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Artistic Intelligence-based Remote Storage System for Artistic Painting Resources

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ABSTRACT

As a kind of humanistic culture, art has existed in people's daily life long ago. Based on the research of the relevant literature in the art field, this paper found that there were some problems in the art field at present. Combining with the relevant problems, this paper proposed a remote storage system of art painting resources based on artificial intelligence. The system mainly included network security part and image scanning and recognition part. According to these two parts to achieve the purpose of safe remote storage of painting resources, this paper has carried out corresponding tests on the network security rate and image recognition rate of the system. Under the condition of ensuring the normal operation of the system, the data was compared and analyzed with the traditional painting resource storage method. The system method surpassed the traditional method in most performance with 100% security rate and 100% integrity rate. However, based on the particularity of the system method, it has not been accepted by most people at present.

Keyword: Artificial Intelligence, Art Painting, Storage System, Image Recognition Technology

1. Introduction

In recent years, with the rapid development of China's market economy, people's demand for art is also increasing day by day. In this context, as the art talent training base of the Academy of Fine Arts began to devote itself to the construction of art painting resource database. The art painting resource database of fine arts colleges is an important platform to meet the demand for art resources of art majors in colleges and universities, and colleges and universities can use this platform to gather all the resources of art painting and play the role of art painting resource sharing [1-3].

Art resource database has its special status and role in the automation, networking and digitalization construction of the development direction of art colleges [4-5]. It makes up for the shortcomings of traditional paper books, digest-type databases and digital full-text databases, and

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the content is refined and specialized, which can provide information on the latest research results of art disciplines, the level of research, and research dynamics, so that the user can obtain the first-hand information, thus grasping the direction of research in the fine arts industry, and obtaining new research results [6-9]. In addition, after the development of recent years, a large number of users for learning and scientific research reasons for the fine arts category of professional information and data show an amazing demand, coupled with the popularization of electronic terminals in modern society, a new generation of readers more and more go online to independently search for the latest information and materials [10-12]. At present computer hardware and software technology, storage technology, information technology has been in a more developed stage, the construction of art painting resources database has also entered a period of high-speed development, and will become the core of the digital construction of the Academy of Fine Arts [13-15].

After reading a large number of documents, this paper determined the idea of combining traditional art painting with modern technology, combined with the problems in the field of art painting summarized in the literature reading, and committed to designing a remote storage system of art painting resources based on artificial intelligence. The system stores art painting resources electronically through artificial intelligence, thus improving the problem of difficult storage in the field of art painting.

2. Theory and Method of Painting Resource Storage System

As an important part of the field of fine art painting, the resources of fine art painting include the materials of fine art painting creation and the works of painters. For painting art lovers who often go out to sketch and capture every beauty in nature, the preservation of art painting resources has always troubled all painting art lovers. Faced with the problem of preserving painting resources, art painting lovers have also sought solutions in their own knowledge reserves. For example, finger painting art lovers have tried to preserve and fix their finger painting works by applying glue. Although this method has a certain preservation and fixation effect, it also destroys the overall sense of the hand painting.

In order to solve the problem of saving painting resources, this paper designs a remote storage system of art painting resources based on artificial intelligence. The main functions of this system include two parts, namely, network security part and image recognition storage part. The main function of the network security part is to protect the system as a whole from the attack and infringement of hackers in the other countries, and prevent the loss or tampering of the internal painting resource data of the system. The image recognition storage part scans the art painting resources of painting lovers, and then transmits the generated electronic image to the hardware storage device through data transmission. The main work flow of this system is as follows: When users need to save painting resources, they first need to enter the system interface to confirm their identity securely. The main method of confirmation is to complete the identity confirmation by entering the key security signature. When entering the image scanning interface after confirmation, the system would convert the painting resources to be saved into virtual data through image recognition and scanning steps. The system would transfer the generated virtual data to the hardware storage device through data transmission, and finally achieve the purpose of remote storage of painting resources. The flow chart of remote storage system for art painting resources of AI (artificial intelligence) is shown in Figure 1:

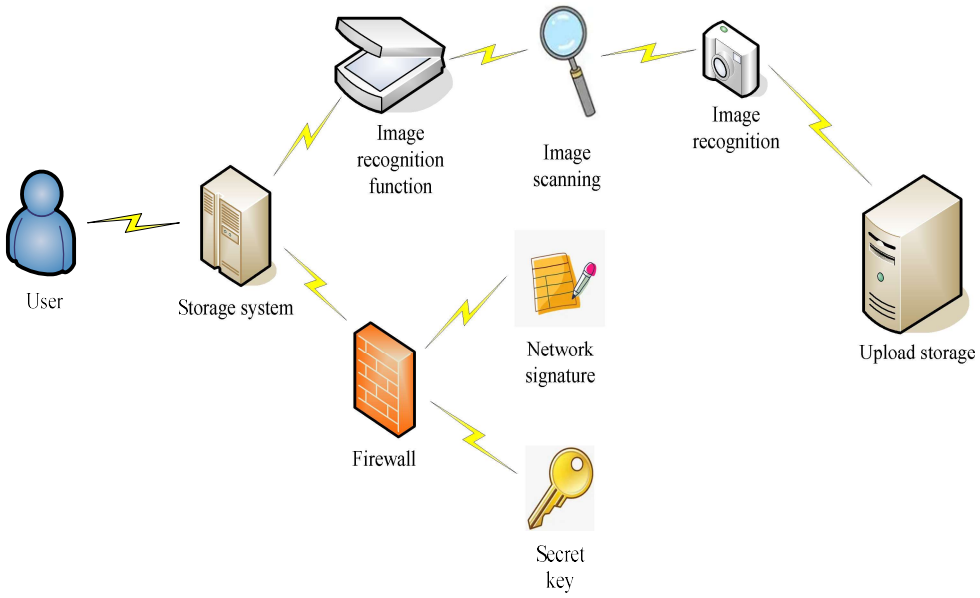


Fig. 1. Flow chart of remote storage system of art painting resources based on artificial intelligence

2.1. Network Security Theory and Method

For art painting lovers, every painting resource has its own value and significance, which is also the common view of art practitioners on art works. Therefore, the safety of painting resources is very important for every painting enthusiast. In order to ensure the security of painting resources, this design uses a key signature authentication system program based on RSA encryption algorithm in the network security firewall module. This algorithm can be used for both data encryption and digital signature, and its overall algorithm construction is based on Euler theorem. In order to generate the key, two prime numbers a and b need to be selected. In order to obtain the maximum security, the two prime numbers a and b should have a certain scale. The product formula is as follows:

$$z = ab \tag{1}$$

The Euler function value is calculated after the product calculation. The Euler function value calculation formula is as follows:

$$\phi(z) = (a-1)(b-1) \tag{2}$$

Select the encryption key r at random, meet $1 < r < \phi(z)$, and r and $\phi(z)$ are mutually prime, namely $\gcd(r, \phi(z)) = 1$. Use Euclidean expansion algorithm to calculate the decryption key to meet the following formula:

$$rd = 1 \bmod \phi(z) \tag{3}$$

r and z are public keys, and d is private key. The two prime numbers a and b are no longer needed and can be discarded. However, to ensure absolute confidentiality and not be known to the outside world, the key can be designed according to the formula and algorithm. After the completion of the key design, the firewall system also contains a network signature program. The signature program would sign and authorize each program node when the user operates on each link of the system, and the network signature needs to be signed and authenticated if the user wants to authorize at each node. The sensor node in the network would register its identity with the sink node with its unique User Identification (UID), and the sink node would use its private key to perform standard signature for the identity information of the registered node, so as to generate its own certificate. Legal nodes can sign the node relationship with their own key. The node signature formula is as follows:

$$Sign_{(b,a)} = TSig\,(SK_b, \sum_b, \sum_a) \tag{4}$$

$TSig$ is a signature with transitivity, a and b represent nodes respectively. The formula can make the signature transitive, which means that the signature can be calculated and verified by a third party to achieve the purpose of authorization to each node. Through the combination of key and node signature authentication, a complete network security firewall system is finally formed to protect the security of the remote storage system of art painting resources based on artificial intelligence.

