucial for improving the quality of synthesized textures. In the teaching of Chinese painting colours, subtle changes in local colours also have a profound impact on the artistic effect of the works. Then, the decoder generates Chinese painting fragments that conform to specific colour styles and stroke features. By training the model on this dataset, Yuan et al. [12] evaluated its ability in Chinese painting colour matching and generation and further optimized the model structure and parameter settings. Therefore, we can introduce similar local colour refinement losses to optimize the performance of the model in colour transitions, colour levels, and other aspects. This model is capable of receiving colour samples and stroke examples of different styles from traditional Chinese colour libraries and extracting deep features of colour and texture through an encoder. This loss function will focus on the smoothness of colour edges, gradient effects within colour regions, etc., to generate a more natural and harmonious colour layout in Chinese painting.

In the programmatic rendering process of ink painting, colour is one of the key elements, and its selection and combination directly affect the visual effect and emotional communication of the work. Through colour matching algorithms, precise transitions and gradients of colours in internal areas can be achieved, simulating the ink colour mixing effect in ink paintings. In the feature line rendering stage, in addition to paying attention to the shape and trend of the lines, the colour variation of the lines should also be considered. For example, when rendering the outline of a mountain, the colour depth and temperature of the lines can be dynamically adjusted based on the undulations of the mountain, changes in light and shadow, and the overall colour tone of the image, enhancing the three-dimensional and layered sense of the image. Colour is an important component of traditional Chinese culture and has high research and utilization value. However, most of the Yunjin colour halo has been lost. The traditional cloud brocade colour scheme has experiential and subjective characteristics. This leads to a lack of scientific and standardized standards in data research, which greatly limits its application in automatic colour matching. Zhang and Romainoor [13] first collected samples for the study of cloud brocade colour halo from cloud brocade collections and physical objects from cloud brocade weaving factories. Based on historical materials and literature, they innovatively extracted cloud brocade colour halo through tripartite mutual verification. For the first time, a systematic colour theory of cloud brocade colour halo and colour halo was conducted. The most prominent feature of Yunjin is its brilliant and harmonious colours, and the core of the colour-matching technique of Yunjin is mainly reflected in the Yunjin colour halo. Taking the study of cloud brocade colour halo as the starting point, collecting and sorting out cloud brocade colour halo and colour halo usage, digitizing colour reproduction, and then carrying out automated colour matching design and application, to achieve a new inheritance of traditional Chinese colour culture. And using image processing technology in conjunction with cloud brocade colour yarn sample cards to digitally extract the colours of various halos, and then using image processing technology to assist in colour restoration. When using noise-based algorithms to generate canvas textures, colour-matching algorithms can be combined to ensure that the generated texture colours are consistent with the overall colour tone of the image. In addition, as the camera angle changes or time passes, Zhang and Rui [14] dynamically adjust the colour distribution and brightness changes of the canvas texture through colour-matching algorithms to maintain the visual coherence and stability of the 2D appearance of the canvas.

Colour matching algorithms can identify and analyze colour application rules in ancient masterpieces, such as colour contrast, gradient, echo, etc., and then apply these rules to newly generated strokes. In the stage of style transition, we not only focus on imitating brushstrokes but also delve into the role of colour in style inheritance. In this way, even on the stroke path drawn by the users themselves, high consistency of style and harmonious unity of colour can be achieved through algorithm optimization processing. By demonstrating the real painting process and combining real-time feedback from colour-matching algorithms, Zhang and Zhao [15] can clearly see how colours change with the movement of strokes. The process of animation drawing not only allows learners to intuitively observe the generation and evolution of strokes but also provides them with a deeper understanding of colour application techniques. How to coordinate with other elements in the picture and gradually master the essence of colour matching. Learners can innovate and experiment with colours based on their personal aesthetic preferences and creative needs while mastering the basic rules of colour matching. This intuitive teaching method greatly reduces learning difficulty, improves learning efficiency, and enables learners who lack a solid foundation and skills in the field of Chinese painting to quickly get started and appreciate the charm of great painting styles. With the help of algorithms, they can easily achieve colour gradients, blends, collisions, and other effects, adding unique artistic charm to their works. In addition, colour-matching algorithms provide unlimited possibilities for artistic creation. This AI-based colour innovation method not only enriches the colour expression language of Chinese painting but also injects new vitality into the modern transformation and development of traditional art.

