ISSN: 2182-2069 / E-ISSN: 2182-2077

Digital Preservation and Network Security Protection: A Case Study of Landscape Painting in Ming Dynasty

Xin Xu[1*], and Wen Lu[2]

[1*] Ph.D Candidate, Department of Fine Arts, International College, Krirk University, Bangkok, Thailand. spark1116@126.com, https://orcid.org/0009-0002-7121-3292

[2] Associate Professor, Department of Fine Arts, International College, Krirk University, Bangkok, Thailand. hades723842430@163.com, https://orcid.org/0009-0007-8861-1779

Received: July 11, 2024; Revised: August 18, 2024; Accepted: September 23, 2024; Published: November 30, 2024

Abstract

In the global wave of digitalization, the digital preservation of Chinese Ming Dynasty landscape paintings has achieved remarkable results. According to statistics, major museums in China have scanned more than 60% of Ming Dynasty landscape paintings with high precision, and the digital preservation work covers a wide range. However, the accompanying cybersecurity challenges cannot be ignored either. In recent years, cyber attacks on digital platforms of cultural heritage have occurred frequently. Worldwide, the number of such attacks has exceeded 3 million every year, of which attacks on works of art account for as high as 15%. Faced with this grim situation, China has taken a series of measures to strengthen network security protection. By upgrading encryption technology, optimizing network security protection systems, and conducting regular network security training and drills, China has made remarkable progress in ensuring the security of digital works of art. According to the latest data, since the implementation of enhanced protection measures, the number of cyber attacks on the digital platform of landscape painting in Ming Dynasty in China has decreased by 35%, effectively protecting precious cultural heritage from cyber threats.

Keywords: Digital Preservation, Network Security Protection, Landscape Painting of Ming Dynasty.

1 Introduction

In the digital age, the protection and inheritance of traditional cultural heritage are facing unprecedented opportunities and challenges. Ming Dynasty landscape painting, as the treasure of Chinese painting art, not only carries profound historical and cultural values, but also embodies the oriental aesthetic spirit (Kovačević et al., 2020). However, with the passage of time, these precious paintings are at risk of natural erosion and man-made damage. Digital preservation, as a new protection means, provides a brand-new possibility for the protection of landscape paintings in Ming Dynasty (Jamil et al., 2024; Gu et al., 2020). At the same time, however, the problem of network security has also become prominent,

Journal of Internet Services and Information Security (JISIS), volume: 14, number: 4 (November), pp. 249-262. DOI: *10.58346/JISIS.2024.I4.015*

*Corresponding author: Ph.D Candidate, Department of Fine Arts, International College, Krirk University, Bangkok, Thailand.

which has become a challenge that cannot be ignored in the process of digital preservation (Jiang et al., 2022).

The digital preservation of landscape paintings in Ming Dynasty refers to the use of modern technologies such as high-precision scanning and 3D modeling to transform every detail of the original works into digital information, so as to realize non-destructive reproduction and permanent preservation of works of art (Singh et al., 2022; Franke et al., 2022). This process can not only effectively avoid physical damage in traditional preservation methods, but also enable global audiences to cross the boundaries of time and space and enjoy these artistic treasures at close range through the Internet platform, thus promoting cultural exchanges and art popularization.

However, the implementation of digital preservation is not smooth sailing, and network security protection has become a key link (Yousefi Kia et al., 2023; Slunjski et al., 2022). With the circulation of digital information of works of art, how to prevent data from being tampered with and misappropriated, how to protect the copyright of works of art and the network protection of landscape paintings have become urgent problems to be solved (Uuganbayar et al., 2021). Once a digital file of a landscape painting of the Ming Dynasty is maliciously tampered with, it will not only destroy the original appearance of the artwork, but also cause copyright disputes and damage the rights and interests of artists and collectors (Matey et al., 2022). Therefore, it is an indispensable part of digital preservation to establish a sound network security protection system, adopt advanced encryption technology, authority management mechanism, and regular data backup and recovery strategies.

In addition, network security protection also involves the improvement of laws and regulations. With the popularization of digital preservation, how to clarify the copyright ownership of digital artworks at the legal level, how to define the right to use digital information, and how to deal with cross-border data flow and protection are all issues that need to be discussed and solved by the international community. For example, by formulating internationally recognized standards for the protection of digital artworks, a safer and more standardized environment can be provided for the digital preservation of landscape paintings in the Ming Dynasty. Digital preservation provides an unprecedented opportunity for the protection and dissemination of landscape paintings in Ming Dynasty.

2 Digital Preservation and Network Security Protection Technology based on Landscape Paintings in Ming Dynasty

2.1. Landscape Painting of Ming Dynasty

Ming Dynasty landscape painting, as a treasure of ancient Chinese painting art, not only shows Ming Dynasty painters' profound understanding and artistic pursuit of nature, but also carries rich historical culture and aesthetic concepts (Hou et al., 2023). The creation of landscape paintings in this period not only reached an unprecedented height in techniques, but also reflected the philosophical thinking of Ming Dynasty literati on nature, universe and life in ideological connotation.

