The Symbol Transformation of Helan Mountain Rock Paintings: Animation Creation Based on Interactive Technology

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Abstract

The objectives of this research are: (1) to study the historical background, pattern types, image meanings, and creative techniques of Helan Mountain Rock Paintings, and summarize and refine the artistic characteristics and spiritual connotations of them. (2) To analyze the cultural values of Helan Mountain Rock Paintings, and transform them into cultural symbols for animation expression. (3) To create interactive digital animation works to promote the culture of Helan Mountain Rock Paintings. The study samples, 30 rock painting patterns photographed at Helan Mountain, were representative data selected according to the type of content represented in the rock paintings for the correlation and spiritual symbols between them.

The results of the research were as follows: 1. The basic knowledge as well as the new knowledge system of cultural value and spiritual connotation of Helan Mountain Rock Paintings were obtained. 2. The creation mode of transforming rock paintings into animation symbols as well as the animation works on the theme of Helan Mountain Rock Paintings were obtained. 3. Helan Mountain Rock Paintings, a world cultural heritage connected to interactive multimedia, were presented to the audience in a new audio-visual form, which reaped a high level of satisfaction from the respondents. In this research, a feasible solution and an analysis of relevant factors for animation transformation of Helan Mountain Rock Paintings was provided, and insights and research directions for interactive animation to transmit culture were put forward.

Keywords: Helan Mountain Rock Paintings; symbol transformation; interactive animation; digital preservation of cultural heritage

Introduction

1. Helan Mountain Rock Paintings

Helan Mountain Rock Paintings are patterns drawn and carved on rocks by human ancestors, which vividly record the life scenes of primitive humans such as herding, holding sacrificial ceremonies, hunting, going on expeditions, and producing from 3,000 to 10,000 years ago. It has become a cultural treasure for us to study the history of human culture, religion, and primitive art today. As a cultural symbol of Ningxia Pronvince, China, Helan Mountain Rock Paintings are widely distributed in Shizuishan, Yinchuan, Qingtongxia, Zhongwei, Zhongning and other places along the Helan Mountain, with rich and diverse content, including curved animals, characters, symbols and other types. These rock paintings, with concise and powerful lines and vivid capture of dynamic scenes, present the living conditions and spiritual world of prehistoric humans (He & Ding, 2017:83). Artificially

speaking, Helan Mountain Rock Paintings not only embody the realistic style, but also integrate the symbolic and decorative styles, which is shown in the representation of images of human faces, in particular as they convey a sense of mystery and solemnity through simplification and abstraction. In addition, the geometric patterns and symbols in the rock paintings may contain specific cultural meanings, reflecting the ancient people's profound understanding of natural and social phenomena.

Despite the significant cultural value of the Helan Mountain Rock Paintings, their current state of preservation faces numerous challenges. Due to historical reasons, the impact of the natural environment, and insufficient preservation efforts, these rock paintings have suffered varying degrees of damage(He & Ding, 2017:212). To address this issue, digital preservation methods are particularly necessary. By using technologies such as high-precision scanning, 3D reconstruction, and virtual reality, it can be achieved to accurately record and virtually restore the rock paintings, so as to provide the public with a means to learn and appreciate them without physically touching the original paintings, thereby reducing physical damage to them.

Currently, while some digital measures have been taken to record and display the Helan Mountain Rock Paintings, efforts are still inadequate to meet the increasing demand for preservation. Therefore, improving digital preservation is not only for the preservation of the rock paintings, an irreplaceable cultural heritage, but also a method of cultural inheritance for future generations. Through further digital development, with innovative means like interactive animations and augmented reality (AR) utilized, it is possible to transform the emergency preservation of rock painting cultural heritage into digital preservation and innovative utilization of rock painting resources (Shu, 2022:140), which will more effectively disseminate the culture of rock paintings while providing more resources for future research and education.

