ArtifactShow: Incorporating Generative AI into Narrative Visualization for Interactive Cultural Experience

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Figure 1: A overview of the *ArtifactShow*, an interactive system for exploring cultural content through narrative visualization.

Abstract

We propose ArtifactShow, an interactive system that engages users in cultural experiences through a series of digital shows powered by generative AI. Current cultural digitization processes rely heavily on labor-intensive efforts to create complex multimedia scenes from vast amounts of cultural data. To address this challenge, we integrate generative AI into narrative visualization, enhancing public understanding of historical and cultural narratives through navigation, exploration, and visual analysis. To evaluate the effectiveness of our system, we conducted user studies with three domain experts and seven volunteers. Our findings suggest that ArtifactShow has significant potential to enhance public knowledge and interest in cultural heritage. Through our exploration, we developed a workflow and design guidelines for using generative AI to construct narrative visualizations for cultural heritage.

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CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**; • **Applied computing → Arts and humanities**.

Keywords

Cultural Heritage, Data Visualization, Generative AI

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1 Introduction

Digital art has become a key research area for cultural heritage, enhancing the preservation, inheritance, and utilization of cultural resources. It goes beyond traditional museum visits, combining artistic expression with emerging technology, and yields immersive cultural narratives and interactive experiences. Digital art makes cultural content more accessible, perceivable, and engaging, fostering greater inclusion and engagement. Cultural institutions have long aimed to enhance cultural interpretation and representation through artistic expression. Multimodal approaches, combining images, sound, and animation, effectively visualize data changes such as temporal variations and spatial distribution [24]. However, challenges remain in transforming data into artistic expressions due to diverse data types, quality, and resource requirements [12]. Generative AI is emerging as a solution, processing and transforming data efficiently. It has significantly enhanced education and entertainment, playing a vital role in cultural dissemination. Narrative visualization, supported by generative AI and embodied interactions, sparks critical thinking and boosts user motivation for knowledge acquisition [4].

In this work, we introduce *ArtifactShow*, an interactive prototype that utilizes AI-generation tools for data visualization in cultural narratives and interactive experiences. We focus on animal totems, which reflects revealing a visualized cultural narrative from the perspective of artifacts. This prototype integrates cultural heritage into artifact appreciation, cultural presentation, and performance interaction, achieving multimodal fusion and creating narrative-driven data visualizations. The major contributions of this paper are as follows:

- **Workflow.** We explore reusing resources from static digital archives to address the lack of design materials for interactive systems and propose a workflow to transform cultural data into visual content.
- **Interactive System.** We developed *ArtifactShow*, an interactive system using our generation workflow to explore cultural content through narrative visualization.
- **Empirical Study.** We validated system usability and learning goals with three experts and assess user experience through a study with seven participants.

2 Related Work

Generative AI art is an emerging field of art creation that employs AI technology to create visual arts, music, poetry, dance, and performance arts, thereby pushing the boundaries of creativity and redefining the role of artists in the creative process. These progress has benefited from some groundbreaking AI techniques to analyze patterns [2, 21], enabling the creation of stories or dialogues with narrative structure, diverse and high-fidelity images [11], and even complex multimedia works [18, 31, 32]. Generative AI's potential is significant. Previous works have demonstrated its remarkable capability in transforming vast amounts of data into creative outputs, particularly in the context of culture expression that mirror or extend the human creativity [2]. For instance, 'ID.8' [1], devised by Antony et al., integrates generative AI with storytelling, allowing users to create visual stories with customizable options. Similarly, 'EmoEden' [26] utilizes generative AI to assist HFA children in emotional learning, providing diverse texts and visual content.

Apart from that, generative AI significantly reduces the time and effort in labor-intensive creation to produce high-quality content. This, consequently, empowers creators to shift their focus towards creative conceptual design, fostering a deeper exploration of art intent [23]. In response to that, Generative AI's ability to generate diverse and visually compelling content can be harnessed to reinterpret and present data narratives in innovative ways. This potential extends to museum data exploration. Representative examples include Lim et al.'s participatory sound installation 'Echo Chamber,' which reinterprets visitor piano-playing through AI variations [16], and Kun et al.'s 'GenFrame', which produces AI-generated artworks resembling classical museum pieces [13]. However, current generative AI tools often prioritize broad applicability over contextual precision, potentially limiting their effectiveness. While these tools revolutionize process automation, especially for repetitive tasks, they still fall short in capturing cultural contexts or generating content that aligns with specific goals. Therefore, human oversight remains crucial to ensure accuracy and relevance in AI-generated content.

