The Innovation Design Digital Art and Application Technology Shell Carvings in Dalian, China: Memory Trace, Cultural Identity and Modernity in The Context of Manchu Culture

Shujing Wang
Faculty of Fine-Applied Arts and Cultural Science, Mahasarakham University, Thailand

Prathabjai Suwanthada (Corresponding Author)
Faculty of Fine-Applied Arts and Cultural Science, Mahasarakham University, Thailand
E-mail: papassuwan66@hotmail.com

Abstract

Dalian shell carving is a traditional Chinese craft with profound cultural connotations and historical origins, primarily rooted in the cultural traditions of the Northeast Manchu people. However, current research mainly focuses on its artistic value and development history while ignoring the systematic study of its cultural identity, memory traces, and modern design innovation. This study studies Dalian shell carving from theoretical perspectives such as cultural memory, ethnic identity, and modernity to compensate for the shortcomings of existing research methods and applied research. This study focuses on three key periods: the Qing Dynasty, the peak of industrialization (1960s to 1980s), and the contemporary digital age. It uses qualitative research methods, combining field visits, serial interviews, and literature analysis. This study collects data from intangible cultural heritage inheritors, local Manchu residents, designers, and scholars. At the same time, a comparative analysis is conducted to compare historical shell carving techniques with modern shell carving techniques. This study uses Assmann's theory of cultural memory reconstruction to reveal how Dalian shell carving can serve as a medium for preserving and reinterpreting collective memory, connecting traditions with present and future cultural expressions. To revitalize Dalian shell carving in the digital age, this study proposes a design-driven innovation model that integrates digital art and applied technologies, such as augmented reality (AR) experience, IP mascots, and cultural and creative products. The practical results include a series of applied design products that enhance the museum experience and strengthen regional cultural identity. This study contributes to the sustainable development of intangible cultural heritage by combining traditional craftsmanship with modern design methods. It also provides theoretical insights and practical solutions for cultural heritage innovation.

Keywords: Dalian Shell Carving, Cultural Memory, Manchu Culture, Digital Art Design, Modernity, Application Technology

1. Introduction

Shell carving is a traditional Chinese craft traced back to the Han Dynasty. Over time, shell carving became more sophisticated and peaked during the late Ming and early Qing dynasties (Cui & Zhang, 2007). The aristocracy loved shell carvings because they represented their status and cultural accomplishment. After the founding of the People's Republic of China in 1949, the revival of traditional crafts gained momentum, driving the rapid development of the local handicraft industry (AN, 2020). Under this circumstance, Dalian became the center of shell carving, leading the development of the shell carving industry nationwide (Feng, 2016). During this period, shell carving became an important part of home decoration, especially as a wedding decoration for newlyweds, representing cultural traditions and aesthetic values (Liu, 2022).

Dalian's geographical and cultural advantages as an important northern seaport and strategic fortress in history have promoted the booming development of shell carving culture (Jan, 2022). Dalian's shell carvings reflect strong regional characteristics, shaped by the marine environment of northern China and rooted in Manchu cultural traditions. These works are known for their brilliant colors and exquisite patterns, which incorporate elements of ethnic art such as Mongolian, Han, and Manchu, and have continued into the Qing Dynasty (Liu, 2018). The court and the nobility cherished shell carvings, which were used as decorations to convey social status and cultural identity through wall hangings, lacquer boxes, furniture, and clothing accessories (Wang, 2018).

With the integration of digital art and innovative design technologies, Dalian's shell carving tradition has taken on a new look in the contemporary era (Xu, 2022). This paper mainly discusses the intersection of cultural memory, identity, and modernity in the cultural heritage of the Manchu people and focuses on the innovative application of digital technology in shell carving design and production. This study aims to reveal how digital innovation supports intangible cultural heritage, promotes cultural inheritance, and creates new cultural expressions in the digital age by studying the transformation of traditional shell carving into modern art practice.