Figure 1 Helan Mountain Rock Painting "Sun God"
Source: From the Author

2. Digital Preservation and Transformation of Cultural Heritage

In cultural heritage preservation, the application of digital technologies has become a crucial means for the long-term preservation and transmission of many non-renewable cultural heritages. Through high-precision scanning and photography techniques, detailed digital archives of cultural relics can be established, which accurately record not only image information but also relevant meta-data such as geographical location, historical period, and artistic style. This has significant effects on resisting natural erosion and man-made destruction. Furthermore, the convenience of digital materials has greatly benefited academic research, making it possible to conduct in-depth analysis of the patterns, colors, and symbols of cultural relics, while also providing better interpretations of their historical backgrounds and cultural connotations(Xing & Ruan, 2024:86). Moreover, digital technologies have also made virtual restoration and recovery of damaged cultural relics a reality. By comparing historical data with the current state, experts can reconstruct the original state of cultural relics, providing important references for the practical restoration.
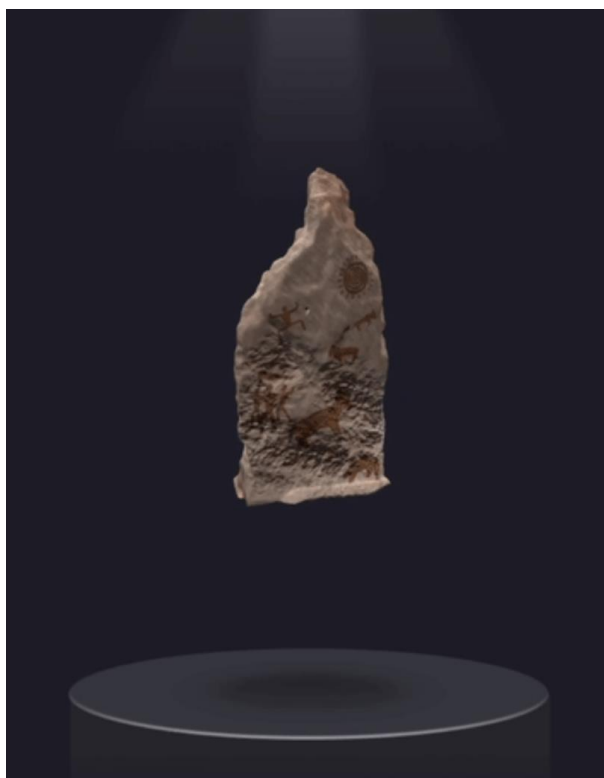

Figure 2 Wuhai Queergou Rock Painting Digital Collection
Source: m.thepaper.cn/baijiahao_18638058

In terms of public education and participation, digital cultural heritage has provided interactive learning experiences for audience of different age groups through media such as online platforms, mobile applications, and virtual reality, effectively enhancing public awareness and interest in relevant cultures. This cross-media approach not only broadens the audience base but also creates conditions for international exchanges and cooperation in cultural heritage. As for disaster risk management, digital materials, as important backups, can

ensure the retention of original information and safeguard cultural heritage even in the face of natural disasters or human-made destruction. Meanwhile, combined with the Geographic Information Systems (GIS) and remote sensing technology, digital monitoring provides real-time warnings for environmental changes in the locations of cultural relics, providing scientific evidence for taking timely protective measures. In summary, digital technologies are playing an irreplaceable role in the preservation and inheritance of cultural relics. It enjoys a broad application prospect in cultural heritage preservation and is of significance for promoting the sustainable development of cultural heritage.

3.Interactive Animation

Interactive animation is a digital media form that integrates animation art with interactive design concepts. By integrating visual narratives, sound effects, and programming logic, it creates dynamic visual content that allows users to directly or indirectly make operation and control. In interactive animation, the user's actions and choices can influence the development, pace, and even the outcome of the animation, so as to provide a participatory viewing experience. This medium not only expands the narrative boundaries of traditional animation but also provides users with richer and more diverse perceptual and cognitive pathways by introducing interactive dimensions of time and space (Yin &Yuan, 2023:123). Beyond that, as interactive animation has a wide range of applications, covering education, entertainment, advertising, art exhibitions, ect., its core value lies in enhancing the efficiency of information transmission, increasing user participation, and promoting emotional connections between the audience and the content.