The styles of landscape paintings in Ming Dynasty are diverse, from delicate "meticulous brushwork" to free and unrestrained "freehand brushwork", all of which show the unique personality and artistic pursuit of painters. Among them, the Wu School of Painting, represented by Shen Zhou and Wen Zhengming, has influenced generations of artists with its fresh and elegant style and literati feelings. The Zhejiang School, represented by Dai Jin and Wu Wei, pays more attention to the layout and momentum of the picture, showing the majestic beauty of landscape painting. Landscape paintings in

Ming Dynasty are also extremely rich in themes, including the depiction of natural landscapes, the reproduction of historical stories and the pursuit of ideal realm. In these works, landscape is no longer a simple background, but a carrier to express painters' emotions and thoughts. For example, Shen Zhou's "A Spring Gathering" not only depicts the beautiful spring scenery of willows sprouting and peach blossoms blooming, but also expresses his yearning for seclusion life through landscapes; Tang Yin's "Autumn Wind and Fan Picture" expresses his feelings about the impermanence of life through the combination of landscape and characters. The techniques of landscape painting in Ming Dynasty have also reached the realm of perfection. Painters not only master the traditional techniques of "dividing ink into five colors" and "outlining and dyeing", but also innovate on this basis and develop new techniques such as "breaking ink" and "splashing ink", which make the pictures more layered and dynamic. In addition, painters in the Ming Dynasty also paid attention to the creation of artistic conception of pictures, and created an ethereal and distant artistic conception through blank space and contrast between distance and near, so that viewers could feel the tranquility and harmony of the world in the paintings while appreciating the paintings.

Figure 1: A Spring Gathering by Shen Zhou

Landscape painting in Ming Dynasty is not only an important chapter in the history of Chinese painting, but also a precious wealth in the treasure house of world art. They not only reflect the cultural features of the Ming Dynasty society, but also reflect the awe of nature and the pursuit of art in Chinese traditional culture. Through these works, we can not only appreciate the aesthetic charm of landscape painting in Ming Dynasty, but also feel the spiritual world of ancient Chinese literati and their yearning and pursuit of ideal life.

2.2. Network Data Security Optimization Technology

Network data refers to any electronic recording of information in cyberspace, that is, all kinds of electronic data generated through the network (Dehghani et al., 2023). "Network data" is a sub-concept of "data". Compared with data, the extension of network data is smaller. The prerequisite for the generation of network data lies in the way of "through the network". Under the background of the era of big data, the network platform has become the way of interaction between people, society and society, and countries, and the interactive transmission between data is no exception (Park & Lee, 2020). However, in addition to the Internet, data can also exist on other media such as paper. For example, in newspapers, the current population proportion and base number of China in a certain year usually appear. Therefore, the method of "through the Internet" has become the key point of electronic networking of data.