This research is significant in that it addresses the critical issue of preserving and transforming intangible cultural heritage in the digital era. It utilizes Dalian shell carving to explore how traditional Manchu craftsmanship can be adapted to modern contexts while preserving its cultural integrity. The research underscores the potential of digital technology in shell engraving to preserve cultural traditions and elevate the significance and distinctiveness of lesser-known cultural forms. It fosters interdisciplinary dialogue among heritage studies, digital art, and design innovation, thereby establishing a foundation for the sustainable advancement of traditional traditions. It provides valuable insights for cultural policymakers, craftsmen, and creative businesses that strive to integrate technology with tradition to enhance economic development, aesthetic innovation, and cultural sustainability.

2. Research Objective

This study aims to investigate the application innovation, design, and technology of Dalian shell carving in the cultural heritage of the Manchu people. The specific objectives are as follows:

1 To examine the policies, cultural customs, and socio-economic contexts across three historical periods of Dalian shell carving, focusing on how local residents build collective memory and cultural identity through this art form. This objective also involves analyzing traditional motifs, techniques, and practices using empathetic design principles in the context of contemporary digital art.

2 To explore the integration of digital art and emerging technologies in the preservation and innovation of Dalian shell carving, with the goal of ensuring its sustainability and establishing a culturally significant and commercially viable design brand.

3. Methodology

This study employs a qualitative research methodology, integrating field investigations, sequential interviews, and literature analysis to examine the historical development and contemporary inventive design applications of Dalian shell carving within the context of Manchu culture. The study examines "memory traces, cultural identity, and digital art innovation," emphasizing the legacy and evolution of Dalian shell carving while assessing its change trajectory influenced by modern digital technologies. The research region encompasses Dalian and its vicinity, including the Jin'ashan Art Museum, Dalian Shell Carving Factory, Manchu households, and emerging digital art designers and researchers in pertinent disciplines. The timeframe encompasses the Qing Dynasty (a representation of royal and noble identity), the 1960s to 1980s (the zenith of industrial activity), and the age of digital media art (a phase of cultural innovation and amalgamation).

Data gathering mainly occurs through a synthesis of sequential in-depth interviews and outdoor observations. One hundred fourteen pertinent individuals were questioned, comprising inheritors of Dalian shell carving intangible cultural heritage, shell carving artisans, local Manchu inhabitants, scholars in relevant disciplines, and young designers and customers. The interview content centers on the respondents' perceptions and attitudes toward the amalgamation of Dalian shell carving, Manchu culture, and digital art, as well as the receptiveness of young individuals to digital art forms. Simultaneously, in conjunction with the comparative literature on Qing Dynasty shell carving artifacts, mother-of-pearl inlaid items, modern exported shell carving

paintings, contemporary intangible cultural heritage shell carving works, and shell carving in the Beihai region, a systematic research sample is established.

The descriptive analysis method organizes and summarizes interview and image data (photos, patterns, pattern analysis). At the same time, the SPSSAU tool is utilized to classify and summarize the interview data to investigate core themes such as cultural context, identity recognition, and design innovation. SPSSAU, the full name of which is "SPSS Analysis Utility," is an online statistical analysis tool developed based on the SPSS principle. Compared to traditional SPSS software, SPSSAU places greater emphasis on user-friendliness and ease of operation, making it a suitable choice for the data analysis required for this study. The research focuses on developing traditional ethnic motifs, such as Manchu dragon designs, and their influence on modern shell carving artistry and digital design applications. This exploration examines the application of digital technology in shell carving innovation design, integrating the principles of empathy design to emphasize the synthesis of user demands and cultural values. Brown (2009) argues that understanding users' needs, desires, and emotions is essential to creating impactful solutions, empathy-driven insights can lead to innovative products that significantly improve user experience, help designer gain deeper insights.