Meanwhile, narrative visualization employs diverse artistic mediums to convey complex information, data, or stories in museum context. For instance, Wirfs-Brock et al. [28] combine sound and narrative to enhance users' perception of data. Similarly, 'MINUET' [19] generates music to accompany text, increasing user engagement. Furthermore, 'TimeQuestAR' [30] demonstrates that integrating scenarios with cultural data boosts motivation and memory retention. In terms of combining with generative AI technologies, narrative visualization allows users to interact with virtual artifacts and historical figures [5, 15], and attach rich and interactive meta-information related to artifacts [10, 30]. This enables users to obtain a more comprehensive understanding of the artifacts and their historical context [14, 29].

In alignment with that, prior research on interactive installations explores natural gesture-based interactions, these technologies also open up a new way for engaging in cultural experience [22]. While traditional interactive devices, keyboard and mouse control provide an accessible experience that aligns with user cognition, it lacks immersive and natural interactive qualities [7]. To address this issue, some interaction methods where hand gestures represent

objects in an embodied manner have been widely applied in interactive applications to enhance user engagement. For example, Gonizzi Barsanti et al.'s research [9] utilizes LeapMotion to augment the experience and cultural comprehension through motion sensing. This approach can be further reinforced by incorporating music clues as an effective guiding strategy [6], as demonstrated by Vayanou et al. in 'ArtStory Beats' [27], which integrates well-designed narrative content, and links the visual artworks and musical compositions.

Building upon these advancements, *ArtifactsShow* enhances cultural and artistic expressions by incorporating AI generative tools into system development. It offers users an immersive and highly interactive experience, simulating the feeling of being in an interactive cultural space. We integrate generative AI into narrative visualizations to bridge static artifact displays and dynamic cultural narratives. Our work represents data through audio and visual elements like color, shape, and texture to deepen cultural comprehension. Moreover, it combines gestures and traditional setups to create a flexible connection among users, artifacts, and data. This approach fosters interactive and immersive experiences, resonating with diverse audiences.

3 Workflow

This section outlines the museum research and design process developed through focus group studies within the research team. Figure 2 illustrates the overall workflow. We focus on the cultural theme of "the evolution of the animal totem" and establish four learning goals (G): (G1) Experience cultural forms and characteristics; (G2) Convey the cultural symbols in social civilizations; (G3) Explore cultural exchange and mutual learning; and (G4) Understand cultural content in an innovative way.

3.1 Museum Data

We accessed the sample dataset from the *China Visualization and Visual Analytics Conference (ChinaVis)* website [1], which includes text and image data from open databases of seven museum. To extract key information, we reorganized these data into ten fields: collection name, species of the animals, material, size, technique, time period (year), dynasty, location, China-related and description. The process involves four steps:

Data Pre-processing and Initial Exploration. We conducted a data review using Azure AI assistant, including overall statistical information and data distribution.

Data Cleaning and Annotation. Image data were segregated based on relevance to China, adding a new 'China-related' column to the dataset.

Data Filtering and Focused Analysis. We filtered data related to figures and other animals from 1500 B.C. to the 20th century for further analysis based on time and location.

Detailed Data Processing and Splitting. The original 'metadata' column was split into multiple parts using semicolons to classify and analyze various attributes.

[1]https://chinavis.org/2024/document/channel2_data.rar

3.2 Design Concept and Process

Through data analysis and processing, we extracted cultural knowledge from the dataset and integrated this information into narratives. All AI-generated content was regularly reviewed and validated by a cultural practitioner to ensure its appropriateness within historical and cultural contexts. The design process encompasses four key aspects to create an optimal learning context:

Interaction Methods and Mechanisms. *ArtifactShow* engages user with data-driven museum collections, using traditional keyboard and mouse input alongside gestures to explore cultural content. Users can interact with scenes, artifacts, figures, and other information in three different shows (museum show, light show, stage show) through embodied interactions.

Musical Narration. We used ChatGPT to craft lyrics based on our cultural findings, incorporating proper structures and vocal cues. Suno AI then generated the fitted music from these lyrics.

Scene Construction. To reduce the influence of uneven light and the problem of shade from other objects, we optimized static images from the dataset using Photoshop and generated 3D models with Artefacts.AI. Animation was created with the Auto-rig feature in Anything World, with further adjustments and movement data in Blender. A storyboard based on lyrics and script guided the animation sequence and camera tracking in Unreal Engine.