2.2. Image Recognition Storage Theory and Method

As a modern science and technology, image recognition technology has been applied in many important fields with its superior functionality. Image recognition technology can not only perform a basic recognition of the image, but also perform a rough data calculation and inference on the creation date of the picture after setting the corresponding conditional data. Although this design does not need to discriminate the year of the painting image, it still needs to combine its image recognition function at the bottom with electronic storage technology to form an image recognition storage system. Image recognition storage is mainly based on frame-by-frame analysis of scanned video images. The scanned video images are stored in the long buffer interval and the short buffer interval respectively. Therefore, in image analysis, each frame of image should be compared with the previous frame of image, and the median of the comparison results should be taken as A_a, which represents the difference between the two regions. At the same time, compare any two images in the long buffer interval, take the median of the results, and record it as A_b, which reflects the average level of difference in the normal scene. The algorithm formula is as follows:

$$A_b = \log(A_a / A_b) \tag{5}$$

The algorithm formula is similar to the linear discriminant method. Both normal video sequences and abnormal video sequences are regarded as two different categories. When the long buffer is normal and the short buffer is abnormal, A_a represents inter-class difference, and A_b is intra-class difference. The larger the inter-class gap, the smaller the intra-class gap, and the smaller the value obtained by A_b. After completing the image scanning step, it is necessary to recognize the image. The recognition method is mainly to analyze the image gray level. Different gray levels represent different color types. The system can restore the scanned image by calculating the image gray level. Therefore, how to grayize the image is particularly important. In this design, the image binarization algorithm is mainly used in the image gray value, and the image gray value is converted through the image binarization algorithm. Among the common system formats, the color format is RGB, that is, red, green and blue primary colors. Various colors in nature can be obtained by mixing the three colors. Generally, each color needs 8 data representations, with the maximum value of 255, and the color zone depth of color can reach 24 bits, which is 16581375 colors. The system needs to spend a lot of time on this level of color depth processing, so the binary method is used to convert the color into black and white, so as to improve the processing speed of the system. After a color image is converted into a grayscale image, the color depth values of the three primary colors are the same, so an 8-bit grayscale data can be used to replace the original color data. The gray value conversion formula is as follows:

$$Gray = a*0.299 + b*0.587 + c*0.114 \tag{6}$$

a represents red, b represents green, and c represents blue. Because general chips are common and do not have floating-point data operation, this paper adds floating-point operation unit to the design system, and improves the algorithm formula through this unit. The improved formula is as follows:

$$Gray = (a*30 + b*59 + c*11 + 50)/100 \tag{7}$$

For ordinary hardware processors, it is very meaningful to save every sub-processor performance. In the process of processor calculation, the design found that the speed of division is slower than the speed of right shift. Without affecting the image quality, the formula has been adjusted accordingly and improved to:

$$Gray = (a*76 + b*150 + c*30) >> 8 \tag{8}$$

Through the formula operation, the scanned image can be grayed, and the system would transmit the grayed image data to the remote hardware device. When the user needs to check the image data, the system would restore the image data through inverse formula calculation according to the path algorithm, so as to achieve the purpose of remote painting resource image data storage.

3. Painting Resource Storage System Performance Test

From the moment of the existence of painting resource works, whether to meet their own pursuit of art or other purposes, their own existence has been endowed with certain value and significance. Just like the remote storage system of art painting resources based on artificial intelligence designed in this paper, when it is designed, it is to improve the storage difficulty in the field of art painting. Although the system design has been completed, whether the system can operate normally still needs further inspection and test. According to the system design concept of this paper, this paper intends to carry out the experimental test according to the design process in the experimental test stage, that is, the corresponding inspection and test of the network security firewall and image recognition storage. By subdividing each module and testing it one by one, the purpose of checking whether the system functions normally can be achieved.

3.1. Function Test of Network Security Firewall

In this paper, the network security firewall part is explained in theory and method in the network security theory and method. The network security firewall part of this design is mainly composed of the key part and the signature authentication part. Therefore, if people want to know whether the network security firewall system is running normally, they only need to test the key and signature authentication function, and judge whether it can run normally through the results. However, the key and signature authentication function basically operates in the form of data, so it is difficult to systematically quantify whether there are exceptions. In order to quantify the two functions, it is decided to take the system security as the measurement standard in the key part. The more average the system security is, the more normal the key function is. In the signature authentication part, the operation degree of the system node is taken as the standard of the signature authentication function. The higher the operation rate of the node, the more complete the node signature. In order to test the function of the network security firewall system, several groups of relevant test data were prepared for this test and tested by different methods. The following is the system security data table of different methods obtained through the test, as shown in Table 1:

Table 1. System safety data sheet

	Data 1	Data 2	Data 3	Data 4
Password	98%	96%	97%	20%
Fingerprint	99%	98%	97%	99%
Face recognition	100%	100%	97%	100%
Mean	99%	98%	97%	73%

From the system security data table, people can see that in the first three groups of data, the security level of the network security system is stable at more than 96%, and the fluctuation range of each group of data is very small. However, there are obvious data fluctuations in the fourth group of

data. The security of using password to log in to the system is only 20%. According to this result, there is reason to suspect that the network security firewall system is abnormal. In the process of artistic painting creation, the painter's painting consciousness may be affected by the objective environment. Also, in the process of system inspection and testing, the detection of the system would also be affected by some unexpected contingencies. In order to ensure the rigor of the test, the fourth group of data was replaced, and the test results showed that the fluctuation value of the data was stable again. So this paper checks and studies the fourth group of data, and finally finds that the security level of the system drops rapidly because the password is too simple.

