

Oil Painting Features Based on Big Data Blockchain Algorithm and Digital Image Technology

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Abstract: Oil painting is a type of non realistic rendering technology that allows people to express the desired information and create artistic images through oil painting. Oil painting does not care about the authenticity of the images and has strong expressive and technical effects. The article introduced three elements of oil painting feature analysis, including color features, color harmony, and theme color extraction, and introduced image processing technology. By calculating the color feature vectors of oil painting features, the features of the oil painting were analyzed based on the feature data. Talking about the security of oil painting images disseminated in the network in the age of big data, the blockchain mechanism was introduced. Oil painting images were tested based on the average number of color bands and pixel ratios of oil painting features from different periods, as well as the changes in oil painting color features. An analysis was also conducted on the falsification of oil painting images under the blockchain mechanism. Data showed that the average number of color bands in early oil painting images was only 4.5. By the 19th century, the number of color bands had increased to 6.8, and the pixel ratio data had changed from 0.5 in the early stage to 0.28 in modern oil painting images. When the number of times oil painting images were shared online was between 100000 and 500000, the fraud rate was controlled within 10%, while under traditional network mechanisms, the highest fraud rate of oil painting images was 55%. The conclusion is that digital image technology can analyze the characteristics of oil paintings in different periods, and the blockchain mechanism can provide a secure network communication platform for oil painting image sharing, providing stronger security protection for oil painting image information.

Keywords: Oil Painting Features, Digital Image Technology, Blockchain Mechanism, Oil Painting Art

1. Introduction

As people's material living standards improve and their pursuit of spirituality gradually becomes intelligent, oil painting art can not only meet people's spiritual needs, but also express deep spiritual connotations through visually visible forms. As computer vision technology develops, the style, characteristics, and quality assessment of oil painting images can also be analyzed using intelligent computer technology. Intelligent oil painting analysis technology is a research technology that spans multiple disciplines, including aesthetics, art, computer science, image processing, etc. The use of high-tech technology to analyze the characteristics of oil painting images belongs to a type of computer vision art, which brings a new visual art enjoyment. The use of digital image processing technology to aesthetic and evaluate oil painting art is a new direction for the future development of image visual art. The analysis of oil painting features must be carried out in a hierarchical manner, as the expressed content is also structural, requiring a comprehensive and holistic analysis of oil painting features. With the influence of oil painting images in the era of big data, their art has been greatly disseminated, but their security issues have also become increasingly prominent. The method of combining blockchain algorithms with image processing technology to analyze oil painting features has also attracted many people's attention.

The Internet has developed in recent years, and people's lifestyles are increasingly oriented towards digital development. The advancement of computer image processing technology has also brought technological innovation to the field of oil painting art. Oil painting image feature analysis is also a hot research topic in the field of visual art. Tse Nicole conducted a material analysis of painting, literature, digitization, and image analysis techniques as a protection model to broaden the perspective of protection knowledge acquisition. The Philippines' protection decisions are another focus. He examined the local values, as well as the trajectory and life of painting, to inform the conservation

action and creative process [1]. Fan ZhenBao studied whether the blank space in Chinese painting is not just a blank background space, but the meaning of aesthetic perception. He applied a computational saliency model to analyze the impact of blank space on audience visual information processing. He conducted eye tracking experiments, analyzed the paintings of renowned artist Wu Guanzhong, and collected subjective aesthetic ratings from users [2]. Pasquale Stefania evaluated the wetting characteristics of historical paintings and quantified the impact of water absorption on color changes. For these purposes, he prepared different types of painting models in the laboratory to reproduce the main antique pattern techniques. The results indicated that binders played an important role in evaluating the wetting performance of contact angle measurements, and these data have been correlated with colorimetric measurements to quantify color changes caused by water [3]. Chu Wei-Ta conducted a comprehensive study on the depth related features of image style classification. The correlation between feature maps can effectively describe image textures. He designed various correlations and transformed them into style vectors, and studied the classification performance brought about by different variants [4]. These studies have certain research value, but most of them are explored from a theoretical perspective.