Data Visualization. We designed museum labels to present descriptions for each artifact from six dimensions, making details easy to follow. In addition, we have incorporated various visual elements in virtual scenes to encode the cultural information, aiming to present cultural values and implications.

4 ArtifactShow: Visualization and Interaction Design

We designed three distinct shows to cater to users with varying levels of experience: the museum show offers a foundational introduction, contextualizing artifacts within history; the light show presents symbolic meanings through visual metaphors; and the stage show empowers users to synthesize insights into dynamic, performative narratives. This three-tiered design aims to encourage users to shift from passive learning to active creators of cultural meaning, fostering deeper engagement and interpretation. The progressive learning experience allows users to gradually build cultural knowledge, and develop an understanding of cultural differences and symbolic meanings. This foundation prepares them to engage in cultural performance that reflect their personal insights and emotional expressions. To achieve this, we developed intuitive interaction techniques to enhance user engagement and accessibility. In each show, users can navigate the scene using the WASD keys and adjust their view with the E and C keys. Additionally, they can use either the mouse or gesture interactions for navigation and manipulation, providing a flexible and immersive experience tailored to different user preferences.

4.1 Museum Show

The first show allows users to freely visit and interact with scenes in a museum layout consisting of two simple rooms (see Figure 3). Cultural insights are spotlighted on a virtual large screen in the guide hall, serving as an interactive item. Users can control reading