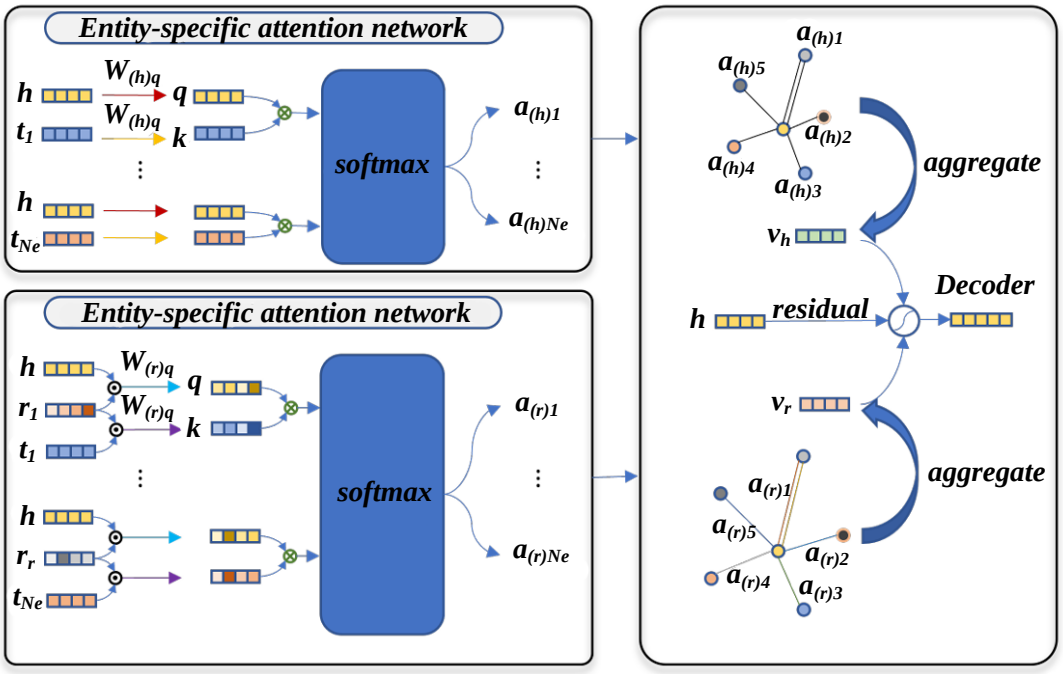

Figure 2: Network Data Security Optimization Model

Figure 2 shows the network data security optimization model. Network data has the characteristics of recordability, objectivity and availability. The characteristic of recording is the specific description of each person, thing, process and subjective consciousness, such as the chat content on the Internet, someone's electronic log, and the record of the whole process of classroom teaching through Tencent conference (Andrasko et al., 2021). The embodiment of network data recordability is also closely related to the formation of this data. All kinds of real data need to be described and saved through a certain medium, and uploaded through electronic network to finally form network data. The characteristics of objectivity require that network data be independent of human will, and can present its main content objectively and factually (Kalogiannidis et al., 2023; Zhou et al., 2023). The feature of availability, which means that network data has the function of a tool. Network data is usually used as a tool in processing various transactions, because the ultimate goal of using network data is to serve people, and it can be more convenient to carry out various tasks, so network data has important tool value (Yin et al., 2024). Different from traditional network data, the current network data has a larger volume, more diversified ways of generation, and unstructured characteristics. However, the traditional network data simply records information in the form of tabular documents, and can only use the existing database for relevant analysis and processing. People can only perceive data, understand data and make limited use of data through superficial data. Because the type of data is relatively single, the value created can only float on the surface (Ye & Zhao, 2022; Zhou et al., 2020). However, in the context of the era of big data, network data can further explore its deep connotation, and at the same time, it can also process all kinds of unstructured content such as images, sounds and files. It can also mark and visualize all kinds of network data when it is put into storage, which can create extraordinary tool utilization value.

3 Research on Digital Protection Technology of Landscape Painting in Ming Dynasty

3.1. Principles of Digital Protection

Authenticity originated in medieval Europe, was cited in the field of heritage protection in 1960s, and became a core concept in world heritage and protection (Lehto & Limnéll, 2021; Enayaty-Ahangar et al., 2020). The principle of digital reproduction of authenticity is: the digital protection of landscape paintings in Ming Dynasty needs to combine the actual situation of history, conduct multi-party investigations, and use digital technology to reproduce landscape painting scenes and other objects on the basis of respecting history; The digital records of characters need to be truthfully verified and respected, without misinterpreting the guidance or interfering with the content, and conveying the real content and intention expressed by the characters.

Software applications under the concept of sharing are booming, but "sharing" can actually be traced. The original concept of sharing can be seen in the common distribution of common labor in primitive society. American librarians believe that resource sharing is that each member has available content that can be contributed to other members, and is willing to provide partnership when needed (Chansun & Kil-Ho, 2021; Dubal et al., 2024). The digital protection of Ming Dynasty landscape painting content is based on the principle of resource sharing, which is convenient for the follow-up research on Ming Dynasty landscape painting content. Through resource sharing and communication, a relatively recognized technical standard for digitalization of Ming Dynasty landscape painting content can be established in the industry, which is more conducive to the display and dissemination of landscape painting.

3.2. Research on Content Digitization Technology of Landscape Painting in Ming Dynasty

Three-dimensional modeling technology is widely used in landscape painting, design and other majors. Computer three-dimensional modeling technology mainly uses computers as the carrier to make models with 3DMAX, Maya, sketchup, CAD, solidworks and other model making software. Computer 3D modeling technology can be used to digitally reconstruct the internal and external scenes and products of landscape paintings that cannot be reconstructed or have changed, and then use graphics and image software such as Photeshop to modify the materials. As long as you have detailed original pictures or drawings and data about landscape painting scenes or products, you can achieve high-precision restoration of landscape painting scenes and products (Priyanka & Hussain, 2021; Li et al., 2022). In the early stage of computer 3D modeling, it is necessary to collect the data to be modeled from many parties. The original pictures or drawings mainly express the appearance content, scale ratio, shape, color, material, etc. of landscape painting scenes and products. If there is black-and-white or photo damage, it is necessary to interview professional institutions or figures with relevant memories many times. If there is no reference for the content of relevant characters' memories, it is necessary to learn from the hand-drawn papers of landscape painting scenes or products at that time (Fernández-Caramés, 2019; Apollonio et al., 2021). At the same time, we have a clear understanding of the detailed parameters of the modeling content, so as to avoid the problem of large proportion and size in the computer modeling process, which will lead to distortion of the final model. If there is a missing data source, you can refer to the actual landscape painting size for landscape painting scenes. The source of early data resources must be true and traceable. In the production process, reasonable selection is made according to the size ratio according to the requirements. After the post-production model is made, appropriate and real

materials are selected according to the data resources, so as to truly restore the original damaged landscape painting items.

Digital preservation is to convert words, pictures and other contents into digital information and store them effectively for a long time. The change of printing industry reflects the change of technology in the preservation methods of two-dimensional content such as text and photos. The earliest poetry printing is the preservation technology of text content, while literary content is spread through the analog technology of movable type printing and reproduction. The development of printing technology has experienced three eras: analog technology, the integration of analog technology and digital technology, and now adding digital technology, and it has developed to the current digital preservation master: to use digital printing technology (CTPrint). As Pu Jialing said, "Computer-to-printing CCTP) is a typical technical feature of this era." At this stage, computers, laser scanners, printers, video cameras, digital cameras and other hardware equipment are mainly used for digital collection and recording of two-dimensional cultural relics. Most laser scanners are fixed scanning, and do not directly touch the scanned text and photos to avoid secondary injury.

