Study on Development of Restoration and Digital Display of Paper Artifacts

Yuanyuan Ma, Yiman Liu,* Yuanting Mo, Yanbo Li, and Jiahui Zhang

Paper artifacts are important carriers of history and culture. As they age and are affected by environmental factors, their protection and restoration become increasingly important. This paper discusses the restoration techniques for paper artifacts, including cleaning, acid removal, strengthening, and surface protection. It also considers the application of digital technologies in artifact restoration. Digital scanning, virtual restoration, and digital display provide new solutions for artifact restoration, effectively protecting artifacts from further damage, enhancing accessibility, and promoting academic research and education. Although digital display faces challenges such as technological limitations, storage, and copyright issues, with technological advancements, the restoration and display of paper artifacts will see more innovations. The protection and transmission of paper artifacts have become an important task in global cultural heritage preservation.

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*Contact information: Hezhou University, No.3261 Xiahe Avenue, Babu District, Hezhou City, Guangxi Province, China, Zip Code: 542899; *Corresponding author: Yiman Liu, Email: 200900047@hzxy.edu.cn*

Paper artifacts, as important historical carriers, hold rich cultural information and historical memories. They are not only crucial objects for research in fields such as history, archaeology, and art, but also key components in cultural heritage preservation. However, due to the fragility of paper materials and the long-term physical, chemical, and environmental deterioration, these artifacts face increasing risks of damage (Titubante *et al.* 2022). Therefore, how to protect and restore these precious cultural legacies has become a significant issue in contemporary cultural heritage protection. At the same time, with the rapid development of digital technologies, digital display has emerged as an important tool in the restoration and preservation of paper artifacts. This paper will explore the restoration methods for paper artifacts, the significance of digital display, the challenges involved, and propose potential improvements.

Restoration Techniques for Paper Artifacts

The restoration of paper artifacts aims to slow down their aging process, restore their physical and chemical structures, and preserve their cultural value to the greatest extent possible. Restoration work typically includes the following aspects:

Cleaning Treatment: Paper artifacts often accumulate dust, stains, and other harmful substances on their surfaces. Cleaning is typically performed using soft brushes or vacuum cleaners to remove surface contaminants, avoiding the use of chemical cleaners that could negatively affect the paper. For more serious contamination, appropriate wet

cleaning methods may be used, but care must be taken to prevent the paper from becoming deformed or moldy due to excess moisture.

Acid Removal: Acidity is one of the main factors in the aging of paper. Therefore, removing acidic substances from the paper is crucial. Methods such as soaking, vaporizing, or using neutralizing agents can effectively reduce the acidity of the paper, preventing further degradation.

Strengthening Treatment: For paper artifacts with fractures or damage, techniques such as fiber reorganization or reinforcement materials can be used. For example, thin and transparent paper can be used for patching, or specialized adhesives can be used to repair torn areas (Croitoru and Roata 2024). These repair materials must have physical and chemical properties similar to the original paper to avoid causing further harm to the artifact.

Surface Protection: After restoration, the paper artifact typically needs to have its surface reinforced to protect it from external environmental factors. Common methods include lamination, placing the artifact in transparent protective cases, or using special storage equipment for preservation.