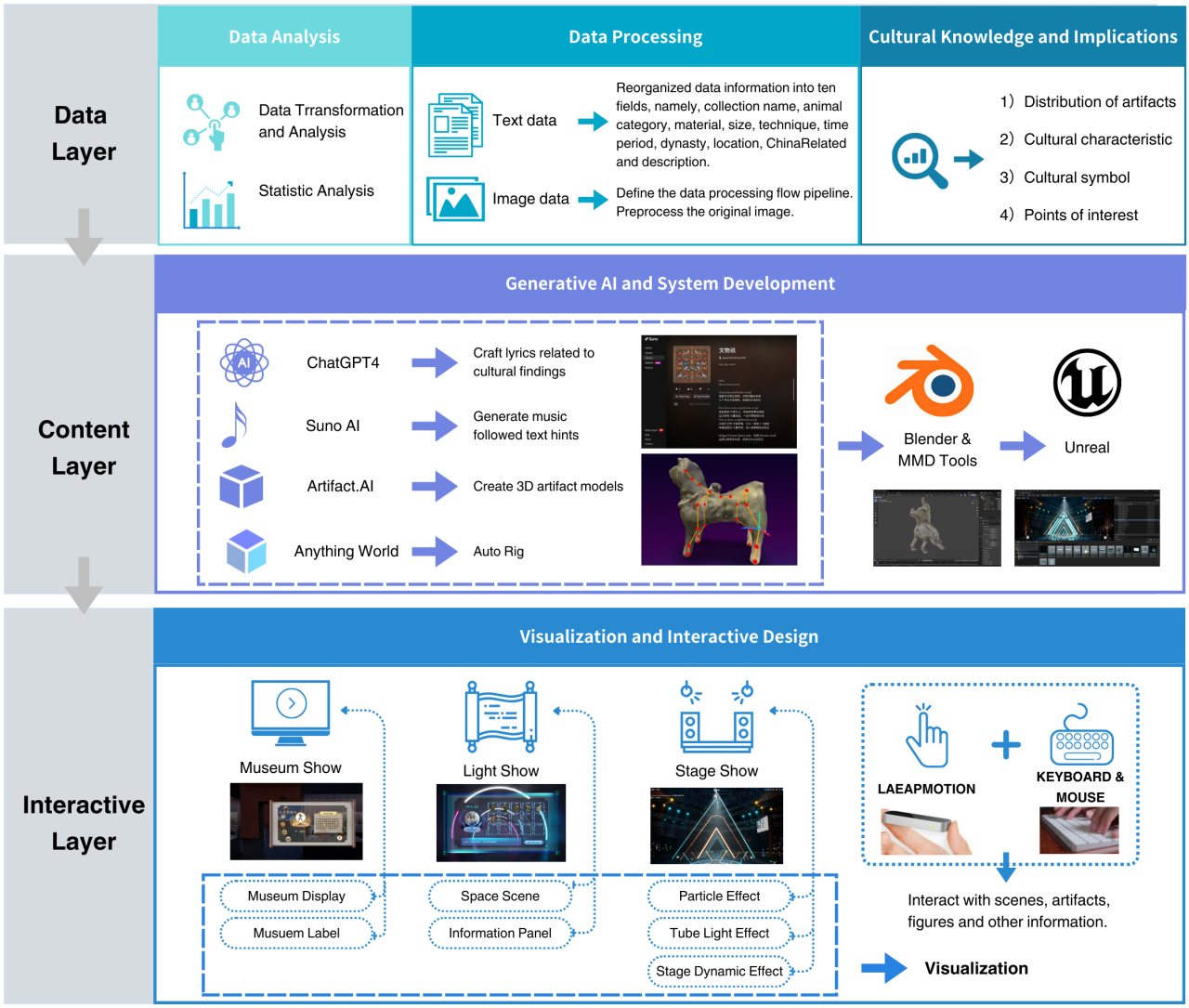


Figure 2: The workflow of the *ArtifactShow*.

time through gestures or mouse clicks. In the main hall, users interact with the artifacts, with associated information displayed on museum labels. Each artifact includes an index label with six sub-pages providing background information: a brief description, technique, material, species of animals, time period, and collection source.

4.2 Light Show

This show supports interactive data exploration for complex visual analytics. As shown in Table 1, Various visual elements reinterpret the distribution of artifacts with spatio-temporal properties and animal species, creating an informative light space. Users navigate the light gallery following the historical timeline. The movement of six representative artifacts, depicting animal species, is guided by camera tracks that follow user movement (see Figure 4). This scenario also supports further exploration of artifacts. Selecting

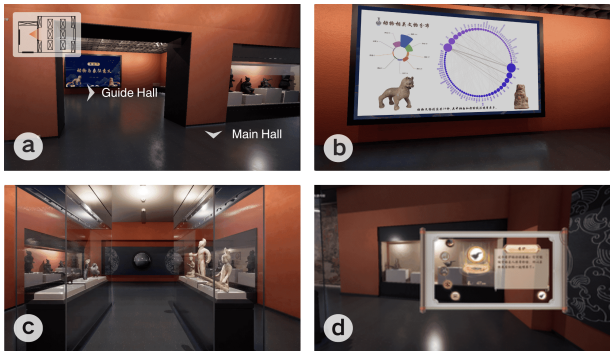


Figure 3: Museum show environment. (a) The museum layout. (b) A guide hall view. (c) A main hall view. (d) A page of museum labels.

a light point presents a visualized panel with interpretations of similar artifacts from the same time period, animal species, and material.

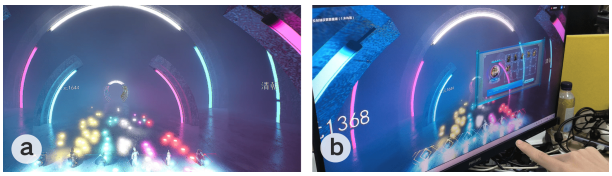
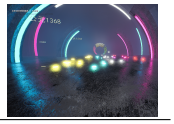


Figure 4: Light show environment. (a) The light gallery. (b) A view of a user interacting with the information panel.

Table 1: Visual elements and coded information in space scene visualization.

Visual Element	Data Information	Example View
tube light - (equidistant) inside track	time period	
tube light - outside track	dynasty	
horizontal position of the light spot	material	
height of the light spot	quantity ratio of similar artifacts	
color of the light spot	species of the animals	

4.3 Stage Show

As shown in Figure 5, the stage show offers users real-time cultural performance experiences. Users control the camera with gestures, immersing themselves in the cultural content of the music. Cultural content is mapped in the lyrics, and visual effects are encoded as intuitive stage decorations as follows.

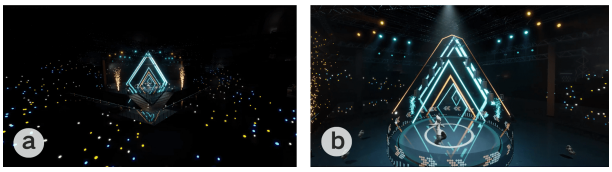


Figure 5: Stage show environment. (a) A zoom-out view of the show. (b) A zoom-in view of the show with data mapping in cyan jet particle effect.