The combination of blockchain algorithms and image processing technology is a new direction for the development of image visual art, which has attracted more and more attention in recent years. Li Mao proposed a new method for quantifying visual balance patterns and automatically evaluating the aesthetic value of images. He first used the k-means clustering method to analyze the color composition of the image. He then proposed a computational method for finding the visual center of gravity of images based on information aesthetics theory and perspective principles [5]. Mao Wenli conducted research and analysis on teaching videos of oil painting art by combining machine learning with virtual reality computing. He first preprocessed the images in the image library to select relatively high-quality images. He then screened out those whose saliency and clarity did not meet the queue value by judging the saliency and clarity values of the image. He ultimately improved the quality and naturalness of images by learning the deep features of images based on style transfer, which greatly improved the implementation efficiency compared to traditional methods [6]. These studies have certain reference significance for the field of oil painting art, but most of them have not been analyzed based on the current situation.

From the perspective of modern oil painting art, the internet is the largest carrier for spreading oil painting art. Transforming oil painting art into digitalization is a new trend in the current development of oil painting art. This article combined digital image processing technology to analyze the characteristics of oil paintings, and studied the security issues of oil painting images in network dissemination under the blockchain mechanism.

2. Oil Painting Features Based on Computer Technology

2.1 Characteristics of Digital Oil Painting

Nowadays, human life has entered a high-speed development stage of informatization, and people's lives are gradually becoming digital and intelligent. People use computers to process information in the objective world, convert it into digital form, and store it in computers. The development of information networking has brought human life and work forms into a new stage of development, shifting from a demand for material life to a pursuit of cultural and spiritual aspects. Oil painting, as an artistic form of expressing emotions, can greatly meet people's spiritual needs and convey rich information. The demand for oil painting art is increasing, and the creative form of oil painting is gradually facing digitization.

2.1.1 Creation of Digital Oil Painting Art

Oil painting refers to a form of artistic creation using pigments and volatile vegetable oils on canvas. The painting is layered on a canvas covered with a photosensitive medium, forming a photo on top of it [7]. Oil painting pigments include pigments, dry oils, and additives [8]. Compared to other types of painting, oil painting has a more three-dimensional and rich form of expression, and can maintain its luster for a long time. It is one of the main types of painting in Western countries, and its oil painting works are also treasures in human art and culture. As image processing technology developed, people gradually learned to use computers to create oil paintings. In the 1990s, a Japanese painter used computer technology to create art works throughout the entire process, pioneering digital painting. The emergence of digital oil painting has brought the field of oil painting art into a new realm, enhancing

modern aesthetics in the field of oil painting art, as shown in Figure 1.



Figure 1. Digital oil painting

The use of computer technology for oil painting creation is different from traditional oil painting creation methods. Digital oil painting integrates painting art with modern technology, giving oil painting a new direction and space for development. Its manifestation is the diversification of two creative forms and sources, as well as innovation in creative technology.

2.1.2 Characteristics of Oil Painting and Computational Aesthetics

Another application of computer technology in the field of oil painting art is computational aesthetics and oil painting feature analysis. Computational aesthetics and oil painting feature analysis refer to the use of computer technology to learn human aesthetic behavior and methods to analyze the quality, style, aesthetics, features, and other aspects of oil painting images. In digital humanities, images play a more prominent role in research, and the quality analysis of digital historical images can be analyzed in various ways [9]. As artificial intelligence technology and computer visual art develop, the computational aesthetics and feature analysis of oil painting is a new direction of research in this field. The mechanical factors that affect oil painting, such as scraping, shaking, tapping, etc., can affect the oil painting layer, including the painting layer [10]. The characteristics of oil painting can be analyzed from the following three aspects:

1) Color features: Color features are the basic elements for analyzing oil painting features, and color is the primary information that people can obtain from oil painting images. The photodegradation process can cause long-term, cumulative and irreversible color changes [11]. Therefore, the first step in analyzing the characteristics of oil painting images is to analyze the color features of the images. Firstly, the global color characteristics of oil paintings are analyzed to give an overall impression of the color composition of the oil painting. When ordinary people appreciate an oil painting, their first impression is also generated from the overall color structure of the oil painting. Global feature color analysis can use computer technology to calculate the average hue, purity, and brightness values of the overall oil painting as statistical values for the global color features of the oil painting. These values can be converted into people's first impression of the oil painting. After analyzing global features, oil painting features can be analyzed based on local features. Local analysis can extract color features from different regions by dividing the image into different regions. This part of the analysis is mainly applied to image segmentation technology. After extracting color features from each region, the purity and brightness of these regions are calculated and compared separately, thus achieving accurate analysis of both the overall and local aspects.