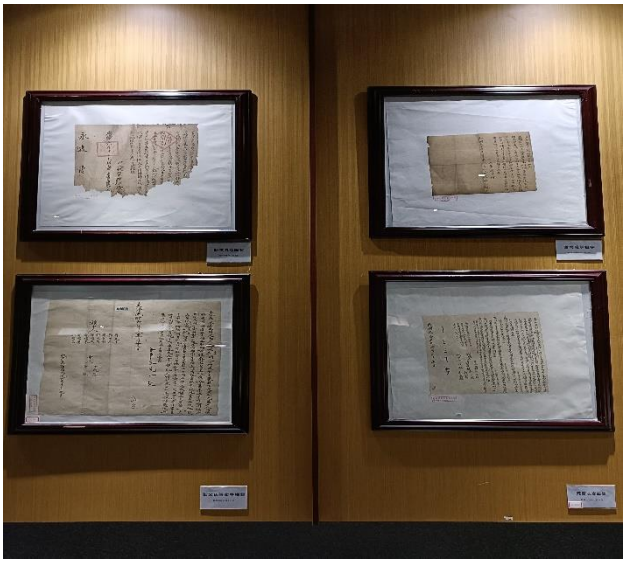

Fig. 1. Exhibition on paper artifact restoration

The Application of Digital Technologies in the Restoration of Paper Artifacts

With the advancement of technology, digital techniques are increasingly playing an important role in the restoration and protection of paper artifacts. Digital technologies allow restorers to analyze, restore, and repair artifacts without directly handling them, thereby significantly improving the efficiency and precision of restoration work.

Digital Scanning of Artifacts: Digital scanning technology can convert the image information of paper artifacts into digital formats, creating high-resolution digital images. This process not only accurately records the original appearance of the artifact but also provides detailed visual documentation for subsequent restoration work. Common scanning devices include flatbed scanners and 3D laser scanners, which capture fine details of the artifact's surface, providing a clear reference for restorers.

Virtual Restoration: Using computer graphics technology, digital tools can perform virtual restoration of damaged paper artifacts. Based on digital image processing

techniques, the software can repair images, restore colors, and perform other operations. Virtual restoration allows the artifact to be restored to its historical appearance without physically altering the original, offering valuable resources for academic research and public display.

Digital Display: Digital display not only addresses the problem of paper artifacts being unable to be exhibited for extended periods due to environmental concerns but also provides an opportunity for broader public engagement with these precious artifacts. Through digital displays, viewers can appreciate high-resolution images of paper artifacts online, and even experience interactive virtual tours through technologies such as virtual reality. This enhances the reach and impact of cultural heritage.

Significance of Digital Display

Artifact Protection: Paper artifacts are easily affected by light, humidity, and temperature during prolonged display, leading to deterioration. Digital display helps avoid physical and chemical damage to the artifacts during the exhibition process, reducing the frequency of physical handling, thus prolonging their lifespan (Grooss 2024).

Increased Accessibility: Traditional exhibitions are limited by space, staffing, and other factors, while digital displays break these boundaries, allowing for global access to artifacts. Regardless of location, viewers can learn about and appreciate these artifacts through the internet, expanding the audience for cultural heritage.

Promoting Academic Research: Digital displays provide convenient tools for academic research. Researchers can analyze artifacts in fine detail using high-resolution digital images, and even employ computer-aided design software for in-depth restoration and reconstruction studies. This fosters innovation in heritage preservation techniques.

Educational Value: Through digital displays, viewers can not only appreciate the aesthetic qualities of artifacts but also learn more about cultural heritage preservation, raising public awareness of the importance of artifact conservation. Virtual museums and digital educational materials provide valuable resources for schools and research institutions.

Challenges and Future Outlook

Although digital display plays a significant role in the restoration and preservation of paper artifacts, several challenges remain:

Technological Limitations: Current digital technologies still have certain limitations, especially in the virtual restoration and reconstruction of complex paper artifacts. The accuracy and detail presented by digital technologies need to be further improved.

Data Storage and Management: The large volume of digital artifact data requires effective storage and management to ensure long-term preservation and accessibility. Establishing a comprehensive digital artifact database and ensuring data security are important issues that need to be addressed.

Copyright and Ethical Issues: In digital displays, how to define the copyright and usage rights of digital artifacts, and prevent misuse or unauthorized use, are legal and ethical concerns that need to be addressed.

Despite these challenges, the future of digital technology in artifact preservation remains promising. With further developments in virtual reality, artificial intelligence, and

big data, the restoration and digital display of paper artifacts will become more refined, pushing the field of cultural heritage preservation to new heights.

Conclusion

The restoration and digital display of paper artifacts are two crucial aspects of contemporary cultural heritage preservation. Through restoration techniques, there is an opportunity to extend the life of these historical artifacts, while digital display offers new ways to protect and disseminate cultural heritage. While there are some challenges in practice, the continued advancement of technology will lead to more innovative and efficient solutions in the field of heritage preservation. In the digital age, the protection and transmission of paper artifacts are not only the responsibility of the academic community but also a shared mission for society as a whole.

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