Currently, while DL technology has shown promise in image processing and artistic creation, its application in teaching Chinese painting colour matching remains nascent. Hence, this study aims to address this gap, investigating the potential value and practical application effects of computer-aided AI in Chinese painting colour-matching education.

# 3 CONSTRUCTION OF COLOUR MATCHING MODEL BASED ON DL

## 3.1 Data Set Preparation and Preprocessing

To build a colour-matching model based on DL, this section first prepares a data set containing a large number of Chinese paintings and their colour-matching information. These data come from the public collections of museums and art galleries, and some of them are obtained from relevant websites through web crawlers. After the original data is collected, it is preprocessed, including image cleaning (removing noise and correcting colour deviation), colour extraction (converting the colour in the image into a numerical form that can be used for model training) and data enhancement (increasing data diversity using rotation, scaling and cropping).

## 3.2 DL Model Selection and Design

In the selection of the DL model, considering the complexity and nonlinear characteristics of colour matching, this article chooses CNN (Involuntary Neural Network) as the basic model. CNN exhibits a broad array of applications and remarkable performance in image processing, effectively extracting feature information from images. To tackle the issue of colour matching, this section devises a specialized network structure (depicted in Figure 1), employing multiple convolution layers for colour feature extraction and utilizing fully connected layers for feature fusion and classification.

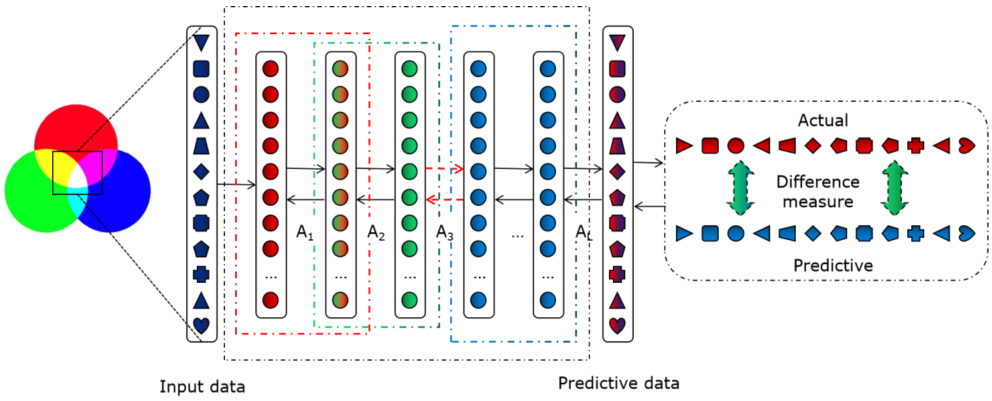


**Figure 1**: CNN structure diagram.

In model design, colour-matching feature extraction is a key step. In this article, the convolution layer is used to extract the colour blocks and colour relations in the image, and then the pooling layer is used to reduce the feature dimension and retain important information. In order to express learning, the embedding layer is used to transform colour features into low-dimensional vectors, which can represent the similarities and differences between colours. Through training, the model can learn effective colour-matching representation for subsequent colour recommendation and evaluation.

## 3.3 Model Training and Optimization Strategy

During model training, it is crucial to employ a suitable loss function to assess the discrepancy between the model's predicted outcomes and the actual colour matching. Commonly used loss functions encompass cross-entropy loss and mean square error loss.

Cross entropy loss is often used in classification problems, especially multi-classification problems. For the colour-matching problem, if it is regarded as a classification problem (for example, the predicted colour belongs to a predefined colour category), the cross-entropy loss can be used. The formula is:

$$L = -\sum_{i=1}^{N} y_i \log\ p_i \tag{1}$$

Where $N$ is the number of categories, $y_i$ is the real label (if the sample belongs to the $i$ category, $y_i = 1$, otherwise $y_i = 0$, $p_i$ is the probability that the model predicts that the sample belongs to the $i$ category.

Mean square error loss is a commonly used regression loss function, which is suitable for continuous value prediction. For the problem of colour matching, colour is predicted by RGB values, and mean square error is a suitable choice. The formula is:

$$L = \frac{1}{N}\sum_{i=1}^{N}\ y_i - \hat{y}_i\ ^2 \tag{2}$$

Here $N$ represents the number of samples, $y_i$ denotes the true value of the sample $i$, and $\hat{y}_i$ signifies the model's predicted value for the sample $i$.