After completing the test of network security, this paper also conducted a relevant data test on the operation rate of the signature authentication function. Before the test, it is necessary to count all nodes in the system and classify the nodes. Then this paper imports three groups of different types of data, and judges whether the signature verification function is normal according to the signature verification rate of the data in different sections. The following is the node signature authentication data table, as shown in Table 2:

Table 2. Node signature authentication data table

	Plate 1	Plate 2	Plate 3	Plate 4
Data 1	100%	100%	100%	100%
Data 2	100%	99%	100%	100%
Data 3	99%	98%	100%	100%

According to the data in the node signature authentication data table in Table 2, the coverage of the node signature authentication is not comprehensive in the first and second node plates. Although the minimum operation rate of the signature authentication of various data nodes is 98%, in the node signature authentication system, as long as 1% of the signature authentication fails to operate, it would seriously affect the use of the entire system. Therefore, according to the data in the node signature authentication data table, it can be judged that the node signature authentication function has certain problems. The inspection team then carried out a comprehensive inspection of all the signature nodes of the system, and finally found the root cause of the problem and improved and repaired it. After the repair, the overall node was tested again, and the results showed that the authentication operation rate of all nodes was 100%. Through the test of the two functions of the network security firewall, after repair and improvement, it is finally determined that the network security firewall system can work normally.

3.2. Image Recognition Storage Function Test

After completing the inspection and test of the network security part, it is necessary to test the image recognition and storage function, which is the focus of this design. As a way of artistic creation, painting image contains a section of the creator's emotion, and the creator's emotional story is contained in every detail of the painting image. Therefore, the scanning and recognition ability of painting images is particularly important for image art creators. In order to detect the image recognition storage function, several sets of image data are selected for scanning and recognition. The obtained image scanning and recognition data table is shown in Table 3:

Table 3. Data table of image scanning recognition

	Group 1	Group 2	Group 3	Group 4
Picture 1	100%	99%	100%	100%
Picture 2	99%	98%	100%	100%
Picture 3	98%	97%	97%	100%

Mean	99%	98%	99%	100%

It can be clearly seen from the image scanning recognition data table in Table 3 that not all of the four groups of 12 painting images selected in the test can be completely scanned and reproduced, but there is still a small gap in the details of some images. In order to determine whether the system function is abnormal, several groups of relatively simple images are selected for secondary detection in this test. The test result shows that the recognition rate of several groups of images is 100%, which means that the function is normal and can work normally. The reason why some images can not be fully scanned and identified is found to be caused by external interference after investigation. When the image is scanned for recognition, it may be interfered by external factors, such as light interference, vibration interference, etc. This kind of interference cannot be avoided. When scanning a relatively simple drawing, this kind of interference is relatively small. If the picture is too detailed and complicated, the requirements for the environment are relatively high, so people can only scan and identify in a relatively stable environment as far as possible.

After scanning the image, this paper stores the image according to the system process. The most direct way to detect the image storage function is to store the image and then restore it. The level of the restore rate determines the working state of the storage system. The following is the data table of image storage restoration rate stored according to the image scanning recognition test data, as shown in Table 4:

Table 4. Data table of image storage restore rate

	Group 1	Group 2	Group 3	Group 4
Picture 1	100%	100%	100%	100%
Picture 2	100%	0%	100%	100%
Picture 3	100%	0%	100%	100%
Mean	100%	33.33%	100%	100%

It can be seen from the image storage and restore data table that the restore rate of all images is 100% except the second and third images in the second group, which are 0. According to the conjecture of the detection team, if there is a problem with the storage system, the restoration of all images should have corresponding problems, but if there is no problem with the storage system, then all images should have no problems. In order to verify whether there is a problem with the storage system, the test team replaced the second set of data. If the restore rate is still 0, people can roughly determine that there is a problem with the storage system. According to the results after data replacement, the image restoration rate after replacement in this paper is 100%, which means that there is no problem with the storage system. In order to understand why the second group of data has a reduction rate of 0, the detection team investigated and analyzed the original second group of data, and finally found that the system could not open the image during image restoration due to the incorrect storage format of the image itself, so it could not be restored. Fortunately, the image itself data is still there, and the original painting image was obtained after the format conversion. Therefore, it is concluded that there are some problems with image storage format in the data restoration system. This situation is mainly caused by the conversion of image format by the image uploading device, which may cause the storage system to be unable to recognize and restore, but as long as the upload is successful, the image data would be retained in the storage system, and can be restored by special means.