Figure 3 Yellow River Civilization Digital Intangible Cultural Heritage Museum
Source: temp.iddhd.com/huanghe2022-new/

As an emerging digital media form, interactive animation provides an innovative approach to the dissemination and education of Helan Mountain Rock Paintings. By transforming the static images of rock paintings into dynamic visual narratives, it not only enhances the audience's sense of participation and immersive experience but also enables them to more intuitively understand the historical background, cultural value, and artistic

characteristics of the rock paintings through interactive elements such as clicking, dragging, and selecting. This interactivity promotes knowledge transfer and sparks the audience's curiosity and desire to explore the stories behind the rock paintings, bridging the gap between entertainment and education and effectively enhancing the visibility and cultural influence of Helan Mountain Rock Paintings in modern society. What's more, the digital nature of interactive animation decides it is easy to be shared and disseminated through online platforms. That's why the audience base is broadened and new possibilities for global dissemination and cross-cultural exchange of the art are created.

Research Objective

1. To study the historical background, pattern types, image meanings, and creative techniques of Helan Mountain rock paintings and summarize the artistic characteristics and spiritual connotations of them.

2. To analyze the cultural value of Helan Mountain rock paintings, and transform them into cultural symbols for animation expression.

3. To produce interactive digital animation works.

Research Methodology

Literature research, field investigation, expert interview, creative practice and other research methods are utilized in this research.

Firstly, the basic information about the Mountain Rock Paintings was understood through the literature research, and the images of the Mountain Rock Paintings were photographed and processed through the field investigation. The photographed images were about Mountain Rock Paintings, and a total of 30 rock painting images were compiled. The photographing took place at Helan Mountain Rock Paintings scenic area and electronic images were preserved. Finally, the design direction is derived through image comparison and analysis, and the effect of modern interactive animation is verified through the design works.

In order to better understand the possibilities for animation improvement, the researcher conducted semi-structured interviews with four persons including the manager, researcher, designer, etc. of the Helan Mountain Rock Paintings, respectively. Interviewees were defined as people who had been working on Helan Mountain Rock Paintings related work for at least three years. The interviews were conducted at the interviewee's workplace and lasted approximately 60 minutes each. The responses were recorded through notes, and analyzed and organized. The audio of the four interviewees was recorded with consent.

Research Scope

This research comprehensively applies semiotics theory, intertextuality theory, cultural identity theory and animation creation theory to research the historical background, pattern types, expression forms and creative techniques of Helan Mountain Rock Paintings, analyze their concepts and values, as well as refine and summarize their artistic characteristics to obtain the cultural values and spiritual connotations of Helan Mountain Rock Paintings; research the narrative theory and expression of animation, transform Helan Mountain Rock Paintings into visual symbols, auditory symbols and imagery symbols for animation expression, and create

an interactive animation, so as to better display their cultural value in contemporary society and obtain a wider transmission of cultural recognition.

Research Results

1. Basic information of the Helan Mountain Rock Paintings

First, through literature and books related to the Helan Mountain Rock Paintings collected and organized in the study, including works such as Helan Mountain Rock Paintings by Xu Cheng and Wei Zhong (1993), Discovering Rock Paintings by Li Xiangshi (2012), and Helan Mountain Helankou Rock Paintings by He Jide and Ding Yufang (2017), a relatively systematic understanding of the content, types, and distribution of rock painting in Helan Mountain is obtained, which has laid a theoretical and informational foundation for this research.

Besides, in this study, fieldwork is conducted at the Helankou Rock Painting Scenic Area in Yinchuan City and 30 works of different categories are selected as samples, yielding first-hand information through personal photography, recording, and experience. Due to the fieldwork, we have understood the spatial environmental information of Helan Mountain Rock Paintings, such as valleys, mountain springs, scorpionweed, rock sheep, and sacred walls and observed the contents of the rock paintings, including images of human faces (such as the sun god), animals, plants, and symbols are also observed, providing a comprehensive perception of Helan Mountain Rock Paintings.