The gradient descent algorithm is a common method in optimizing model performance, which minimizes the loss function by iteratively adjusting model parameters. Adam (Adaptive Moment Estimation) is a modified gradient descent algorithm that integrates concepts from both the momentum method and the RMSprop algorithm. It designs unique adaptive learning rates for various parameters by computing the first and second-moment estimations of the gradient.

The formula for updating model parameters by the Adam algorithm is as follows:

Initialization parameters:

Initialize the parameter vector $\theta$ (that is, the weight and offset of the model).

Initialize the first-order moment vector $m_0$ and the second-order moment vector $v_0$ as zero vectors (in practice, a very small number is usually used for initialization to avoid dividing by zero).

Set the time step $t = 0$.

For each time step $t = 1,2,3,\ldots,T$:

Calculate gradient:

$$g_t = \nabla_\theta J\ \theta_{t-1} \tag{3}$$

Where $J\ \theta_{t-1}$ is the loss function value under the parameter $\theta_{t-1}$.

Updating biased first-order moment estimation;

$$m_t = \beta_1 m_{t-1} +\ 1 - \beta_1\ g_t \tag{4}$$

Where $\beta_1$ is the attenuation rate, which is usually close to 1 (such as 0.9)?

Updating the biased second-moment estimation;

$$v_t = \beta_2 v_{t-1} +\ 1 - \beta_2\ g_t^2 \tag{5}$$

Where $\beta_2$ is another attenuation rate, which is usually close to 1 (such as 0.999).

Correcting the deviation of the first moment;

$$\hat{m}_t = \frac{m_t}{1 - \beta_1^t} \tag{6}$$

Correcting the deviation of the second moment:

$$\hat{v}_t = \frac{v_t}{1 - \beta_2^t} \tag{7}$$

Update parameters:

$$\theta_t = \theta_{t-1} - \frac{\eta}{\sqrt{\hat{v}_t} + \in} \hat{m}_t \tag{8}$$

Where $\eta$ is the learning rate and $\in$ is a very small number (such as 10-8) to prevent division by zero?

The Adam algorithm automatically adjusts the learning rate of each parameter by computing the exponential moving average of the gradient, encompassing both the first and second moments. Specifically, it employs first-order moment estimation to expedite convergence and utilizes second-order moment estimation to adjust the learning rate by parameter scaling, ultimately achieving independent adaptive adjustment for different parameters.

## 4 APPLICATION OF COLOUR MATCHING MODEL IN CHINESE PAINTING TEACHING

The colour-matching software consists of three parts: standard colour description files, colour-matching methods (CMM), and application software interfaces, with CMM being its core component. Colour conversion is not only a simple data calculation problem, but effective colour compression is also an important aspect of measuring the completeness of a colour-matching system. A high-quality colour-matching system should be able to compress colours by human visual characteristics while performing colour-space conversion operations. The function of CMM is to achieve colour conversion, which includes two aspects: colour space conversion and colour gamut matching. The mismatch of colours is mainly caused by the mismatch of colour gamut and the smaller colour gamut in CMYK colour space compared to RGB colour space. The research on colour gamut matching technology was first started abroad, and the main research results were also obtained abroad. Maintain subtle differences in colour, minimize colour loss as much as possible, and ensure colour quality throughout the entire process from the original manuscript to the final replica. If a mixed colour contains two components, if one of the components changes, the colour of the mixed colour will also change accordingly. Additive colour mixing not only includes the mixing of coloured light, but also occurs when the distance between two types of light is extremely small and cannot be distinguished by the human eye, or when two colours alternate and act on the same visual position. In daily life, dial colour mixing and television are both additive colour mixing. And if a certain colour has a large proportion of coloured light, it will produce unsaturated colours with a large proportion of coloured light. If any two pigments in the three primary colours are not mixed in equal quantities, then the colour of the mixed colour changes towards the primary colour with a larger proportion for subtractive mixing.