4. Comparative Analysis of Traditional and Intelligent Painting Resource Storage Data

In the field of art painting, artists' mutual cooperation can improve the value of their creative art. Similarly, the combination of technology and art painting can better assist the development of

painting art. After confirming that the painting storage system can operate normally as a whole, in order to understand the advantages of its system performance more deeply and intuitively, it is decided to compare the intelligent painting resource storage system with the traditional painting storage method, so as to comprehensively analyze the advantages and disadvantages of the system.

4.1. Comparison of Safety and Integrity Data of Painting Resources

For the preservation of an object, the most important thing anyone cares about is the security and integrity of the object, which is the same for art lovers. Therefore, as the two most important elements of art painting resource storage, this paper would use the traditional image storage method (traditional method) and the artificial intelligence painting resource remote storage system method (system method) to compare the painting resource security and painting resource integrity data, and judge and analyze the strength of the two methods according to the data. In order to conduct data analysis, this paper randomly selected several groups of data to carry out data statistics for two different methods. The following is the comparative analysis of the safety and integrity data of painting resources, as shown in Figure 2: (a is the comparative analysis of the safety data of painting resources, and b is the comparative analysis of the integrity data of painting resources)

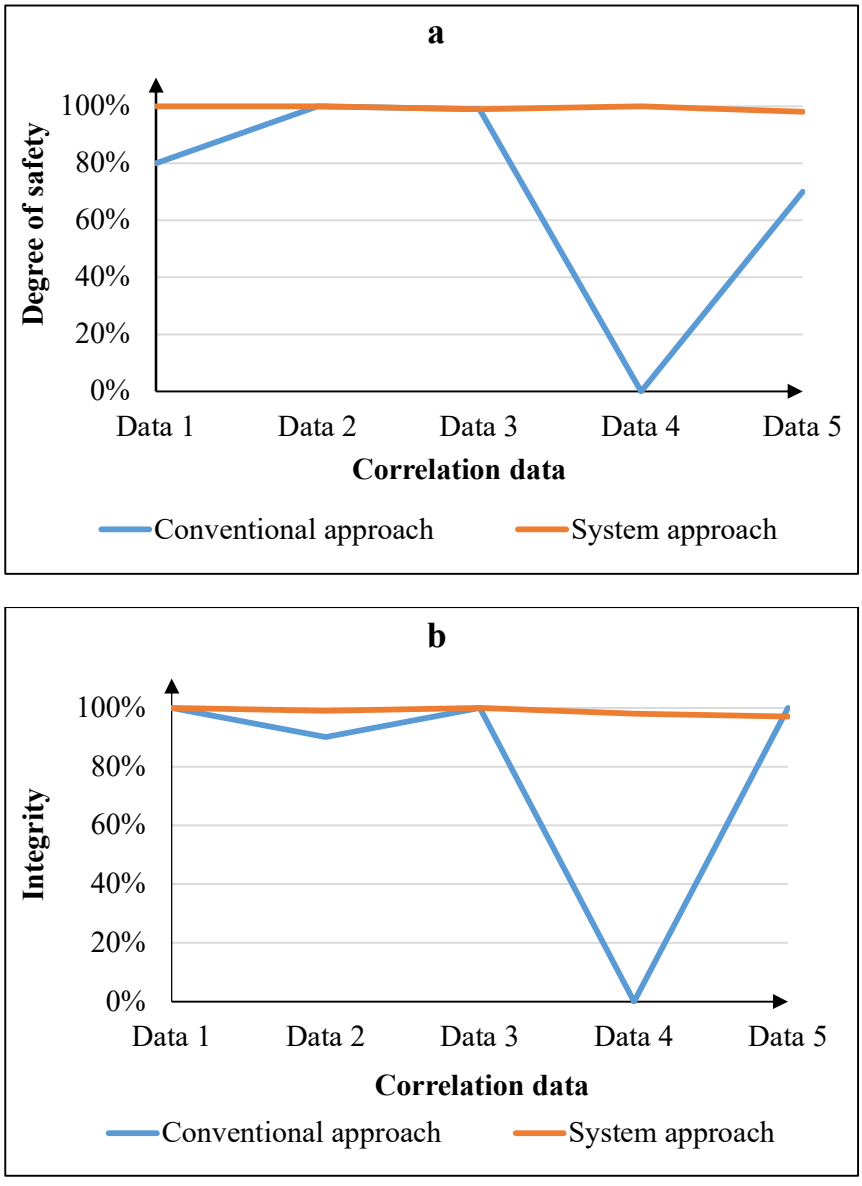
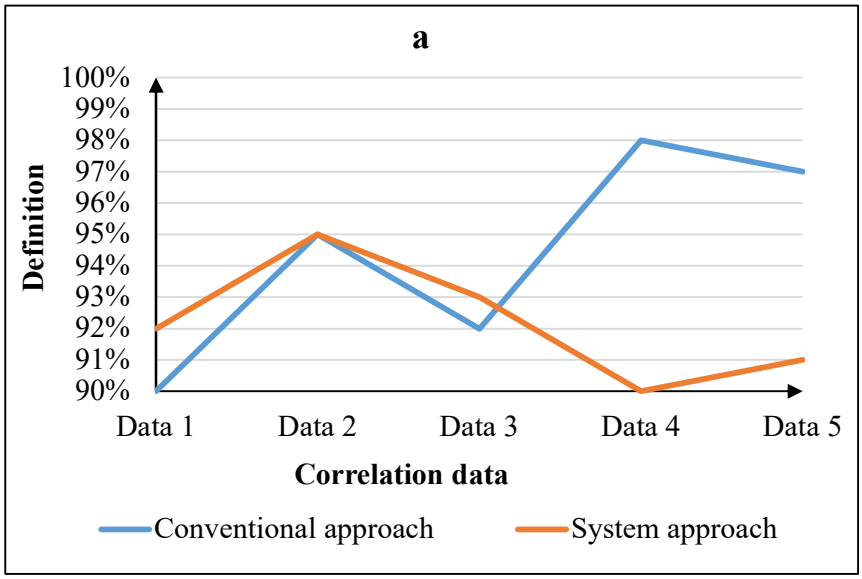