For the contents that have been saved in the early stage, first, the portrait is physically repaired, the negative is developed, and then the photo contents are stored electronically through two-dimensional scanning; The second is the existing content that needs to be saved: for text, you can first use a scanner or camera to electronically store documents or pictures, and convert the text content into an electronic document form that can be edited and operated by a computer, so as to avoid saving missing words after irreparable damage over time in the later period. Pictures and images are counted in the form of electronic documents, audio, photos, etc. with the help of corresponding equipment; Two-dimensional digital acquisition does not require much investment in human resources and professional skills. With the development of application software, mobile phones can be completed independently and easily operated, and the stored content can be quickly obtained. At the same time, the scanned content can be downloaded and used repeatedly through the network or replica and photocopying. However, some precious photo files need to be adjusted to external conditions such as light during the scanning process. There are some problems such as errors in document content scanning. In addition, the content displayed by two-dimensional digital scanning is not three-dimensional enough, and the single picture or text content is thin and needs to be explained and annotated. This requires the original restoration of the protected content, and the damaged part should be supplemented after querying the information or asking relevant characters. It must be digitally preserved based on the principle of respecting historical truth.

3.3. Establishment of Landscape Painting Database

After digitally collecting the landscape painting heritage of Ming Dynasty, it is necessary to digitally store and protect it, use keywords to search on the Internet, and divide four databases that meet the keywords according to the access mode and content, focusing on professional fields: the full-text database of Chinese landscape painting industry standard at the library resource entrance and the database of landscape painting materials owned by National Defense Industry Press. The database resource belongs to the entrance of the campus and cannot be logged in to the external network. The database resource is about the content of landscape painting industry standard documents, and the landscape painting material database may be secretive due to the content; It is divided into internal and external networks. The external network accessed by ordinary tourists also requires user passwords. After entering it, although they log in as tourists, they can still query and read the research literature and

book content related to landscape painting materials online. Compared with the full-text database of Chinese landscape painting industry standard, the openness is higher, and both databases require relevant professional background knowledge in terms of content. Databases focusing on popular science education: Chinese Landscape Painting Gallery and AVIC Media's Landscape Painting Online Database.

4 Network Framework of Landscape Painting Network Protection

4.1. Landscape Painting Network Protection Security Protocol

Figure 3 shows the optimization framework of landscape painting network protection security protocol. Landscape painting network protection security protocol is a comprehensive and sophisticated network security management system, which integrates modern encryption technology, firewall strategy, intrusion detection and prevention system, user behavior analysis and other multi-dimensional security measures. This protocol ensures the security of sensitive information in network transmission by implementing high-strength data encryption; At the same time, build a multi-level defense system to resist various network attacks from the outside; In addition, the protocol also emphasizes the strictness of identity authentication and access control, ensuring that only strictly verified legitimate users can access network resources; Finally, the protocol also includes a perfect data backup and recovery mechanism to deal with possible network failures or security incidents, and ensure the security of critical data and business continuity.

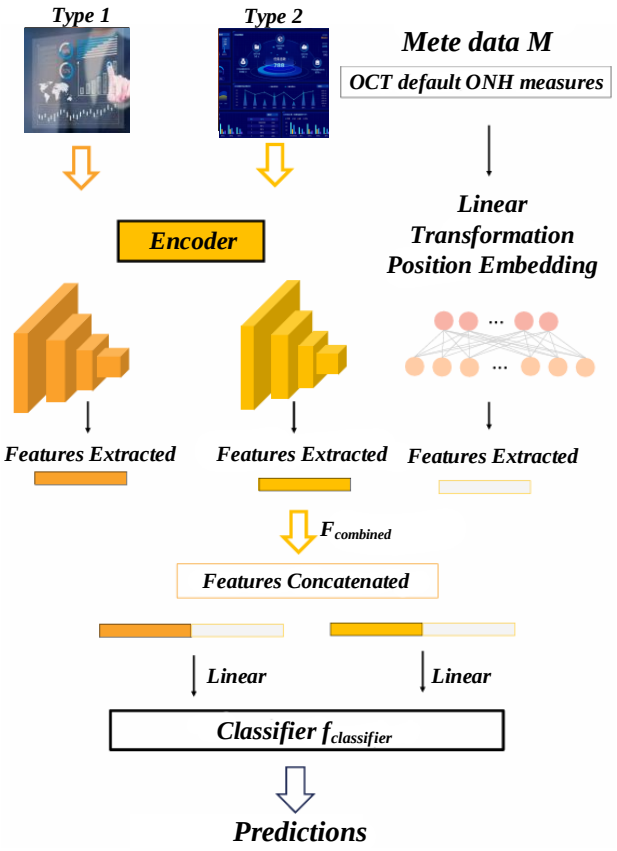

Figure 3: Optimization Framework of Landscape Painting Network Protection Security Protocol

4.2. Network Optimization Framework for Landscape Painting Network Protection

In Table 1, we detail the number of rounds required for the online phase of each network layer security protocol and the complexity of these protocols in landscape painting communication scenarios. From the link layer to the application layer, different levels of protocols show different online interaction efficiency and data transmission characteristics. Specifically, link layer protocols usually focus on efficient and low-latency authentication and encryption processes, and their online rounds are relatively small, making them suitable for scenarios with high real-time requirements. As the network level rises, especially when it reaches the application layer, security protocols not only need to deal with more complex authentication and access control logic, but may also involve the round-trip transmission of more data packets, resulting in a significant increase in the number of online rounds and communication complexity.