Particle effect. Particle lights are positioned around the stage to enhance visual effects. Synchronized with the point of interest of these artifacts from music lyrics, the quantity and height of the cyan particle jets represent the number of related artifacts (see Figure 5.b).

Stage dynamic effect. It includes decorative arrows and histogram bars. Cyan arrows encode the duration of each dynasty, while orange arrows mark the start and end points. Histograms under the orange arrows show artifact distribution by animal species. As shown in Figure 6, bar heights represent the count of different materials used for each animal species per period, with empty data shown as translucent bars at minimal height.

Tube lights. Eight triangular tube lights correspond to each dynasty throughout the historical timeline. The height and color of these tube lights denote the total quantity of artifacts and the materials that are most frequently used in these artifacts, respectively (refer to Table 2).

Table 2: Visual elements and coded information in space scene visualization.

Visual Element	Data Information	Example View
the distance between two tube lights	time period and dynasty	
height of the tube light	number of artifacts	
thickness of the tube light	species of the animals	
color of the tube light	material	

5 Evaluation

We invited three domain experts (E1-E3, aged M=34.00, SD=11.36) to validate the prototype's feasibility and recruited seven volunteers (P1-P7, aged M=19.86, SD=1.46), representing the target audience, to further evaluate our design. The audio recording collected in the interviews were transcribed, coded and analyzed by two researchers independently, following theme-based approach [20].

5.1 Usability and the Achievement of Learning Goals

We initially assessed system usability through expert evaluation. Then, these experts participated in a focus group interview to discuss the fulfillment of learning goals using case studies. The system usability [3] was rated as 'good' or 'excellent'. Below, we present the detailed findings on the learning content.

G1 is fulfilled. E2: *'ArtifactShow not only presents history but also records the evolution of cultural forms and characteristics.'* All this information conveyed aligns with historical literature and was further confirmed with experts in the interviews. To conclude, *ArtifactShow* presents the cultural implication in three aspects (see Figure 7).

- **Technique.** Early Bronze Age artifacts were rough due to casting limitations. Technological advances later made them intricate and artistic.

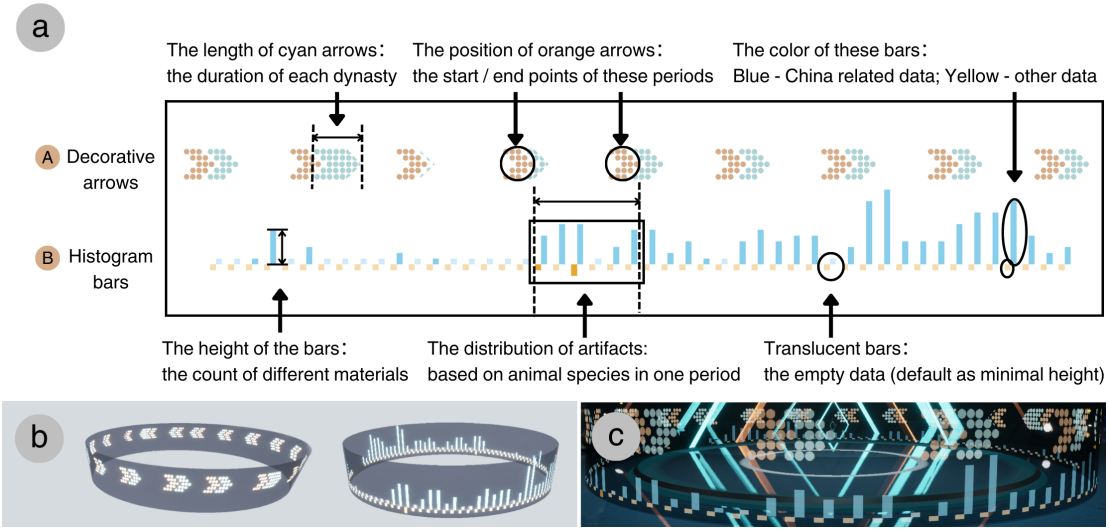


Figure 6: Stage dynamic effect construction process. (a) The cultural data transform into Component A - decorative arrows, and Component B - histogram. (b) 3D modeling output. (c) The final effect.

- **Lifestyle and social production.** Horses played a vital role in daily life and production during the Tang Dynasty, as reflected in human-horse ceramic sculptures embodying the horseback culture.
- **Cultural characteristics in times.** Tang Dynasty women participated in sports like archery, and the popular riding dress of Chang'an is depicted in pottery from that period.