Fig. 2. Comparative analysis of safety and integrity data of painting resources

The data trend in the figure is analyzed by comparing the safety and integrity data of painting resources in Figure 2. It can be clearly seen that whether in terms of image security rate or image integrity rate, the traditional way of broken line fluctuation is very large, and in the fourth group of data, the security rate and integrity rate have reached 0%. The reason for this situation is not difficult to understand. Traditional image storage methods are mainly based on physical storage, and physical painting storage is quite difficult. Paintings may be disturbed by a series of natural or human factors, such as fire, moisture, oxidation, etc., which would lead to great changes in the safety and integrity of paintings. The fluctuation in the security rate and integrity rate is very small when the system method is used to store the image. In terms of the safety rate data of the system method, the maximum safety rate is 100%, and the minimum safety rate is 98%, and the difference of safety rate is only 2%. The painting image integrity is also excellent. The highest integrity rate is 100%, the lowest is 97%, and the difference of integrity rate is only 3%. The high safety and integrity rate of painting images is mainly due to the image data conversion of this method. The storage of electronic data is far simpler than the storage of physical objects, and the reproducibility of its data is far less difficult than the reproduction of physical paintings. Therefore, the system method is superior to the traditional method in terms of the safety and integrity of painting images.

4.2. Comparison of Drawing Resource Definition and Saving Cost Data

In order to ensure the rigor of the comparative analysis, in the comparison of the definition data of painting resources, it was decided to randomly select part of the data from the painting data with high security and integrity in the traditional way as the comparison data of the definition of painting resources. Through the comparison of the data in the two ways, the following comparative analysis chart of painting resource definition and saving cost data is obtained, as shown in Figure 3: (a is the comparative analysis chart of painting resource definition data, and b is the comparative analysis chart of painting resource saving cost data)