Table 1: The Number of Rounds in the Online Stage of each Network Layer and the Communication Complexity of Landscape Painting

Safety protocols	Number of rounds	Communication complexity of landscape painting
FPConv	1	2 (m-n+1) 1
BPConv	1	2(m²+m²)1
FPReLU	3	6m1
BPReLU	3	6m '1

The security of specific protocols within the FPGA framework will be demonstrated based on the ideal/realistic simulation paradigm. The framework structure is shown in Figure 4. If the probabilistic polynomial time simulator can generate a view indistinguishable from the real protocol calculation based on the input and output, then the protocol is safe in Privmaxpool.

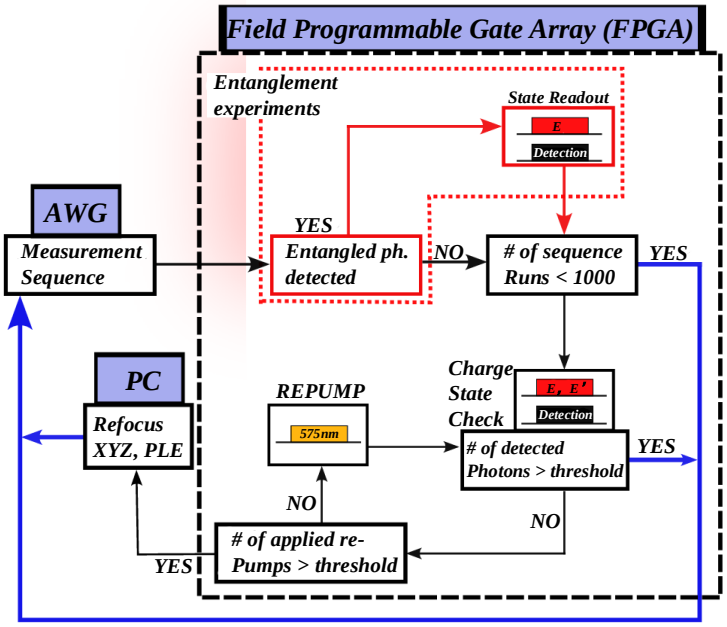

Figure 4: FPGA Framework

5 Results and Analysis

Ideal multiplication is the core of convolution operation and matrix multiplication, and its efficiency has a great impact on the whole landscape painting network protection framework. Therefore, we first evaluate the performance of multiplication protocol. Our multiplication protocol has the characteristics that the traffic of landscape painting is independent of the number of multiplication gates. The core of convolution operation and matrix multiplication is actually the addition of multiple multiplication gates. Based on the advantage of multiplication protocol, our secure convolution protocol and secure matrix multiplication protocol can greatly reduce the amount of information sent. Our multiplication protocol also has the characteristic that the traffic of landscape painting has nothing to do with the number of inputs of multiplication gates. As shown in Table 2, the complexity of landscape painting communication in the online stage is always 2l, where l represents the bit length.

Table 2: Traffic Analysis of Landscape Painting in the Online Phase of Multiplication Protocol

Number of inputs to the multiplication gate	Communication complexity of landscape painting
3	2a
4	2a
5	2a
6	2a
7	2a
8	2a

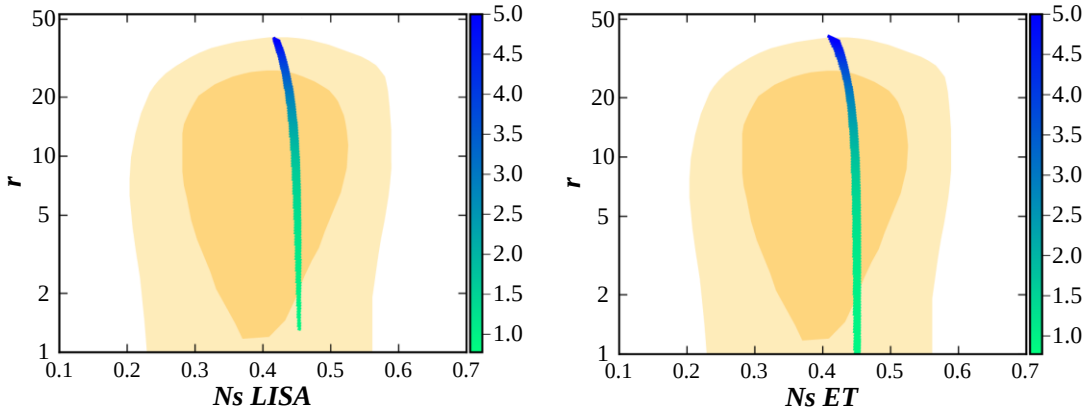

Figure 5: Performance Comparison between different Multiplication Protocols

In Figure 5, we test the running time and landscape painting communication overhead of the online phase between the traditional multiplication protocol and our multiplication protocol in the local environment. The experimental results confirm that the running time and landscape painting communication volume of our protocol are significantly lower. In this study, the traditional secret sharing technology and bit decomposition method are used for security comparison, and its running time and landscape painting traffic will increase with the bit length l. The bit length of MINIST database is 32, so if the method of the scheme is applied to CNN protected by landscape painting network, it will