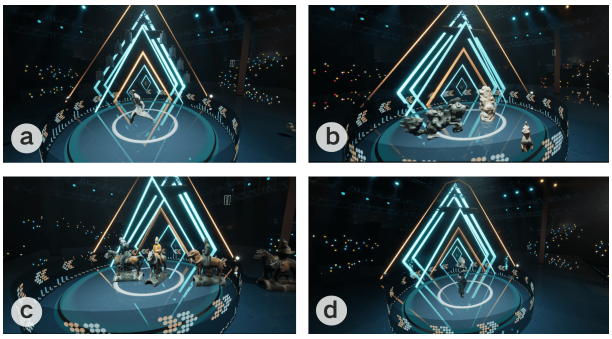


Figure 7: Stage show of cultural forms and characteristics. (a) Bronze artifacts. (b) Various exquisite artifacts. (c) Human-horse ceramic sculptures. (d) Pottery figure.

G2 is fulfilled. E3: *'The stage show visualizes cultural content in lyrics to reveal symbolism in history and society.'* For example, dragon and phoenix patterns represent Chinese royal nobility, while phoenix and peony together symbolize prosperity and good fortune. Scroll paintings often use cranes and pine to represent longevity. As shown in Figure 8, these scenes effectively convey societal structures and values.

G3 is fulfilled. E1: *'The stage performance of the Silk Road impressed me a lot.'*, and E2: *'In ArtifactShow, we see cultural heritage influenced by religious thought from cultural exchange.'* Chinese civilization has deeply engaged with global cultures, extending

Figure 8: Stage show of cultural symbols. (a) Cloth pattern of dragon and phoenix. (b) Scroll painting.

beyond trade to philosophy and religion. For example, the artifacts *Lan Caihe* and *Crane* are from Eastern Taoist legends, while *Lotus Guanyin* and *Lion (as a mount)* are from Western Buddhism (see Figure 9).

G4 is fulfilled. All experts have positive attitudes about promoting cultural inheritance innovatively. As E2 noted, *"It was amazing that the generated 3D artifacts are very realistic. ArtifactShow offers a cost-efficient method to create digital replicas and novel interactions."* Additionally, two experts comment on the gameplay and data visualization. E1 reported, *'Everything is perfect. Museum labels are informative, visual elements are meaningful and well-designed, and the system supports various interaction methods.'* E2 added, *'Users can engage, explore, and play with cultural content in an organized manner, enhancing interest in cultural heritage.'*

5.2 User Study

Here, we report our qualitative findings based on themes-based analysis from in-depth interviews.

User experience. Participants report their attitudes and feelings in two dimensions. (1) Cultural experience (N=8). P3 commented, 'Museum Show provides vivid artifact appreciation and informative narratives, sparking my interest and promoting cultural comparison.' Moreover, P6 suggested that 'Stage Show can be recorded as musical movies to promote social sharing, enhancing

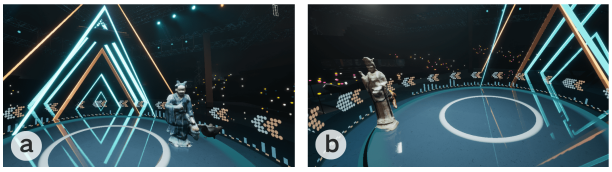


Figure 9: Stage show of cultural communication. (a) Immortal and animal in Taoism. (b) Bodhisattva and animal in Buddhism.

collective learning.' (2) Visualization (N=5). Participants confirmed the effectiveness and art of data interpretation. P1 mentioned, 'Images enhance visual memories; for example, the light points represent artifact types and counts, making it easier to remember that the Qing Dynasty had more varieties of artifacts.' However, some found data-driven presentations challenging for cultural understanding. P6 pointed out,. P6 pointed out, 'While data encoding in the stage show enhances the visual effect, it also makes interpretation more difficult.' This suggests that balancing aesthetics and comprehension is crucial in data visualization.

Interaction Techniques. Several factors affect participants' choices: (1) Efficiency and Convenience (N=6). Most participants prefer to use a keyboard and mouse. P3, a game enthusiast, said 'Keyboard is more suitable for my operation habits.' P5 added, 'Gesture interaction requires more effort for the same actions.' P4 reported, 'Extended use of gestures is especially prone to fatigue.' (2) Immersion (N=2). P2 mentioned, 'Gesture interaction gives me a sense of control. When I click the museum label, I feel a consistent experience with this natural interaction.' (3) Personal Choice (N=1). P1 expressed, 'I like to experience various interaction methods for different actions such as movement, rotation, and navigation to find the perfect personal control.'