The law of brightness addition refers to the sum of the brightness of each monochromatic light that makes up a mixed colour, which is the brightness of the mixed colour. Subtractive colour mixing includes the mixing of pigments and dyes, which involves mixing various colours of dyes to produce new colours. Its essence is the superposition of colour absorption, suitable for colour mixing in reflective media. The more frequent the mixing of colours, the lower the brightness of the colours, and the more they tend towards neutral mixing of black colours. This is based on human visual psychological traits, and the visual colour mixing that occurs does not require changing the colour of the colour or material. The other is the law of intermediate colours, which refers to the phenomenon where a colour is mixed with a non-complementary colour, resulting in a colour that lies between the two colours. There are two laws based on this: the complementary colour law, which refers to the possibility of producing white when a certain colour light is mixed with its complementary colour light in a certain proportion. Light with the same colour appearance, regardless of whether the reflectance curve is the same or not, has the same visual effect in colour light mixing and can also be considered as equal colour. Such as textile product colouring and watercolour mixing. The three primary colours of subtractive colour mixing are magenta, yellow, and cyan. Similar to the mixing of coloured light. Rather, due to the inability of the human eye to distinguish colour blends that are too small, too fine, or change too quickly at a certain distance, colours will affect each other, disperse, and blend into adjacent colours, thus forming a new mixed colour.

## 5 EXPERIMENTAL RESULTS AND ANALYSIS

### 5.1 Performance Evaluation of Colour Matching Model

The performance of the model in accuracy, recall and F1 score is shown in Figure 2.

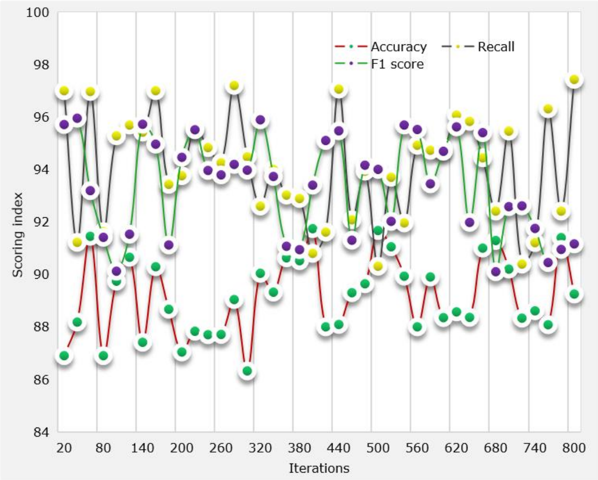


**Figure 2**: Accuracy, recall, F1 score performance.

The performance of the model in terms of rationality and aesthetics of colour matching is shown in Figure 3.

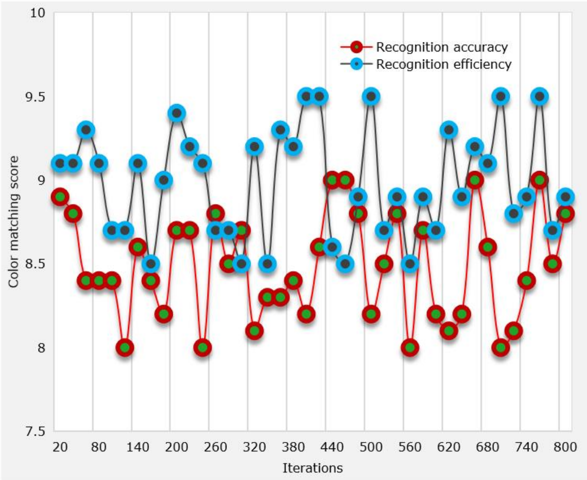


**Figure 3**: Rationality and aesthetics of colour matching.

Combining the experimental results of Figures 2 and 3. The reason for this result is the shape of the source colour gamut and the copied colour gamut. A plane with a constant phase angle usually resembles a triangle, and the brightness corresponding to the point of maximum saturation in the source colour gamut is higher than that of the copied one. From this result, we can see that while ensuring brightness matching, giving more consideration to colour saturation can result in better matching results. Another conclusion drawn from the evaluation is that if the test image is divided into colour and fading regions for further analysis of these two algorithms, the compression algorithm preserves more colour saturation. Therefore, linear compression of brightness reduces the saturation of many colours, especially high-saturation colours. Especially the colours in high saturation areas; But on the dark and fading axes, they result in segmented linear brightness compression. The rationality score of 8.5 and the aesthetic score of 9.0 show that the colour matching generated by the model not only conforms to the actual colour-matching principle but also has high visual appeal.

To sum up, the colour-matching model performs well in prediction performance, rationality and aesthetics, and has high practical value and application prospects.

## 5.2 Quantitative Analysis of Improving Teaching Efficiency

To quantitatively assess the enhancement of teaching efficiency through the colour-matching model, a series of controlled experiments are designed in this section. Students in the experimental group utilized a computer-aided Chinese painting teaching platform incorporating the colour-matching model, whereas those in the control group relied on traditional teaching methods and resources. The experimental outcomes are presented in Figure 4 and Table 1.