Figure 4 Helan Mountain Rock Painting Environment
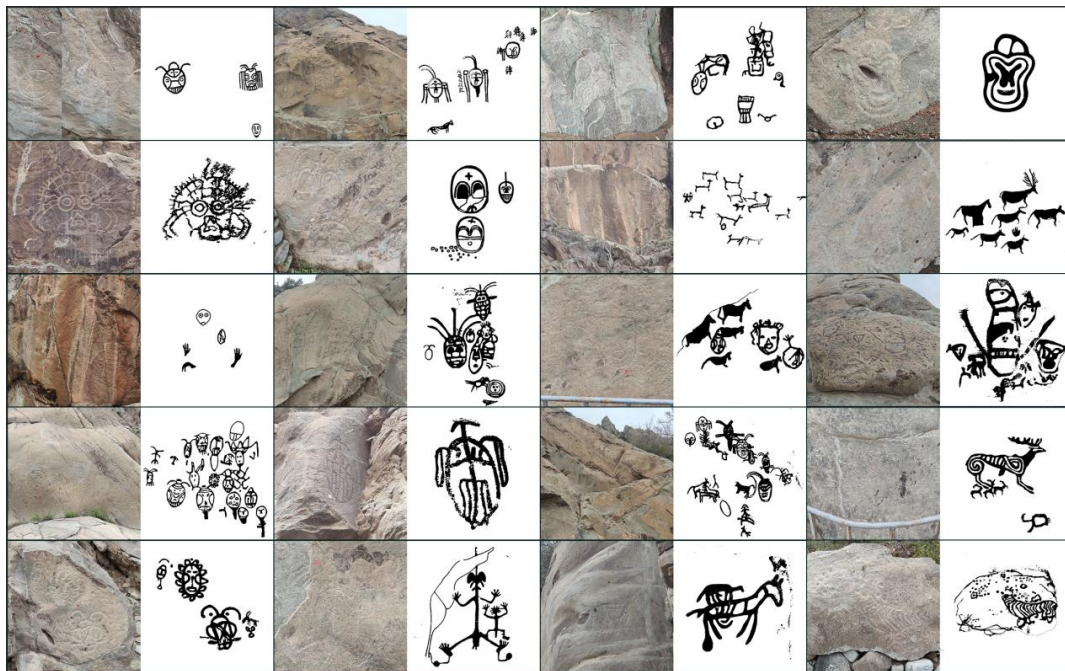Source: From the Author

Figure 5 Helan Mountain Rock Painting and their Counterdraw
Source: From the Author

Moreover, we have also interviewed relevant experts, including Professor Li Tong, the director of the Ningxia Rock Painting Research Center, Professor Zeng Famao from the Silk and Road Ningxia Cultural and Creative Center at Ningxia University, as well as Zhang Xu and Xia Liangliang from the Propaganda and Education Department of the Helan Mountain Rock Paintings Administration Office. These interviews enable us to understand the current research status, artistic characteristics, development direction, and cross-disciplinary research progress of rock paintings from an academic perspective and recognize the current situation, problems, development opportunities, and challenges of the Helan Mountain Rock Paintings scenic area from the perspective of market.

2. Analysis of the Contents of the Helan Mountain Rock Paintings

The Helan Mountain Rock Paintings are widely distributed, featuring a rich and diverse array of interconnected images. Through a comprehensive and comparative analysis of the content, this study has arrived at the following conclusions.

2.1 The Helan Mountain Rock Paintings serve as a means for ancient humans to record information, acting as both the content and carrier of communication. Ancient humans engraved patterns on the rocks of Helan Mountain, utilizing these patterns and symbols to document their daily lives, production activities, as well as their observations and understanding of natural phenomena. These patterns constitute objective facts that record information. As a form of non-verbal communication, they transcend the limitations of time and space, transmitting the life experiences and knowledge of ancient humans. In academic research, the Helan Mountain Rock Paintings are regarded as a primitive information encoding system. Their mysterious images and symbol system provide a unique perspective for studying ancient information dissemination methods. By decoding these rock paintings, scholars can reveal the patterns of information exchange in ancient society and understand how ancient

people preserved knowledge and transmitted culture through visual art, thus proving that the rock paintings played a crucial role in ancient information dissemination.