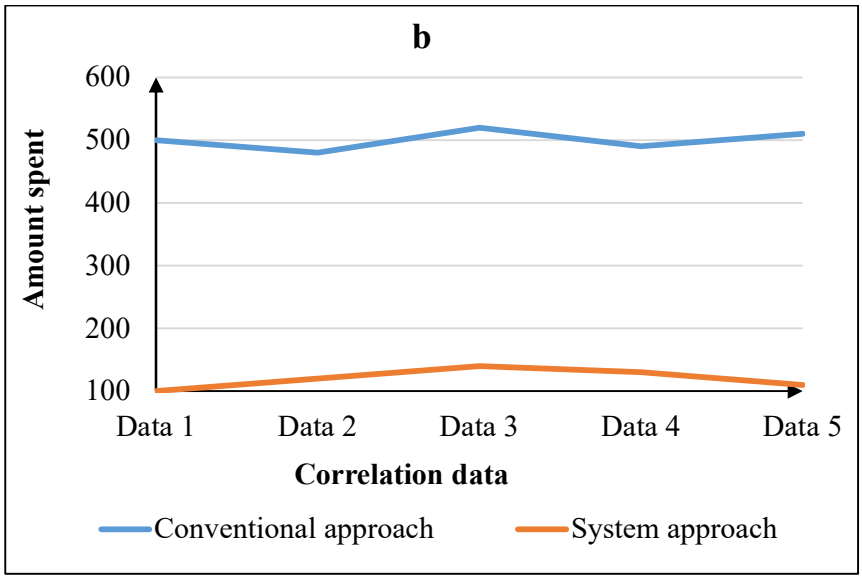


Fig. 3. Comparison and analysis of drawing resource definition and saving cost data

Through the comparative analysis of the data in Figure 3 between the definition of painting resources and the saving cost data, people can see that in terms of the definition of painting resources, there is no big difference between the traditional method and the system method in the definition of painting resources, both of which are stable at more than 90%. However, in contrast, the definition of the traditional method is slightly higher than that of the system method. The minimum definition of the system method is 90% and the maximum is 95%. The traditional method has a minimum definition of 90% and a maximum of 98%. The main reason for this is the essential difference between the two methods. The traditional method is based on the original entity. Therefore, even if it may be affected by many factors in reality, as long as it is properly preserved, the image definition would hardly change. In contrast to the system method, due to the technical factors and the reasons of the conversion of the painting image itself, there must be some deviation in the restoration of the image definition. Although this kind of deviation would be controlled within a certain range, the final result is still slightly worse than the traditional method. The system method also has its advantages. Compared with the traditional method, the system method is particularly cheap in storage costs. The traditional way of painting storage costs 520 yuan at the highest and 480 yuan at the lowest, while the system way costs 140 yuan at the highest and only 100 yuan at the lowest. The main reason for the huge cost of painting preservation is that it is difficult to preserve physical painting resources, so it needs to spend a lot of money to assist. The cost of system mode is almost only hardware cost. Therefore, in terms of the cost of painting preservation, the systematic way is far lower than the traditional way.

4.3. Comparison of User Survey Data of Painting Preservation Methods

After comparing and analyzing the data of the two methods for saving painting resources, the results of performance show that the performance of the traditional method is basically inferior to the system method in terms of the definition of painting resources, except that the performance of the traditional method is the same as that of the system method. No matter the traditional method or the system method, only when it is used by people can it have the meaning and value of existence. In order to compare the two ways which are more suitable for the needs of the crowd, this paper selected 100 painting lovers, divided into two categories, five groups in each category, 10 people in each group, to understand the feelings of these 100 painting lovers on the two methods through the form of surveys. The following is a comparative analysis of 100 painting enthusiasts' method

satisfaction and willingness to use data, as shown in Figure 4: (a is a comparative analysis of method satisfaction data, and b is a comparative analysis of method willingness to use data)