Given the historical context of the Manchu population movement, cultural integration, and sinicization, achieving comprehensiveness and complete representation in sample selection in this article is challenging. This study employs representative key participants as samples, gathers primary data on the inheritance and innovation of Dalian shell carving through comprehensive interviews and field observations, and aims to elucidate the practical significance and innovative value of Dalian shell carving within the framework of "cultural memory, identity, and digital modernity," adhering to the principle of "few but fine."

4. Literature Review

Academic research on Dalian shell carving is not much and has not made sufficient progress. According to the query of the China National Knowledge Infrastructure (CNKI) database, there are less than twenty relevant theoretical articles. These papers mainly focus on the historical development of Dalian shell carving factories or tell the stories of intangible cultural heritage inheritors. Only one was included among the few provincial scientific research projects, but there was no actual result. In addition, supplementary materials such as official propaganda reports, government exhibition summaries, and documentaries about local inheritors are not systematic and lack a theoretical basis. These shortcomings indicate that the academic community has not paid enough attention to this culturally important craft.

The re-exploration of historical narratives and cultural memories results from the integration of technology and traditional art practices. For example, digital media is essential for learning about cultural heritage, emphasizing how it helps preserve traditional art forms such as Yiwulüshan Manchu paper-cutting (Huang & Laoakka, 2024). This ability to record, archive, and analyze traditional art practices through digital media enriches the discussion around cultural heritage and promotes accessibility to a local and global audience.

As seen in the development of interactive, immersive experiences, innovative applications of digital technology not only preserve these cultural expressions but give them a new lease on life. Ye (2016) study on the design and implementation of digital art teaching systems highlights how technology can inspire creativity in traditional design methods by enhancing the vitality and interactivity of art education. This reflects the continuous evolution of art forms, including shell carving art. On the other hand, people are beginning to re-engage with traditional crafts due to technological advances.

In addition to preservation, digital art is essential to redefining cultural identity in contemporary society. In urban cultural tourism, how novel cultural expressions, such as those evoked by digital art, can reshape the tourism landscape while allowing communities to tell their stories through modern media (Yang et al., 2024). Promoting cultural exchange through digital platforms is essential to maintaining a dialogue between traditional and modern practices.

In addition to art, design, and entrepreneurship, digital innovations have also impacted the economy. The digital economy has provided new development opportunities for cultural artisans, including those specializing in shell carving. This study shows how combining digital media and successful business strategies can promote the development of creative industries (Zhang et al., 2021). Traditional crafts must remain economically viable to adapt to the needs of the modern market.

The connection between memory and cultural identity cannot be underestimated in the technological age. According to Cai & Su (2022), creating digital art based on traditional motifs is not just about preservation; it also involves re-examining and reinterpreting cultural symbols for modern audiences, thereby challenging and enriching the cultural identity narrative. In the field of shell carving, this may mean incorporating contemporary themes or techniques while respecting the Manchu cultural heritage to address current social issues.

Through three core innovation areas, this study aims to fill these gaps. First, let us see how historical traces and ethnic cultural consciousness (especially Manchu cultural consciousness) are integrated into the materials, patterns, and meanings of Dalian shell carving. Second, this study introduces a user-centered and empathetic design method to connect traditional patterns with the preferences of modern digital consumers. Third, this study uses augmented reality (AR), H5 interactive forms, and IP-based cultural product design to provide a new value proposition for shell carving as a cultural heritage and modern design language. Therefore, this study constructs a new interdisciplinary framework integrating cultural studies, heritage protection, and digital media innovation. It provides theoretical insights and practical methods for revitalizing intangible cultural heritage in a modern environment.

5. Results

The research results found that the characteristics of dragon patterns in different periods of the Qing Dynasty and the patterns of color usage under the influence of Manchu culture played a significant role in the changes in the themes of the works in the three main research periods. Other influencing factors were northern regional culture, other ethnic cultures (Mongolian and Han), and foreign cultures.