2.2 There exists a connection between the contents of the Helan Mountain Rock Paintings, which perpetuates specific cultural ideologies and knowledge. The continuity of content in these rock paintings reveals a mode of cultural heritage and knowledge dissemination that spans across time. These rock paintings, with a significant number of similar but evolving graphics, show continuity in content and recurrence in themes, demonstrating the enduring influence of specific cultural ideas (Su, 2021:69). For instance, although the theme of hunting appears multiple times in the rock paintings, the "plots" depicted vary significantly. Take Figure 6 as an example. It can be seen that two hunting scenes are depicted on the same boulder, while seemingly similar, they differ in the type of prey and the position of the hunting dogs, reflecting diverse hunting processes and outcomes. In addition, as the carving of rock paintings requires a considerable amount of time, the two should be records of two separate hunting experiences. Thus, such continuity of content makes the rock paintings an information carrier, documenting and transmitting knowledge about hunting.
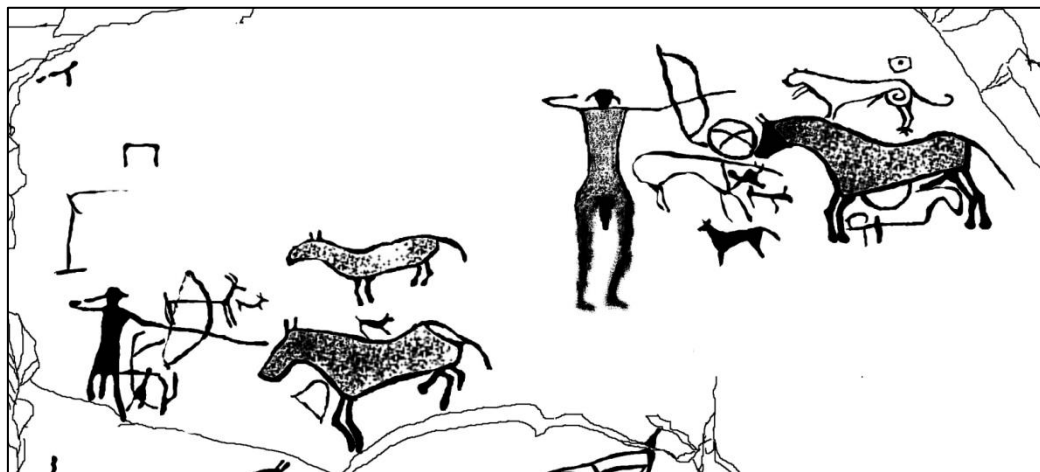

Figure 6 Helan Mountain Hunting Rock Paintings
Source: From the Author

2.3 As information carriers, the Helan Mountain Rock Paintings circulated among different groups and regions. Through comparative analysis of rock paintings in Helan Mountain and its surrounding areas, scholars have discovered that despite the vast geographical span, certain pattern elements in the rock paintings, such as animal images, hunting scenes, and abstract symbols, all demonstrate cross-regional characteristics, which may reflect a shared symbol system and cultural traditions among ancient humans, thereby promoting the dissemination of information and the formation of cultural identity (Xu, Zhou, Ha & Ding, 2014:27). As shown in Figure 7 which is a Damaidi Rock Painting depicting a hunting scene, although it is located approximately 200 kilometers away from the location of Figure 6, the posture of the figure shooting an arrow in both of them is strikingly similar. The difference lies in the type of prey, which has changed to a "sheep," and the behavior of the hunting dogs tearing at the prey to assist in the hunt, indicating more mature hunting training. This fully

proves the role of rock paintings as information carriers and provides important evidence for cross-regional communication and social interaction among ancient humans.