2) Color Harmony: The color harmony of oil painting refers to the painter's comprehensive combination of colors during creation, which makes the colors of the oil painting appear more harmonious. Experts point out that if several pigments on an oil painting are mixed together and the result is white, it can indicate that the colors of the oil painting are harmonious. Therefore, color harmony refers to the complementary relationship between various colors, and more specifically, the

complementary relationship between hue, purity, and brightness. Color harmony can be divided into single, adjacent, and complementary color harmony.

3) Theme color extraction: Theme colors are the main color scheme in oil painting creation, which can represent the overall color impression of the oil painting. The main task of theme color extraction is to extract the main visual color features in the oil painting, which means that the number of colors is not considered, but the saliency of colors is considered.

2.2 Digital Oil Painting Image Processing Technology

With the increasing popularity of computer applications, images have become important carriers of information transmission and an important way for people to understand the objective material world. The amount of information conveyed by images is gradually increasing with the progress of technology, and oil painting image processing has become an essential research hotspot in the field of computer vision. Both oil painting creation and oil painting feature analysis have been influenced by digital image processing technology. Digital oil painting and digital image processing both belong to the field of digital media. In recent years, the combination of digital media and computer vision has led to technological innovation in oil painting art creation. Digital media, as a high-tech means, has gradually influenced various aspects of social production, including artistic creation, in the information age [12]. Image processing cannot directly process manually drawn or natural oil painting images, but rather converts natural images into digital form and processes these digitized image features using computer technology. Therefore, processing oil painting images and conducting digital analysis on them is a complex project that involves various digital image processing techniques. Digital oil painting image processing technology can be divided into spatial domain processing and frequency domain processing.

1) Spatial domain: It refers to the formation of different domains of pixels in the oil painting image plane, namely geometry. The overall oil painting image is represented by functions, and then processed. Its method can also be divided into two types: domain and point processing.

2) Frequency domain: Unlike spatial domain methods, the frequency domain first performs Fourier transform on oil painting images. After the transformation, the corresponding results of spatial domain processing can be obtained, which is then processed. However, after processing, it is necessary to transform its inverse Fourier transform into the spatial domain in order to obtain the corresponding results.

In the previous section, the three elements of oil painting feature analysis are introduced. For each element, certain image processing techniques are required,

Regarding the color features of oil paintings, there is a need to analyze them from both global and local color features. To process the color features of oil paintings, the first step is to extract the color of the oil painting image, which includes analyzing the hue, purity, and brightness of the oil painting. The following formulas can be used to represent the three elements:

$$O(\alpha) = \frac{1}{XY} \sum_y \sum_x L_\alpha(x, y) \quad (1)$$

$$O(\beta) = \frac{1}{XY} \sum_y \sum_x L_\beta(x, y) \quad (2)$$

$$O(\gamma) = \frac{1}{XY} \sum_y \sum_x L_\gamma(x, y) \quad (3)$$

Formulas (1), (2), and (3) respectively represent the extraction of hue, purity, and brightness of oil painting colors, where X and Y represent the width and height of the oil painting image. This is the use of image processing technology to process the global color features of oil paintings. For the local features of oil painting, it is necessary to analyze the hue, purity, and brightness of each area more accurately. Therefore, image segmentation technology is needed here. Firstly, the oil painting image is divided into several parts, and image processing techniques can be used to automatically segment the image. When segmenting, attention should be paid to optimizing the texture and edge features of the image, which can improve the quality of image segmentation. In recent years, convolutional neural networks for deep learning have shown good characteristics in the field of image segmentation, so convolutional neural network models can be used for segmentation here. After image segmentation, the color elements of the local area are further extracted using the following formulas:

$$O(\alpha)_P = \frac{1}{i} \sum_{(x,y) \in P(i)} I_\alpha(x,y) \quad (4)$$

$$O(\beta)_P = \frac{1}{i} \sum_{(x,y) \in P(i)} I_\beta(x,y) \quad (5)$$

$$O(\gamma)_P = \frac{1}{i} \sum_{(x,y) \in P(i)} I_\gamma(x,y) \quad (6)$$

Formulas (4), (5), and (6) are related to the extraction of local color features in oil painting images. After extracting hue, purity, and brightness, they are analyzed, and the characteristics of oil painting features can be analyzed through color distribution. Calculating color feature vectors can analyze the overall color characteristics of oil painting images. For how to use image processing technology to analyze the color matching of creators, so that the image appears more coordinated, that is, how to use computer technology to analyze the color harmony of oil painting images, a matching template for color and tone harmony is introduced. Among them, the template matching function can be represented by the following formula:

$$G = \sum_Y \sum_X ||L_\alpha(x,y) - \alpha_{k(\theta)}(x,y)|| * L_\delta(x,y) * S(x,y) \quad (7)$$

Formula (7) represents the representation function of the matching template. When the image matching template reaches a certain threshold, the lowest template is selected for matching. The data generated after matching can be used to calculate color harmony. After calculating color harmony, the final step is to analyze the theme color elements of the oil painting. The main feature element of extracting the theme color from oil painting images is the representation of the image's saliency, which has a significant impact on visual perception. The formula for calculating significance can be expressed as:

$$F(h) = \sum_{(x,y)} L_S(x,y) * S(x,y) \quad (8)$$

Formula (8) represents the calculation formula for the color saliency of oil painting images. By obtaining this value, the theme color of the oil painting can be analyzed. The above is the entire calculation process of oil painting features using image processing technology. Feature analysis is conducted from three aspects of three oil paintings, and the color feature elements of hue, purity, and brightness of oil painting images are digitally extracted. The role of image processing technology is to extract and analyze oil painting features. However, in recent years, the credibility of oil painting images has been questioned by many people, and this situation is becoming increasingly serious with the development of internet networks. Many people use high-tech technology to simulate famous oil painting images, resulting in a large number of fake oil paintings appearing on the market. This article introduces a blockchain algorithm to analyze the credibility of oil painting images in order to prevent their falsification and preserve their authenticity.

2.3 Application of Blockchain Technology in the Credibility of Oil Painting Images

Blockchain refers to one chain after another, each containing a unique piece of information. The blockchain it constitutes is stored on all servers, enabling an end-to-end connection system, and it also has multiple security systems. The current infrastructure for cross site image transmission relies on trust in third-party intermediaries, and blockchain enables parties to establish consensus without relying on a central authority [13]. However, due to various flaws in the internet, a large number of oil painting art forgeries have emerged in the market, thereby hindering the reliable dissemination of oil painting images. The oil paintings of the 20th and 21st centuries presented a series of challenging protection issues, which are completely different from those of previous centuries [14].

In terms of the dissemination of oil painting images, the ultimate goal of dissemination is the information contained in oil painting images. Image information can be transmitted to the information production, sharing, and consumption ends of the blockchain, that is, image data can be linked up. Blockchain has become an effective tool for protecting sensitive information [15]. After the oil painting image information is linked, it can access and share the oil painting information. Through the blockchain's own access mechanism, it can provide digital identity certificates for oil painting

information sharers and oil painting consumers, and can also allocate accounts and develop contracts for oil painting creators. Regarding the online information of oil paintings, it is possible to set and add accessible nodes. Strict identity authentication and permission authentication must be carried out for every access and browsing of oil painting information, and the records of accessing oil painting information must be saved in the system. This can not only protect the legitimate rights and interests of picture information publishers, but also ensure the safe transmission of picture information. Figure 2 is about the security guarantee technology of blockchain technology for oil painting image information.