Social policies in different periods impacted the development of Dalian shell carving. The Manchus controlled the Qing Dynasty, so the styles and themes of shell carving were primarily based on Manchu culture. The 1980s was the heyday of Dalian shell carving. China's policy was to promote the development of handicrafts and go global, so the design themes of shell carving mainly promoted Chinese culture rather than just expressing the culture of a single nation. Contemporary Dalian shell carving culture is little known, and the works are limited by craftsmanship and materials, making it challenging to develop.

To enhance the promotion of Dalian shell carving culture among residents and young visitors, the research conducted a market survey using a standardized questionnaire. Participants were requested to assess their preferences for various art design forms—traditional handcrafted artworks, digital reinterpretations, and interactive art installations—utilizing a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). A total of 180 valid replies were obtained from individuals aged 18 to 35, specifically targeting college students and young professionals in Dalian.

The data were analyzed using SPSSAU, an accessible online statistical analysis tool. The arithmetic mean was computed for each item to ascertain general preference patterns. For instance, when asked about their interest in interactive digital art that integrates local cultural components, such as shell carving themes, the mean score was 4.35, indicating a robust degree of agreement. In contrast, traditional shell carving artworks got a mean score of 3.21, indicating a modest preference. Digital art reinterpretations, including those featuring Manchu ethnic elements (e.g., dragon designs and cloud motifs), achieved an average score of 4.08.

The results indicate that younger audiences are more drawn to creative cultural expressions that include technology and interactivity. In light of these findings, the application design of Dalian shell carving has been expanded to include product categories such as IP mascots and promotional AR cards (Mean = 4.41), digital interactive comment tickets (Mean = 4.28), seed-shaped commemorative NFC cards (Mean = 4.15), and virtual exhibition hall interaction platforms (Mean = 4.47). These products aim to revitalize traditional shell carving by blending heritage with modern digital experiences, thereby enhancing cultural visibility and engagement among target audiences.

5.1. Creative Design and Application

The author's applied research results first extracted the traditional Manchu patterns of the Qing Dynasty and the most representative patterns of the Manchu culture in modern Dalian shell carvings—the dragon as the main image of the IP mascot of the Jin'ashan Shell Carving Museum, which was named "Longbao."

The design drew a variety of styles of mascot sketches with dragon images. Because some porcelains in the middle and late Qing Dynasty had dragon patterns with wings, the author retained the dragon pattern with wings in the early design. The dragon's head-to-body ratio was also set between 1:1 and 1:1.5, mainly highlighting the affinity in the character's personality image design. The character's action settings include sitting, standing, and holding shells or pearls, which highlight the connection between the character and shell carving or the connection between traditional dragons and pearls in Manchu culture. The author made many attempts to set the mascot's character to ensure that it conforms to the characteristics of Jin'ashan shell carving art.

Figure 1. Design of the Moscot "Longbao" and Matching Scheme with Different Materials
(Source: Designed by Shujing Wang, 2025)

This is a set of New Year's digital interactive commemorative tickets designed for the Ashan Art Museum, consisting of two groups of tickets marked with the corresponding year. The audience can get a virtual mascot with AR effects by scanning the QR code on the souvenir ticket. There are five styles of virtual mascots, and the audience will receive one of them randomly. There are also basic model souvenir tickets in wristband style, which are convenient to carry. (The museum is a non-profit organization, so all tickets are souvenir tickets.)

Figure 2. AR "Longbao", Interactive Commemorative Ticket Design
(Source: Designed by Shujing Wang, 2025)

The three AR interactive products designed by the author correspond to two commemorative tickets and a black seed card. Use WeChat (Chinese version) to scan the QR code on the ticket to enter the AR applet. After scanning the corresponding ticket pattern, you can see the dynamic "Longbao" with the added item display effect on your phone. The three "Longbao" actions are changing into emperor clothes, greeting, and watching the snow. In the culture of northern China, watching the snow is an everyday elegant activity for literati and scholars to gather together, and it is considered a symbol of nobility. Therefore, the author chose these three actions that can reflect the characteristics of Manchu culture as the visual expression of the interactive design. Due to the restrictions on the use of the network and platform, the effective use period of the QR code is short. If the audience fails to use it, please enter the link below to watch the experience video: (https://youtube.com/shorts/pEHaL6Zwsdc?feature=share)