Figure 7 Damaidi Hunting Rock Painting
Source: From the Author

2.4 The Helan Mountain Rock Paintings may be the rudiments of early hieroglyphic writing and played a significant role in cultural dissemination. Rock paintings, as an ancient form of visual expression, are closely associated with the origin and evolution of writing. In academic research, rock painting symbols are considered rudiments of early hieroglyphic writing due to their intuitive imagery and symbolic meanings(Wang, 2014:74). Hieroglyphic writing, as one of the oldest writing systems, is characterized by directly imitating the shapes of natural objects to express specific concepts or information. In rock paintings, we can observe similar modes of expression, with many symbols depicting the contours of animals, figures, or natural phenomena to convey specific information or abstract concepts(Shu, Nie & Liu, 2022:40). For instance, the image of an animal such as a "Deer" not only visually resembles its real-world counterpart but also functionally serves to transmit information. This process of transitioning from specific images to abstract meanings aligns with the development trajectory of hieroglyphic writing. Furthermore, the repetition and fixity observed in rock paintings echo the standardization trends in writing, indicating the evolution from rock painting symbols to mature writing systems. Therefore, rock paintings have not only witnessed the culture and social structure of prehistoric, but also provided valuable clues for understanding the origin of writing, revealing the early stages of human language and writing system development.
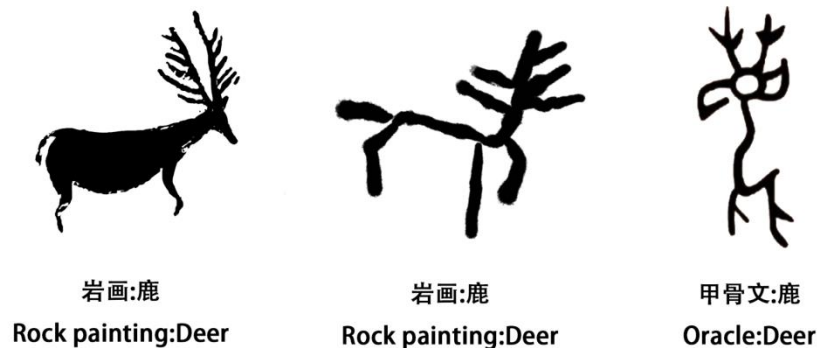
岩画:鹿
Rock painting:Deer
岩画:鹿
Rock painting:Deer
甲骨文:鹿
Oracle:Deer

Figure 8 Comparison Between Deer in Rock Paintings and the Oracle "Deer"
Source: From the Author

2.5 From information dissemination to knowledge transmission, the Helan Mountain Rock Paintings embody the spirit of "inheritance". These paintings exhibit a rich array of communication phenomena, not only revealing the complexity of information transmission among ancient humans but also profoundly reflecting a transgenerational "inheritance" spirit. The significance lies in the revelation of the mechanisms of cultural continuity and knowledge preservation. As carriers of information, these rock paintings, in their dissemination across different groups and regions, have facilitated the exchange of cultural ideas and knowledge, strengthening the formation of shared identity and values. The continuity and evolution of the content in the Helan Mountain Rock Paintings reflect the ancient society's respect for traditional knowledge and its tolerance for innovation. This balance maintains cultural stability while also providing impetus for cultural development and adaptation. Furthermore, the possible embodiment of early hieroglyphic rudiments in the rock paintings further emphasizes the role of the inheritance spirit in the evolution of language and writing, providing crucial clues for understanding the development of human civilization. Therefore, through the inheritance spirit reflected in the Helan Mountain Rock Paintings, we can not only gain insight into the cultural dynamics of ancient society but also recognize the fundamental role of knowledge and cultural inheritance in social continuity and identity construction throughout human history.
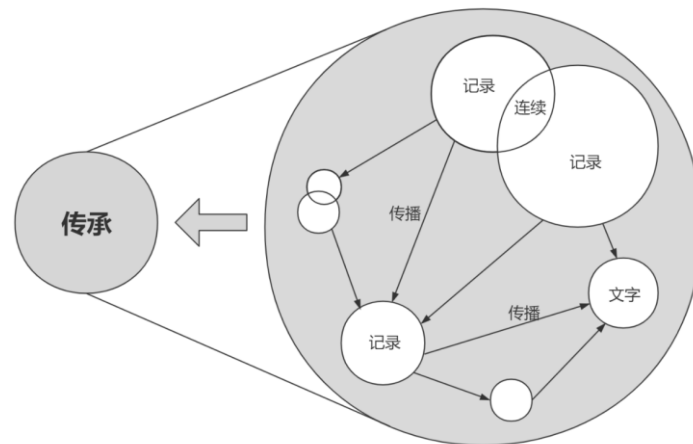
Figure 9 From Transmission to Inheritance
Source: From the Author