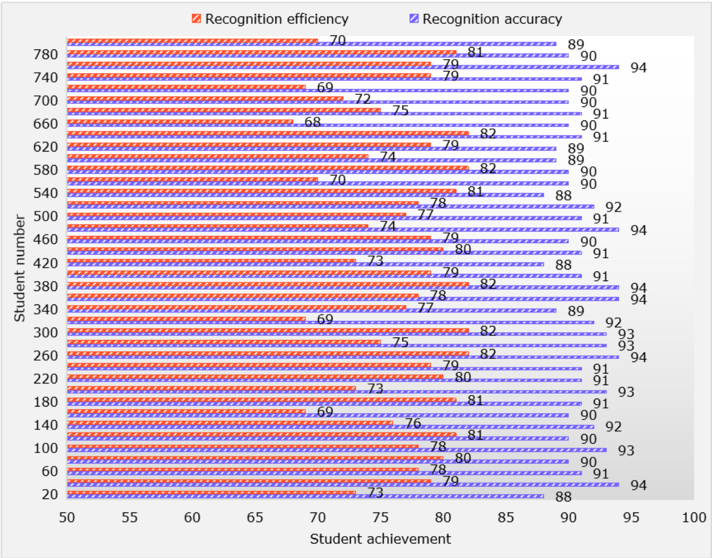


**Figure 4**: Comparison of students' grades.

According to the data in Figure 4, we can observe the following specific values and trends:

The scores of students in the experimental group hovered around 88 points, displaying a tight concentration of data. This indicates that the experimental group generally exhibited high academic performance, highlighting the positive impact of the colour-matching model in teaching.

On the other hand, the scores of students in the control group oscillated around 75 points. Notably, the average score of the control group was lower, accompanied by significant data dispersion, suggesting potential limitations of traditional teaching methods in elevating students' scores.

| *Group* | *Learning Progress (minutes)* | | *Number of Completed Works (pieces)* | | *Work Quality (score, out of 10)* | |
|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Mean | Std. Deviation | Mean | Std. Deviation |
| Experimental | 80 | ±10 | 5 | ±0.5 | 8.5 | ±0.5 |
| Control | 100 | ±15 | 4 | ±0.8 | 7.0 | ±0.7 |

Table 1: Experimental results on teaching efficiency improvement with colour matching model.

A stereo matching algorithm based on fusion similarity measurement function is proposed to address the two major drawbacks of traditional non-parametric transformations. Stereoscopic matching technology is a key and important research direction in the field of computer vision inspection. Therefore, this article focuses on the research of matching disparity search strategy and proposes a step-by-step search strategy based on image segmentation disparity constraints, which greatly improves the accuracy and speed of the matching algorithm. This is an important way to solve the problem of mismatching, which has significant implications. Its selection directly affects the speed and accuracy of matching. The disparity search strategy and similarity measurement function, as important components of binocular stereo-matching technology, are two essential steps in the matching process. Aiming at the problem that most local stereo matching algorithms cannot simultaneously meet the requirements of high accuracy and high speed, a colour segmentation-based stepwise volume matching algorithm is introduced. Then, we focused on studying the similarity measurement function in matching and proposed a stereo-matching algorithm that integrates the similarity measurement function. Then, colour segmentation was introduced into the matching process, and a disparity constraint criterion based on colour segmentation was proposed to achieve a fast step-by-step matching algorithm and obtain dense disparity maps. This paper discusses the traditional Census non-parametric transformation, analyzes its robustness, and then introduces the image segmentation algorithm based on the Mean shift algorithm. Finally, simulation experiments were conducted on images based on ideal conditions and amplitude distortion and compared with a series of other local stereo-matching algorithms.

### 5.3 Evaluation of Students' Works

The research has proven that the stereo-matching algorithm proposed in this chapter is a correct and reliable local stereo-matching algorithm. Finally, simulation experiments were conducted separately for ideal images and ideal images based on amplitude distortion. Then, a certain improvement was made to the traditional non-parametric transformation by adaptively weighting the non-parametric transformation process, and a matching cost function based on weighted non-parametric transformation was proposed. A matching cost function based on colour segmentation is proposed by incorporating colour information into the matching cost function. Compared with a series of other stereo-matching algorithms based on non-parametric transformations, it was proved that the matching algorithm proposed in this paper can improve the shortcomings of traditional non-parametric transformations. This improves the matching accuracy of low texture areas, occluded areas, and discontinuous areas, as well as robustness to amplitude distortion, making it a reasonable and effective stereo-matching method. Based on the matching proxy value obtained from matching, a parameter function is defined, and two matching cost functions are weighted and fused to complete a similarity measurement function for the fusion mechanism. The results are shown in Figure 5 and Figure 6.