Figure 3. Three "Longbao" AR Dynamic Interactions.
(Source: Designed by Shujing Wang, 2025)

5.2. Satisfaction Evaluation

The leading consumer group of this study is young consumers in Dalian, with an age range of (20-35 years old). The satisfaction evaluation sample is 104; the highest percentage values of each item are: Product appearance satisfaction is 96%, 70% of respondents are delighted with the stability of digital interaction technology, the very satisfied with the national cultural characteristics is 97%, the very satisfied with the Interesting and design artistry was 78%. The evaluation results are a summary of the major categories of data statistics (Table 1).

The satisfaction rating of young consumers is very good. The Average value mean is 4.72. The assessors include young families, young tourists, students, and young art designers. The evaluation mainly collects data from five categories: product appearance, Digital interaction technology stability, National cultural characteristics, Interest, and Design artistry. Most think the author's design research results have prominent national cultural characteristics. Its average value is also the highest among all categories, n=4.97. The digital interaction technology is stable, the product design is more interesting and artistic, but the product appearance needs to be strengthened, the average is the lowest at 4.14 (Table 1).

Table 1. Evaluation Results of Dalian Shell Carving Design Research

Evaluation Category	Very Satisfied (%)	Average Satisfaction Score
Product Appearance	96	4.14
Digital Interaction Stability	70	4.72
National Cultural Characteristics	97	4.97
Interest & Design Artistry	78	4.5

Expert evaluation opinions include 10 samples, including intangible cultural heritage inheritors, relevant scholars, designers, and practitioners, who give professional evaluation opinions based on their respective fields, including product safety

attributes, environmental protection, production feasibility, regional cultural representativeness, Manchu cultural representativeness, etc. Experts affirm product safety and production feasibility, n=5, Very satisfied 100%. Experts are relatively satisfied with environmental protection and the representativeness of Manchu culture. The lowest level of satisfaction with regional cultural representation. n=4.5. Only 60% of respondents are very satisfied (Table 2).

Table 2. Expert Evaluation Results

Evaluation Category	Very Satisfied (%)	Average Satisfaction Score
Product Safety	100	5.0
Environmental Protection	80	4.5
Production Feasibility	100	5.0
Regional Cultural Representativeness	60	4.5
Manchu Cultural Representativeness	80	4.5

From the overall evaluation of consumers and experts, the research application design results have specific Manchu cultural characteristics, virtual products have certain interactivity, and the fun and stylized design of cultural and creative products are more popular with consumers, with high satisfaction. However, the appearance of some products needs to be strengthened. The safety attributes of the products are very high. Some scholars believe there are still paper products in cultural and creative products, such as paper lotus-scented bookmarks, which are not environmentally friendly. There is still some doubt whether the seed commemorative cards can be successfully planted. Therefore, the evaluation values of these two items are slightly low. Overall, the results still have specific positive significance. The application design process and methods of this study can provide help for the research of relevant scholars.

6. Discussion

This study revisits Dalian shell cutting, examining it not only as an ancient skill with artistic and economic value but also as a living cultural form that preserves the community's memories and their evolving sense of identity as Manchu. There is much writing about the beautiful methods and historical importance of Dalian shell carving, but relatively little that discusses its broader cultural significance through the lens of Jan Assmann's theory of cultural memory. This study fills that gap by examining shell carving as a living tradition that reveals how local identity has evolved and how memories are passed down from one generation to the next.