3. The Animation Transformation Process of Symbols in Helan Mountain Rock Paintings

3.1 Symbol Transformation of Helan Mountain Rock Paintings

It is a process of encoding and decoding to transform Helan Mountain Rock Paintings into animation. During the animation transformation, it is needed to reinterpret and visually reconstruct the original symbols while striving to maintain the artistic style and aesthetic characteristics of the original rock paintings. At the same time, modern animation techniques should be employed to enhance the visual impact and narrative effectiveness. Through this symbolic transformation, the rock paintings are transformed from static images which are difficult to understand into dynamic and interactive new media animations with distinct meanings. This provides the audience with an intuitive perception, promoting a deeper experience, understanding, and dissemination of this culture.

Figure 10 Image of the Work
Source: From the author

The symbols in the Helan Mountain Rock Paintings primarily consist of two types, the environmental symbols and the content symbols. The former mainly include mountains, rivers, vegetation, and creatures, which require the designers to carefully observe and extract the environmental features of the rock paintings in the transformation process so as to accurately represent the natural scenery of the Helan Mountain region in the animation, creating a specific spatial field for the audience. Content symbols, on the other hand, refer to the specific patterns in the rock paintings. Therefore, the transformation of these symbols should place greater emphasis on the specific patterns and symbolic meanings within the paintings. Animation designers need to profoundly analyze the depicted patterns and scenes of daily life and transform them into dynamic images and storylines. In this process, not only should the visual characteristics of the patterns be considered but also efforts should be made to capture the cultural and historical connotations behind.

3.2 Storytelling for the Revitalization and Inheritance of Rock Paintings

In animating the Helan Mountain Rock Paintings, storytelling serves as a crucial element in bringing the rock paintings to life. When writing the story, it is essential to first conduct a deep cultural interpretation of the symbols and patterns in the rock paintings, extracting their inherent narrative elements and symbolic meanings. Then, a narrative framework that is consistent with the historical background and cultural environment should be established, with the combination of these elements with story creation theories. For instance, mysterious patterns like the images of human faces can be invented as characters of fictional "mentor", while hunting scenes can serve as plot points and the real-life threat of floods eroding the rock paintings can be incorporated into the story as a challenge. By weaving

these characters and plots that resonate with the rock paintings, an engaging story is crafted, truly giving vitality to the ancient rock paintings.

In addition to respecting the original rock paintings, story creation should also incorporate modern narrative techniques, such as suspense, conflict, and plot twists, to enhance the attractiveness of the story, like giving characters emotions and motivations to make them more emotionally charged, able to deeply touch people's hearts and evoke emotional resonance among audiences. Through such storytelling, the Helan Mountain Rock Paintings can be presented to modern audiences in a novel form, thereby promoting the dissemination of rock painting culture while sparking people's interest and contemplation about history and cultural heritage.

3.3 The Application and Empowerment of Interactive Technologies

The application of interactive technology significantly empowers the enhancement of cultural transmission effects. Leveraging new media platforms, mobile devices, and interactive technologies such as virtual reality (VR), augmented reality (AR), and multi-touch, audiences can actively explore the scenes of rock paintings in a virtual environment and even interact with them, generating a game-like deep experience that deepens their understanding of the culture and history behind the rock paintings. For example, they can experience ancient hunting scenes through a bow and arrow mini-game or complete missing patterns in the rock paintings through fingertip painting. Such interactions not only make the animation more funny but also improve the effectiveness and scope of cultural transmission.

Moreover, interactive technologies can also support user-generated content (UGC), allowing audiences to influence the development of the story through interaction or create text and artistic works related to the rock paintings, thus promoting the collaborative creation and multiple dissemination of cultural content. In this process, audiences are no longer passive recipients of information but can more proactively participate in the narration of the rock painting stories through interactive experiences, obtaining an immersive cultural experience. This has greatly stimulated public interest in the Helan Mountain Rock Paintings and has enriched the forms of cultural transmission and expanded the boundaries of cultural inheritance.