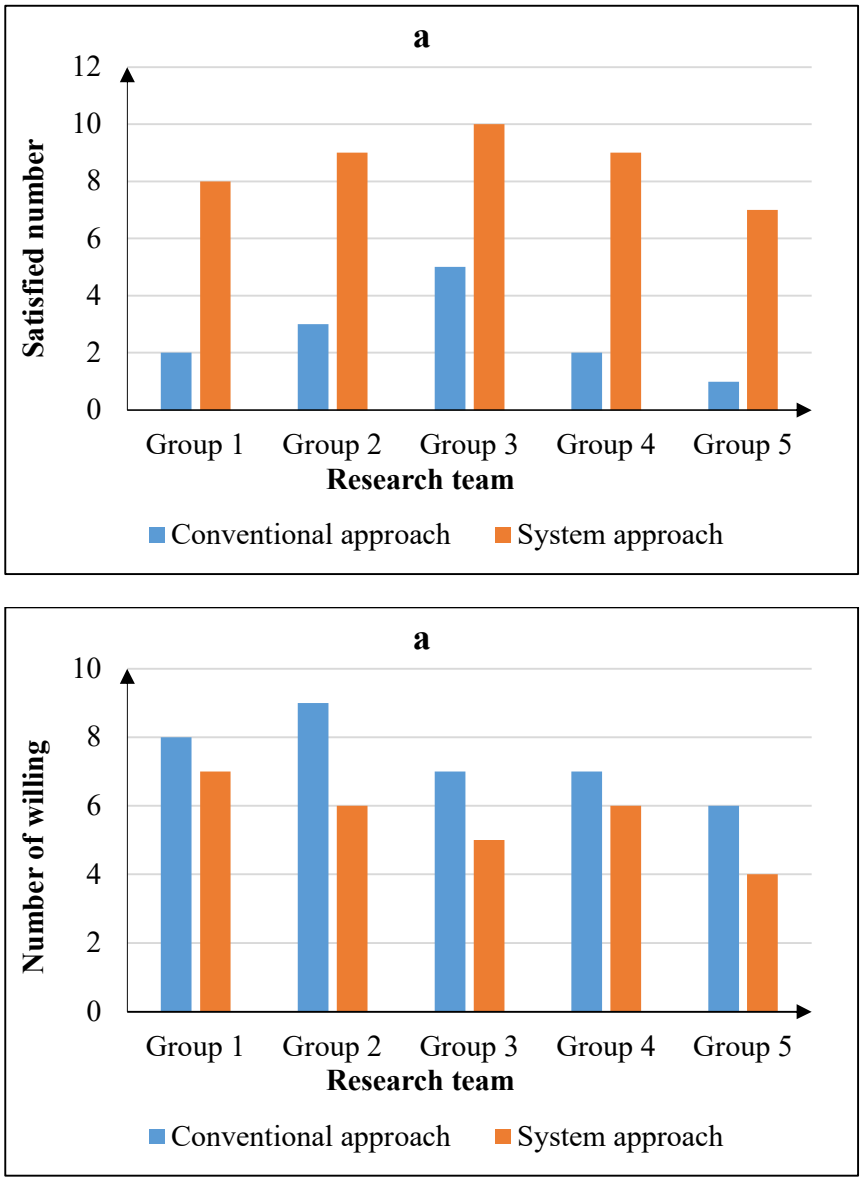


Fig. 4. Comparative analysis of method satisfaction and willingness to use data

According to the data in Figure 4, it can be clearly seen that in terms of method satisfaction data, the highest value of traditional method satisfaction is 5, the lowest value is only 1, and the overall satisfaction rate is only 26%. The highest satisfaction rate of the system method is 10, and the lowest is 7. The overall satisfaction rate is 86%. On the data of willingness to use, the number of people willing to continue using the traditional method is from 6 to 9, and the overall willingness to continue using is 74%. On the contrary, the lowest number of people willing to continue using the system method is 4, and the highest number is only 7. The overall willingness to continue using the system method is 56%. Through the data analysis in the comparative analysis chart of method satisfaction and willingness to use data, a very strange phenomenon was found. Obviously, the satisfaction of the traditional method is not as good as that of the system method, but most people are still willing to continue to use the traditional method rather than the system method. In response to this strange phenomenon, the investigators made a deep understanding of the problem, and finally came to the conclusion that although the traditional method has many disadvantages, the remaining

painting resources are the most realistic, which can not be replaced by any virtual data. Therefore, most people are still reluctant to use the system method to store painting resources.

5. Conclusions

Through the design and detection of the painting resource storage system, the creation of the remote storage system of art painting resources based on artificial intelligence was finally completed. This system not only combines artificial intelligence technology, but also digitizes traditional painting image resources and saves painting resources in the form of data, which is a breakthrough innovation in the field of art painting. The digitization of image resources can transfer and transfer painting resources better and faster, and solve the problem of difficult transportation of painting resources that has been puzzling the field of art painting for a long time. Although the remote storage system of art painting resources based on artificial intelligence is superior to the traditional storage method of painting resources in terms of performance, there are still many art painting lovers who cannot accept it because of the particularity of the system method. In the field of art painting, the remote storage system of art painting resources based on artificial intelligence has a long way to go.

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