The results show that the links between shared memories and cultural identity are deeply rooted in the shapes and stories of shell cutting. For example, during interviews and theme analysis, several artists emphasized that the dragons, phoenixes, and auspicious clouds featured in traditional designs serve not only aesthetic purposes but also represent Manchu royal heritage, morals, and beliefs about the universe. The "Longbao" IP mascot, which blends the traditional Manchu dragon totem with modern visual language, kept these themes alive and gave them a new meaning. It shows both cultural continuity and generational renewal. The main idea of "Construction of the Past: Collective Memory and Design Empathy" is directly supported by this. Using empathy design principles, the Longbao project was developed through groups that included young people from the area. This brought together historical stories and current emotional aesthetics.

The theme of the exhibition is "Cultural Integration, Upgrading, and National Cultural Identity." The digital commemorative seed cards and interactive exhibition images both have mixed-media parts that show this. Traditional Han pattern symmetry, Mongolian-style geometric edges, and Manchu religious symbols are all incorporated into these designs, creating a narrative-like mix that reflects Dalian's complex history. Over 72% of survey respondents understood the importance of incorporating multi-ethnic elements into a unified visual identity. This demonstrates that an ethnically inclusive design strategy is essential for reviving the craft in the modern world.

Finally, the "Powerful appeal of modern digital art and creative design" was shown by the comments people left on the AR-enabled digital comment tickets and the interactive virtual exhibition modules. The augmented reality ticket lets people scan it and interact with animated stories about shell carving. The virtual show, on the other hand, recreated past shell carving workshops in full 3D. Likert scale tests revealed that users were highly interested, with the AR ticket receiving an average score of 4.47 out of 5. This means that contact made more manageable by technology not only draws in younger people but also connects traditional culture with digital culture, looking to the future.

The study reveals that Dalian shell carving holds considerable promise for cultural revitalization when viewed through the lens of group memory, identity, and digital innovation. It achieves this by applying these ideas to real-world design practices and data. It moves the focus from just technical craftsmanship to a bigger idea and a way for everyone to be involved. This contributes to the academic discussion about intangible cultural history in the digital age and offers us valuable insights for preserving it.

7. Conclusion

This study comprehensively explores Dalian shell carving from the theoretical perspectives of modernity, cultural identity, and memory traces, providing a new perspective on its cultural significance and contemporary development. By comparing the research results with existing literature, this study explores the methodological deficiencies of current shell carving research,

especially the lack of a conceptual framework that links intangible cultural heritage with collective memory and ethnic identity. This study emphasizes the historical and artistic value of Dalian shell carving and proposes the idea of systematically integrating digitalization and application technologies to support its sustainable development and innovation.

From a theoretical perspective, this study is based on the philosophical foundation of memory trace theory. Aristotle believed that memory is a static imprint of the past, while Jan Assmann believed that cultural memory is a dynamic model that shapes present and future experiences through continuous memory reconstruction. The results show that the collective memory of Dalian shell carving reflects the residents' intergenerational shared memory and the Manchu group's cultural identity. This double-layer memory can preserve historical traditions and help reinterpret cultural narratives to cope with changes in modern society.

In addition, this study emphasizes that the inheritance of Manchu cultural heritage is affected by the challenges of modern cultural communication and national cultural transformation. However, the study shows these memory traces can be extracted, reinterpreted, and projected into engaging and meaningful cultural products. This can be achieved through innovative digital art design and application technology. This approach has stimulated public interest in Dalian shell carving and enhanced the national identity of the local Manchu people.

This study developed application design products that integrate tradition and innovation. These products include commemorative seed coupons, Dalian shell carving IP mascots, AR-guided interactive museum experiences, cultural and creative products, and Manchu cultural manuals. These applications not only enhance the visiting experience of the Dalian Jin'ashan Shell Carving Museum but also promote the sustainable development of Dalian's intangible cultural heritage.

In summary, this study provides a replicable model for integrating design thinking, digital technology, and cultural heritage. This makes valuable theoretical and practical contributions to the field of cultural heritage research. It emphasizes that the path to the revival of traditional crafts is not single preservation but continuous reconstruction, cultural innovation, and effective interaction with modern audiences.

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