bring huge landscape painting communication overhead. Our comparative protocol data analysis is shown in Figure 6, and the study still uses the method of bit decomposition, but optimizes it with new secret sharing techniques. Because of the high consistency between arithmetic sharing and Boolean sharing in this study, and the advantages of multiplication protocol, our comparison protocol achieves that the traffic of landscape painting is independent of bit length. In our comparison protocol, the reconstruction of v − − type can be moved to the offline stage to reduce the traffic of landscape painting, and the calculation of the online stage can be completed by sharing protocol and multiplication protocol. In the local environment, we tested the running time and communication cost of the traditional comparison protocol and our comparison protocol respectively. The experiment shows that the running time and communication cost of our protocol are obviously lower than the previous work, and the traffic volume of landscape painting is independent of bit length.

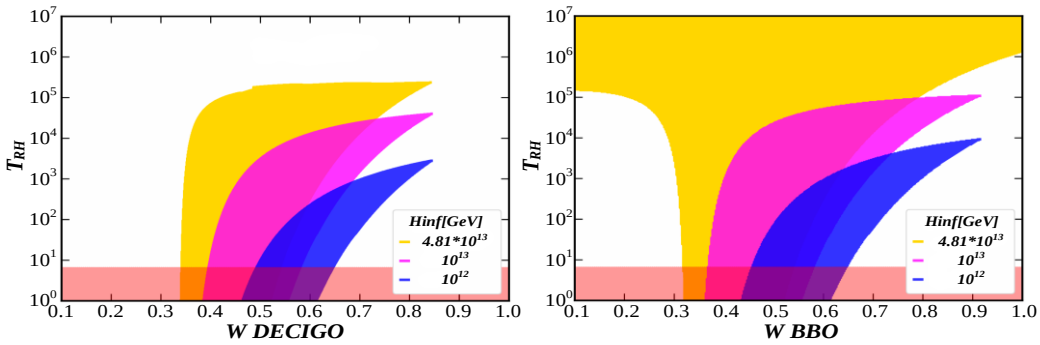

Figure 6: Performance Comparison between different Comparison Protocols

All computational operations and security protocols required for forward propagation and back propagation processes, the number of online rounds of security protocols required by these network layers and the complexity of landscape painting communication are shown in Table 3. The main basic operations of this framework are multiplication, comparison and softmax, and the performance analysis of its security protocol has been introduced above. All the security protocols in our PPCNN framework are based on the new secret sharing technology, which can significantly reduce the communication overhead of landscape painting. In our framework, users calculate shares of images using secret sharing techniques and upload them to cloud servers for training and prediction.

Table 3: Performance Analysis of each Layer of Network Optimization Layer

Layer	FP	BP
Conv	3.5	4.7
ReLU	4.2	4.6
Maxpool L	3.1	2.6
Conv	4.6	1.7
ReLU L	3.8	7.5
Maxpool L	3.6	2.7
FC I	4.2	3.5
ReLU L	4.7	0.5
FC L	3.9	4.7
Softmax L	4.1	1.5

We tested the network security decision tree trained from 4 datasets, including Nursery, Cancer, Housing, and Spambase, under the condition of 88.5 ms latency and 220Mbps bandwidth. The specific parameters of network security decision-making are shown in Table 4. Latency and bandwidth are emulated via Linux tc tool. The experimental data of the two control protocols were derived from the original paper. The protocol in this paper is implemented by MP-SPDZ framework, and the bit length is set to 64.

Table 4: Network Security Decision Parameters

Network security decision tree model	**Number of attributes**	**depth**	**Number of decision nodes**
Nursery	9	9	13
Heart-disease	14	4	10
Credit-screening	17	8	64
Cancer	1	9	50
Housing	63	6	30
Spambase	14	3	12

First, we show the comparison with the experimental results of network protocols. The experimental data of the client is shown in Table 5. In this protocol and other protocols, the customer needs to send the secret share of the generated feature vector to the cloud server at the beginning, and receive the secret share of the predicted result after the cloud server completes the calculation. Different from other protocols, the protocol in this paper can download the secret share of the prediction result between, while other protocols require the customer to download the secret share of two vectors with dimensions, which leads to its computational cost and landscape painting communication cost increasing exponentially with the increase of the depth of the network security decision tree. For example, for Spambase with a depth of 17, other protocols require 25.3844 ms of computation time and 4096.89 KB of landscape painting communication cost, while the protocol in this paper only requires 0.246 ms of computation time and 2.7 KB of landscape painting communication cost. Such an obvious gap shows that on the client side, with the increase of the depth of network security decision tree, the protocol in this paper is more efficient than other protocols.