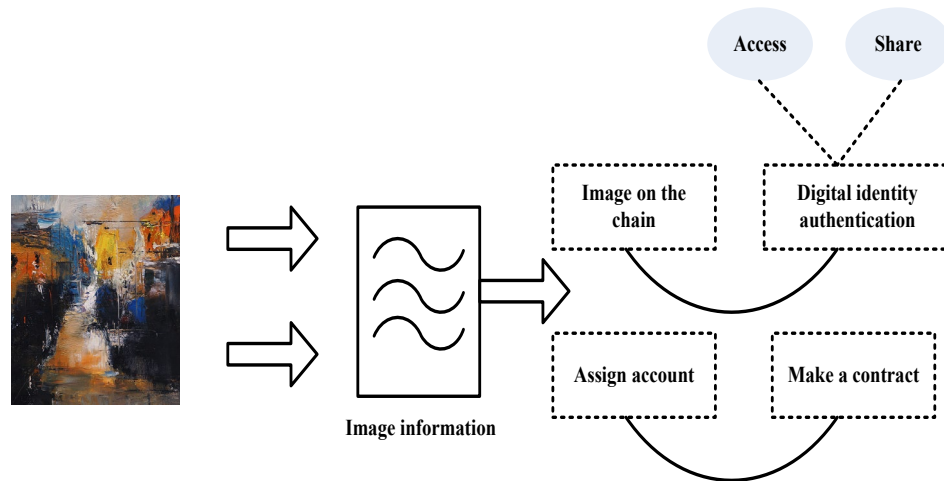


Figure 2. Security guarantee technology for oil painting image information dissemination using blockchain technology

In recent years, blockchain intelligent seal technology based on blockchain technology has brought great value to the secure sharing of digital oil paintings. The blockchain intelligent seal is composed of the blockchain platform and the business backend of each module. The intelligent seal terminal platform passes the oil painting information through the blockchain, that is, the oil painting image information obtained by the terminal device. Each oil painting image information has an identity seal. Intelligent seal technology fully utilizes the advantages of blockchain in data sharing.

3. Oil Painting Features Based on Image Processing and Security Simulation Experiments for Digital Oil Painting Dissemination

Under the influence of visual art and digital media, the popularization of oil painting art is becoming increasingly popular. Through the internet, oil painting art no longer needs to be looked up to, but has entered the lives of the public. Digital image processing technology has also extended to the field of oil painting art. Using computers or artificial intelligence to analyze the aesthetic value of oil painting images like humans is no longer difficult for humans. Transforming oil painting features into data form and analyzing them through feature data can also provide people with reference results. This article tests oil painting images based on the average number of color bands and pixel ratios of oil painting features from different periods, as well as the change value of oil painting color features. Finally, the performance of oil painting image forgery under the blockchain mechanism is analyzed. The oil painting styles of different periods (15th, 17th, 18th, 19th, and modern) in a certain region are tested separately, as the color of the oil painting is an important factor in analyzing the characteristics of the oil painting. The colors of different oil paintings represent the different creative directions expressed by the creators, as shown in Table 1.

Table 1. The creative style represented by oil painting colors

Color	Creative style
Black	Steady, mysterious, serious
Blue	Energetic and positive
White	Clean and refreshing
Light blue	Refreshing and young
Dark color	Rigorous and powerful
Bright and turbid color	Mature and elegant
Turbid color	Reliable and stable

From Table 1, it can be seen that different oil painting colors represent different creative styles. For example, black represents the stable, mysterious, and serious creative style expressed by creators. White represents the clean and refreshing creative style expressed by creators, thus indicating that the color of oil painting is an important indicator for analyzing the characteristics of oil painting. The average number of color bands and pixel ratio of oil painting features from different periods were calculated, as shown in Figure 3.



Figure 3a. Average number of color bands

Figure 3b. Average pixel ratio

Figure 3. Calculation of the average number of color bands and pixel ratio of oil painting features in different periods

Through the introduction of image processing technology earlier, it can be seen that the number of color bands is an important representation of oil painting features. Figure 3 shows the average number of color bands in oil painting images from the 15th, 17th, 18th, and 19th centuries to modern times, as well as the development trend of pixel ratio. From the bar chart in Figure 3a, it can be observed that since the 15th century, the overall number of color bands in oil painting images has been increasing, while the pixel ratio has been decreasing. Data showed that the average number of color bands in early oil painting images was only 4.5. By the 19th century, the number of color bands had increased to 6.8, and the average number of color bands in modern oil painting images was also 6.4. The pixel ratio data in Figure 3b also decreased year by year as the number of color bands increases, from an early pixel ratio of 0.5 to a modern oil painting image pixel ratio of 0.28. Based on this data, it can be analyzed that the number of color bands in early oil painting images was relatively small. With the advancement of oil painting technology, the number of color bands gradually increased and the pixel ratio decreased, indicating that the colors used by creators in oil painting are becoming increasingly rich. The changes in hue, purity, and brightness of oil paintings in different periods were calculated, as shown in Figure 4.