Application Prospects. Participants confirmed its value in society, economics, and culture, applicable in various fields. (1) Culture and education (N=5). P7 commented, 'Broken artifacts can be restored and exhibited this ways.' P1 added 'It can be placed in a real museum to create a personalized and meaningful experience.' (2) Business (N=2). P2 said, 'The Stage Show has great commercial potential, promoting cultural preservation with lively interactive experiences.' (3) Entertainment (N=2). Participants appreciated the art, music, stories, and interaction. P3 said, 'I would pay for this.'

6 Discussion

Here we discuss design suggestions, potential values and benefits extracted from the *ArtifactShow* prototype.

Generative AI. Generative AI enables people to create and produce multimedia content automatically through computing devices, which simplifies the complex process of data analysis, enhanced visualization, and 3D construction [8]. This makes data more accessible and reduces time and cost with manual labor. With the large support of Generative AI, *ArtifactShow* transforms the way cultural artifacts and narratives are interpreted through limited static cultural archives. We extracted the cultural data to narrate cultural content in lyrics and music, and visualized the static images into animated 3D models that enrich the storytelling forms. We also refer back to these cultural materials to ensure that AI-generated content maintains a high level of accuracy and cultural authenticity to avoid any misrepresentation or distortion of historical narratives. Additionally, *ArtifactShow* supports rich control methods to allow users to obtain a smooth, buttery interaction in a multi-sensory cultural experience. It is not only a storyteller telling a fixed story to visitors through curatorial design, but a story co-maker with cultural experience in the interrelationship between visitors, cultural space, and digital storytelling [17]. This evokes the emotional connection to bond the artifacts and users in co-creation performance.

Narrative Visualization. Narrative visualization breaks through communication barriers with natural expression [25]. This goes beyond cold statistic expression and connects with a broader audience, promoting informative representation within compelling stories. In museum show, the museum label and interactive large screen incorporate interaction and information visualization in narrative. This allows the user to further explore particular points of the background knowledge and artifact features, facilitating user engagement. Moreover, we encode rich cultural information into a part of 3D scenes construction in visual processing. It has transcended the traditional aesthetics that comprehends the immersive narrative and data representation. Overall, we see the potential for narrative visualization to create immersive and exploratory environments that guide users to perceive knowledge within meaningful storytelling.

Potential Values and Benefits. Both expert evaluation and user feedback confirm the intrinsic value and social benefits of this interactive system. By embedding knowledge into narrative visualization, all learning goals have been fulfilled in *ArtifactShow*, which is acknowledged by experts. The integration of generative AI and data visualization represents the future trend in cultural experience. It provides new perspectives for cultural institutions to explore new ways for cultural digitization and transmission. Furthermore, our work has demonstrated its enormous potential to foster cultural sustainable development. This not only makes historical and cultural aspects more accessible to the general public but also provides insights to implementing the tool for the future design of similar virtual visits.

7 Limitation and Future Work

We are aware of the limitations of the design and evaluation of this work. Firstly, we did not clarify the specific learning task in each scenario. As P4 noted, 'If I did not know what to explore, I would not reflect on the data represented by the visual elements.' Second, participants did not have enough time to adapt to the new interaction method. P2 said, 'Gestures could be a better control method, but it may take longer for me to get familiar with them.' Third, we acknowledge the constraint of AI to faithfully reproduce accurate and reliable content. This causes extra manual effort in data processing to ensure AI-generated images meet the high standards of accuracy and authenticity expected in museum contexts that require cultural precision. Lastly, *ArtifactShow* is an early prototype with limited functions and content. Future work will focus on design improvement and formal user study, which could benefit from more quantitative measures to evaluate its learning effectiveness.

8 Conclusion

In this work, we present *ArtifactShow*, an interactive system that engages the public in three scenarios: museum show, light show, and stage show. The system presents a novel workflow to create a data story that integrates generative AI into narrative visualization for cultural experiences with the support of embodied interaction. We evaluated this prototype's system usability, learning effort, user experience, interactivity, and application prospects. The results indicated that it could be an innovative way to increase public interest in cultural narratives.

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