Figure 11 Interactive design in work
Source: From the author

Discussion

1. A new paradigm for digital protection and transmission of cultural heritage is proposed in this research. Unlike existing cultural heritage protection, it goes beyond mere digital restoration and protection (Shu, 2022:140) to new creations and adaptations that incorporate new art forms, enriching the story texts of the Mountain Rock Paintings and expanding its tourism resources. In this research, a multidimensional interpretation of the cultural and artistic values of the Mountain Rock Paintings is provided, and a method of generating new knowledge is explored. This approach not only enriches our understanding of the Mountain Rock Paintings, but also provides new perspectives for the protection and inheritance of cultural heritage.

2. A new idea for in-depth analysis of cultural heritage is provided in this study. It differs from previous researches in that it emphasizes the analysis of the spiritual power embodied behind the rock paintings from the perspective of transmission, which provides a new perspective for researching the deeper meanings of rock paintings. In the process of transforming cultural heritage, in addition to analyzing the original significance of rock painting patterns, it is more important to further analyze the spiritual symbols behind the cultural symbols from the specific research of the symbolic meanings and the process of transmission, which is an even more important content in artistic creation. Therefore, future research shall pay more attention to the in-depth analysis of cultural symbols and refine the core cultural values of cultural heritage while respecting the original meaning of the text.

3. This research has made innovations in the form of transmission of Mountain Rock Paintings. In the past, the forms of transmission mainly focused on the rock painting images, or the extended utilization of the patterns, such as cultural and creative products. By exploring the novel transmission method of interactive animation, this research increases public participation and interest in the Mountain Rock Paintings. The audience gets a new way of experiencing depth through the contextualization of the animation, which not only enhances the effect of cultural transmission, but also opens up new possibilities for the display and education of cultural heritage (Yin &Yuan, 2023:123).

Recommendations

1. Theoretical Recommendation

At the theoretical level, future research should focus on deepening the analysis of the semiotics of Helan Mountain Rock Paintings and exploring their position and significance within ancient social culture, religion, and philosophical systems. By comparing symbol systems across different cultural backgrounds, we can reveal the universality and uniqueness of the patterns and symbols in the rock paintings. Additionally, the further expansion of communication theory will pay much attention to how interactive animation transforms information dissemination patterns in the digital media environment and how narrative theories enhance the narrative power and dissemination effect of animation. The integration of interdisciplinary theories, combining perspectives from anthropology, history, and art history, will provide more comprehensive theoretical support for the animation transformation of Helan Mountain Rock Paintings.

2. Policy Recommendations

At the policy level, it is recommended to formulate and implement a series of policies that support the digitization of cultural heritage and the application of interactive technologies. This includes providing financial assistance for related projects, encouraging technological research and development, and fostering talent cultivation. Promoting international cooperation is crucial for resource sharing, experience exchange, and technological collaboration, especially in the application of interactive technologies and the global dissemination of cultural heritage. Furthermore, developing policies on education and public participation will enhance public awareness and engagement with cultural heritage, strengthening its social influence through diversified avenues such as school education, public exhibitions, and interactive experiences.

3. Practical Recommendations

At the practical level, technological development and application are crucial. There is a need to develop interactive technologies suitable for the animation transformation of Helan Mountain Rock Paintings and test and optimize them in actual projects. User experience research will provide valuable feedback for the design and improvement of animation products, ensuring that the animation content is both attractive and educationally valuable. The implementation of practical projects, such as animation workshops and interactive exhibitions, will directly promote the dissemination and educational activities of Helan Mountain Rock Paintings. Simultaneously, establishing evaluation and feedback mechanisms is essential for monitoring project effectiveness, collecting user feedback, and guiding future research directions. Through these practical measures, the digital preservation and dissemination of Helan Mountain Rock Paintings will be more efficient, laying a solid foundation for the innovative inheritance and widespread dissemination of cultural heritage.

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