Figure 4 shows the changes in hue, purity, and brightness during each period. From the distribution of line chart, the change trend of each vector of oil painting color characteristics can be learned. It can be seen that there was an overall upward trend in color, purity, and brightness. Data showed that in early oil painting color features, the values of hue, purity, and brightness were 62, 75, and 106, respectively, while in modern oil painting color features, the values of hue, purity, and brightness were 97, 95, and 122, respectively. However, overall, the color characteristics of oil paintings increased the fastest in terms of hue, purity, and lightness between the 17th and 18th centuries. It can be seen that during this period, the painting features of oil paintings were rich in color, and with the development of society, the colors of oil paintings became increasingly rich, and the color span also became larger.

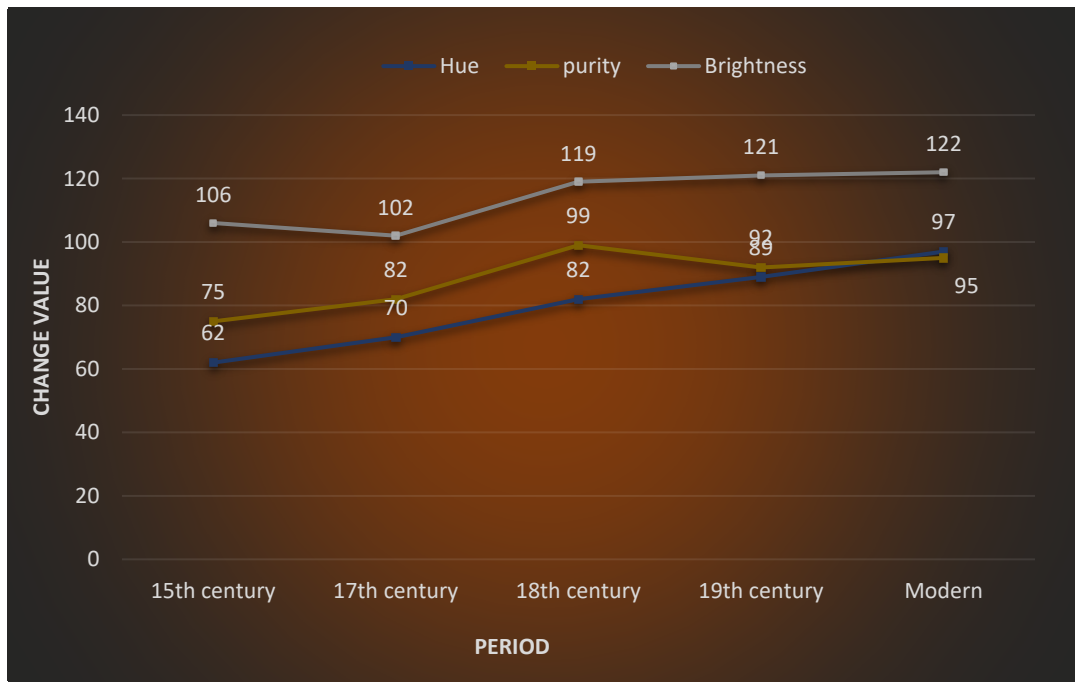


Figure 4. Changes in color characteristics of oil paintings at different periods

While analyzing the characteristics of oil paintings, it is also important to ensure the security of ancestral oil painting images in online dissemination, ensuring the authenticity of oil painting image information in the dissemination images. Blockchain technology provides a good backend guarantee for the dissemination and sharing of online oil painting image information. After using blockchain technology, the effectiveness of the blockchain oil painting image information sharing method was tested, as shown in Figure 5.