The traditional local matching algorithm specifies the size and shape of the matching window before performing the matching algorithm, and the matching window remains fixed throughout the entire matching process. Not only can it improve the accuracy of matching, but it can also suppress the phenomenon of foreground enlargement and enhance the clarity of parallax edges.

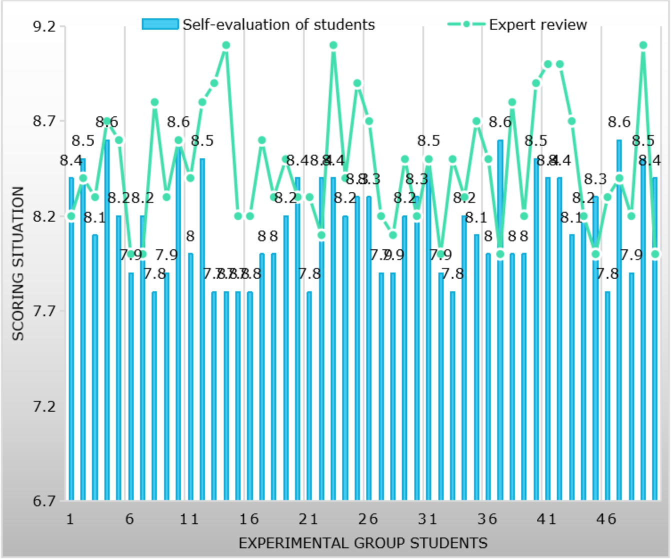


**Figure 5**: Scoring situation of the experimental group.

Due to the fixed matching window, it is difficult to adapt to changing image features such as occlusion and low texture areas, resulting in a decrease in matching progress and blurred disparity edges. The adaptive weighted stereo matching algorithm, a traditional local matching algorithm, considers the influence of all neighbouring pixels within the matching window on the disparity value of the centre pixel as equal when performing pixel matching, without making any distinction, resulting in an increase in the false matching rate. The adaptive window matching algorithm is proposed to address this issue, which flexibly selects the size and shape of the matching window based on the changing image structure during the matching process. However, when selecting windows adaptively, it will waste a lot of time and affect the real-time performance of the algorithm. Assign large weights to neighbouring pixels with strong correlation and assign small weights to neighbouring pixels with weak correlation. The adaptive weighted stereo matching algorithm is proposed to address this issue. During pixel matching, it adaptively weights neighboring pixels based on their degree of association with the central pixel. Not only did we obtain high-precision disparity maps that are comparable to global matching, but we also suppressed foreground enlargement and enhanced the clarity of disparity edges.

The use of modern digital technology to study traditional colours has certain feasibility and research significance and is conducive to the innovation and application development of traditional colour culture. Based on the Yunjin color blending mnemonic and digital color information obtained from this study, an automated color-matching design with color-matching features is carried out. Ultimately, modern patterns with transitions between two and three colours will be processed for automated colour-matching design, and the three colour-matching effects will be simulated in 3D on different objects to showcase the colour-matching characteristics and effects in the colour halo. Establish a "colour blending and matching" colour library based on pattern design software, and verify the feasibility of the colour library, the recognizability of simple elements, and the applicability of the colour blending mnemonic on modern patterns. In the past, colour selection for colour halo was subjectively evaluated and judged by referring to colour cards. The article proposes a digital study of colour halo mnemonic colour. This validates the applicability of colour blending in contemporary design and the feasibility of automated colour-matching technology. Moreover, we will further explore and refine the artistic and cultural value of colours in colour blending, and broaden the application areas of colour blending mnemonics.