Table 5: Comparison of Client Experiments

Network security decision tree model	**Calculation time (ms)**		**Landscape Painting Communication Cost (KB)**	
	Other	This article	Other	This article
Heart-disease	0.00396	0.2079	0.495	0.693
Credit-screening	0.00605	0.2178	0.803	0.803
Cancer	0.05731	0.1705	8.954	0.495
Housing	1.72568	0.2365	281.82	0.693
Spambase	27.92284	0.2706	4506.579	2.97

The comparison of running time between the Ma et al protocol and the network security decision tree model in this paper, as shown in Table 6, shows that the protocol in this paper has more advantages when the network security decision tree is deeper.

Table 6: Comparison of Running Time

Network security decision tree model	Ma et al. (s)	This article (s)
Nursery	0.946	2.948
Cancer	1.793	2.959
Housing	3.02	2.97
Spambase	4.378	2.959

The communication cost comparison of landscape painting is shown in Figure 7. It can be seen from the figure that the protocol in this paper requires less communication cost of landscape painting, whether it is the preprocessing stage or the online stage. In the preprocessing stage, the protocol in this paper only needs the preprocessing of "daBit" technology, while Ma et al., 's protocol needs the preprocessing of GC, OT and other technologies and the ciphertext of the encrypted network security decision tree model, which makes the protocol in this paper save 486 times the communication cost of landscape painting at most compared with Ma et al. 's protocol in the preprocessing stage. In the online stage, the protocol in this paper saves 7 to 28 times the communication cost of landscape painting.

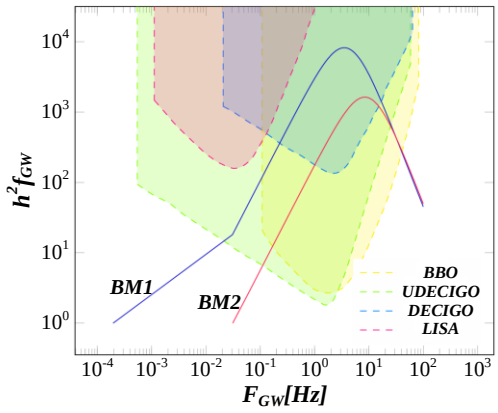

Figure 7: Comparison of Communication Costs of Landscape Painting

6 Conclusion

In the digital age of information explosion, how to effectively protect and inherit precious cultural heritage has become an urgent problem to be solved. As a treasure in the history of Chinese painting, the digital preservation and network security protection of landscape painting in Ming Dynasty are particularly important. In recent years, with the continuous progress of science and technology, digital preservation technology has made great progress, which has opened up a new way for the protection of landscape paintings in Ming Dynasty. According to statistics, as of the end of 2022, more than 80% of Ming Dynasty landscape paintings have been successfully digitized. These high-precision digital images can not only truly restore the details of the paintings, but also provide convenient access channels for researchers and enthusiasts around the world. However, digital preservation is not once and for all, and

network security protection has become a new challenge. In order to meet this challenge, this study constructs a multi-level network security protection system. Through the adoption of advanced encryption technology and firewall system, the network security protection capability of digital Ming Dynasty landscape paintings has been significantly improved, and the incidence of network attacks has dropped by more than 70% compared with 2019. Through regular security audits and risk assessments, potential security vulnerabilities can be found and repaired in time, ensuring the security and integrity of digital works. Digital preservation and network security protection not only provide strong support for the inheritance and research of landscape painting in Ming Dynasty, but also provide valuable experience for us to explore a new mode of cultural heritage protection.

References

[1] Andrasko, J., Mesarcik, M., & Hamul'ak, O. (2021). The regulatory intersections between artificial intelligence, data protection and cyber security: challenges and opportunities for the EU legal framework. *Ai & Society*, *36*(2), 623-636.

[2] Apollonio, F. I., Foschi, R., Gaiani, M., & Garagnani, S. (2021). How to Analyze, Preserve, and Communicate Leonardo's Drawing? A Solution to Visualize in RTR Fine Art Graphics Established from “the Best Sense”. *Journal on Computing and Cultural Heritage (JOCCH)*, *14*(3), 1-30.

[3] Chansun, K., & Kil-Ho, R. (2021). SWOT Analysis of the Direction of the New Normal Cyber Security Industry: The Value of Soft Power. *Korean Journal of Convergence Science*, *10*(5), 242-258.

[4] Dehghani, M., Niknam, T., GhasemiGarpachi, M., Alhelou, H. H., Pourbehzadi, M., Javidi, G., & Sheybani, E. (2023). Public policies for cyber security of sustainable dominated renewable smart grids. *IET Generation, Transmission & Distribution*, *17*(18), 4057-4071.

[5] Dubal, P., Das, S., & Sidhu, T. S. (2024). Wide Area Measurement-Based Cyber-Attack-Resilient Breaker Failure Protection Scheme. *IEEE Transactions on Smart Grid*, *15*(4), 4228-4244.

[6] Enayaty-Ahangar, F., Albert, L. A., & DuBois, E. (2020). A survey of optimization models and methods for cyberinfrastructure security. *IISE Transactions*, *53*(2), 182-198.

[7] Fernández-Caramés, T. M. (2019). From pre-quantum to post-quantum IoT security: A survey on quantum-resistant cryptosystems for the Internet of Things. *IEEE Internet of Things Journal*, *7*(7), 6457-6480.