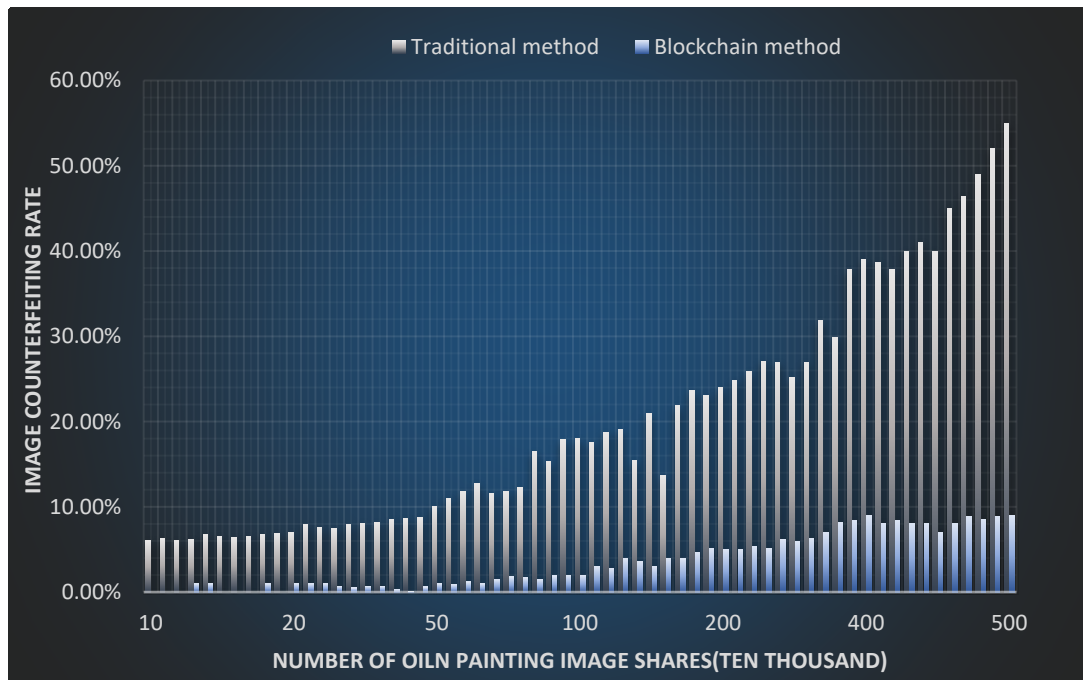


Figure 5. Fake rate of oil painting images under different network mechanisms

Figure 5 shows the network information dissemination mechanism using traditional methods and blockchain methods. As the number of times oil painting images were shared online increased, the bar chart in the figure showed that the fraud rate of oil painting image network dissemination under traditional methods was much higher than that under blockchain mechanism. Data showed that when the number of times oil painting images shared on the internet was between 100000 and 500000, the

fraud rate was controlled within 10%. Under traditional network mechanisms, the highest fraud rate of oil painting images has reached 55%. Moreover, from the data, it can be found that when the number of oil painting image shares was 100000, the oil painting image fraud rate under the blockchain mechanism was 0, and the oil painting image fraud rate under the traditional mechanism has already reached 6%. From this data, it can be seen that the blockchain mechanism can provide a secure network dissemination platform for oil painting image sharing, providing stronger security guarantees for oil painting image information.

4. Conclusions

Digitalization and networking are the main trends in the development of today's era. In order to adapt to modern aesthetics, oil painting art is gradually moving towards digital oil painting. Big data and the internet can promote the dissemination of oil painting art and enhance its influence. The digital analysis and processing of oil painting images is also a hot topic in digital media research today. The security issue of digital oil painting dissemination is also becoming increasingly severe. This article conducted research on oil painting art based on blockchain technology and image processing technology. The article introduced the characteristics of digital oil painting and the elements of oil painting feature analysis, introduced image processing technology, and studied the security of network image dissemination of oil painting features. The problems that arise when oil painting image information was shared are indicated, and the application of blockchain technology in oil painting image network dissemination was introduced. Through experimental analysis and testing of image processing technology and blockchain technology, oil painting images were tested based on the average number of color bands and pixel ratios of oil painting features in different periods, as well as the changes in oil painting color features. Finally, the performance of oil painting image forgery under the blockchain mechanism was analyzed. The data obtained indicated that the characteristics of oil paintings in different periods had different forms of expression. Moreover, with the advancement of oil painting technology, its oil painting feature colors are becoming increasingly rich, and it can be concluded that blockchain technology can provide a safer platform for oil painting image dissemination.

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