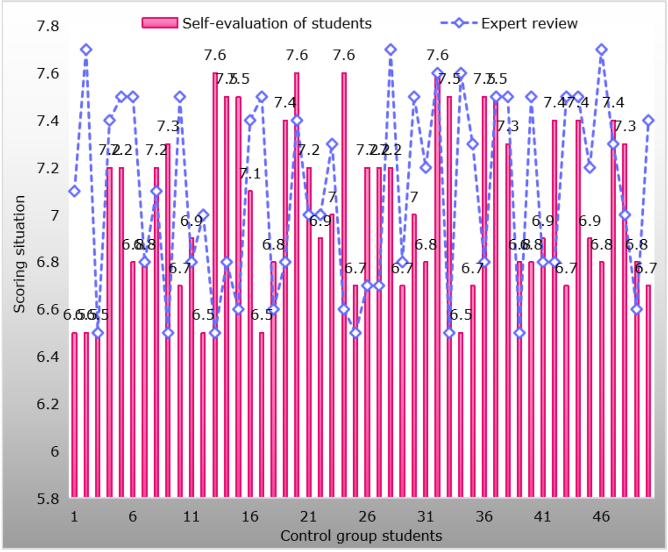


**Figure 6**: Score of control group.

This improves the efficiency of designer colour matching and has significant implications for promoting its development. Improved the flexibility and operability of colour selection, allowing for quantitative and rational judgment, and more scientifically and accurately summarizing the distribution patterns of colour samples. This will provide a basis for establishing a scientific colour order for cloud brocade.

## 5.4 Teaching Cases and Empirical Analysis

In order to further verify the application effect of colour colour-matching model in practical teaching, this section selects a specific teaching case for analysis. This case involves a group of students learning with a computer-aided Chinese painting teaching platform, and Figure 7 shows the comparison of students' works before and after learning.


**Figure 7**: Display of students' works.

Through comprehensive analysis and comparison of the works of the two groups of students, we can find that the students in the experimental group are more outstanding in the innovation and diversity of their works. Table 2 gives the feedback from students:

| *Student ID* | *Feedback Before Using the Model* | *Feedback After Using the Model* |
|---|---|---|
| 1 | Difficulty in colour matching, works appeared monotonous | More proficient in colour matching, works became more colourful and diverse |
| 2 | Poor work quality lacked depth and layering | Significant improvement in work quality, better colour hierarchy and depth |
| 3 | Lack of innovation felt that own works were similar to others | Increased creativity, ability to experiment with more diverse colour matching and composition |
| 4 | Lack of understanding of colour theory, difficulty in applying | A deeper understanding of colour theory, the ability to flexibly apply it in works |
| 5 | Conservative in colour matching, hesitant to try new colours | More daring in colour matching, willing to experiment with different colour combinations |
| 6 | The limited colour palette works lacked vibrancy | Expanded colour palette, works now appear more vibrant and lively |
| 7 | Struggled with creating harmonious colour combinations | Improved ability to create harmonious and visually appealing colour combinations |
| 8 | Felt unsure about colour choices, often relied on trial and error | More confident in colour choices, able to make deliberate and effective decisions |
| 9 | Works lacked visual impact, colours did not stand out | Works now have greater visual impact, colours are more prominent and eye-catching |
| 10 | Difficulty in achieving desired colour effects | Improved ability to achieve desired colour effects and create intended atmospheres |

**Table 2**: Comparison of Student Feedback Before and After Using the Colour Matching Model.

Comparing the students' works and feedback before and after using the model, we observe a significant improvement in their colour-matching ability, along with an enhancement in the overall effect and aesthetics of their works. This case further demonstrates the effectiveness and practicality of the colour-matching model in teaching.

## 6 CONCLUSIONS

As mentioned earlier, colour gamut matching technology is a very complex problem, and there are many factors that affect the colour gamut matching effect. There are also many types of algorithms proposed by predecessors. Research has shown that due to the fact that the CIELAB space is only an approximately uniform colour space, matching while maintaining a constant hue will ultimately result in hue displacement. Due to my time and ability limitations, I only conducted comparative research on several colour gamut matching algorithms that maintain the same hue. Finally, the SLCUSP algorithm was proposed, which has relatively good matching accuracy and stability. There is still room for further improvement in this algorithm. So it's best to adjust the hue at the end. In the second step of the SLCUSP algorithm, the CUSP algorithm is used to simultaneously compress brightness and saturation. The best solution for colour gamut matching should be to find a balance between maintaining the relative relationship between colours and minimizing the total colour difference. In terms of matching methods, it is best not to modify the matching direction, and to change from simultaneous linear compression to matching between linear compression methods. It ensures that most of the colours within the target colour gamut remain unchanged while preserving the colour detail changes in the out-of-colour gamut, thereby further improving the accuracy of matching.

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