[8] Franke, U., Friberg, E. L., & Bahşi, H. (2022). Maritime cyber-insurance: the Norwegian case. *International Journal of Critical Infrastructures*, *18*(3), 267-286.

[9] Gu, A., Yin, Z., Cui, C., & Li, Y. (2020). Integrated functional safety and security diagnosis mechanism of cps based on blockchain. *IEEE Access*, *8*, 15241-15255.

[10] Hou, J., Teng, F., Yin, W., Song, Y., & Hou, Y. (2023). Preventive-Corrective Cyber-Defense: Attack-Induced Region Minimization and Cybersecurity Margin Maximization. *IEEE Transactions on Power Systems*, *39*(3), 5324-5337.

[11] Jamil, H., Zia, T., Nayeem, T., Whitty, M. T., & D'Alessandro, S. (2024). Human-centric cyber security: Applying protection motivation theory to analyse micro business owners’ security behaviours. *Information & Computer Security*. https://doi.org/10.1108/ICS-10-2023-0176

[12] Jiang, W., Song, Z., Zhan, J., Liu, D., & Wan, J. (2022). Layerwise security protection for deep neural networks in industrial cyber physical systems. *IEEE Transactions on Industrial Informatics*, *18*(12), 8797-8806.

[13] Kalogiannidis, S., Paschalidou, M., Kalfas, D., & Chatzitheodoridis, F. (2023). Relationship between Cyber Security and Civil Protection in the Greek Reality. *Applied Sciences*, *13*(4), 2607. https://doi.org/10.3390/app13042607.

[14] Kovačević, A., Putnik, N., & Tošković, O. (2020). Factors related to cyber security behavior. *IEEE Access*, *8*, 125140-125148. https://doi.org/10.1109/ACCESS.2020.3007867
[15] Lehto, M., & Limnéll, J. (2021). Strategic leadership in cyber security, case Finland. *Information Security Journal: A Global Perspective*, *30*(3), 139-148.
[16] Li, H., Liu, R., Wang, L., & Zhang, J. (2022). Design of visual communication effect evaluation method of artworks based on machine learning. *Mobile Information Systems*, *2022*(1), 4566185. https://doi.org/10.1155/2022/4566185
[17] Matey, A. H., Danquah, P., & Koi-Akrofi, G. Y. (2022). Predicting Cyber-Attack using Cyber Situational Awareness: The Case of Independent Power Producers (IPPs). *International Journal of Advanced Computer Science and Applications*, *13*(1), 700-709.
[18] Park, J. W., & Lee, S. J. (2020). A quantitative assessment framework for cyber-attack scenarios on nuclear power plants using relative difficulty and consequence. *Annals of Nuclear Energy*, *142*, 107432. https://doi.org/10.1016/j.anucene.2020.107432
[19] Priyanka, Keswani, B., & Hussain, R. (2021). Blockchain-based cryptography model to preserve privacy for smart contracts. *Journal of Discrete Mathematical Sciences and Cryptography*, *24*(8), 2279-2289.
[20] Singh, J., Wazid, M., Das, A. K., Chamola, V., & Guizani, M. (2022). Machine learning security attacks and defense approaches for emerging cyber physical applications: A comprehensive survey. *Computer Communications*, *192*, 316-331.
[21] Slunjski, M., Sumina, D., Groš, S., & Erceg, I. (2022). Off-the-shelf solutions as potential cyber threats to industrial environments and simple-to-implement protection methodology. *IEEE Access*, *10*, 114735-114748.
[22] Uuganbayar, G., Yautsiukhin, A., Martinelli, F., & Massacci, F. (2021). Optimisation of cyber insurance coverage with selection of cost effective security controls. *Computers & Security*, *101*, 102121. https://doi.org/10.1016/j.cose.2020.102121.
[23] Ye, F., & Zhao, W. (2022). A Semi-Self-Supervised Intrusion Detection System for Multilevel Industrial Cyber Protection. *Computational Intelligence and Neuroscience*, *2022*(1), 4043309. https://doi.org/10.1155/2022/4043309
[24] Yin, Z. Y., Huang, A. M., & Huang, Z. Y. (2024). Virtual tourism attributes in cultural heritage: Benefits and values. *Tourism Management Perspectives*, *53*, 101275. https://doi.org/10.1016/j.tmp.2024.101275.
[25] Yousefi kia, M., Saniei, M., & Seifossadat, S. G. (2023). A novel cyber-attack modelling and detection in overcurrent protection relays based on wavelet signature analysis. *IET Generation, Transmission & Distribution*, *17*(7), 1585-1600.
[26] Zhou, B., Cai, Y., Zang, T., Wu, J., Sun, B., & Chen, S. (2023). Reliability Assessment of Cyber–Physical Distribution Systems Considering Cyber Disturbances. *Applied Sciences*, *13*(6), 3452. https://doi.org/10.3390/app13063452.
[27] Zhou, X., Liang, W., Shimizu, S., Ma, J., & Jin, Q. (2020). Siamese neural network based few-shot learning for anomaly detection in industrial cyber-physical systems. *IEEE Transactions on Industrial Informatics*, *17*(8), 5790-5798.