Treasure Transformers: Novel Interpretative Installations for the National Palace Museum

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Abstract. Museums have missions to increase accessibility and share cultural assets to the public. The National Palace Museum intends to be a pioneer of utilizing novel interpretative installations to reach more diverse and potential audiences, and Human-Computer Interaction (HCI) technology has been selected as the new interpretative approach. The pilot project in partnership with the National Taiwan University has successfully completed four interactive installations. To consider the different nature of collections, the four systems designed against different interpretation strategies are uPoster, i-m-Top, Magic Crystal Ball and Virtual Panel. To assess the feasibility of the project, the interactive installations were exhibited at the Taipei World Trade Center in 2008. The purpose of this paper is to present the development of the "Treasure Transformers" exhibition, design principles, and effectiveness of installations from the evaluation. It is our ambition that the contributions will propose innovative media approaches in museum settings.

Keywords: Museum, interactive exhibition, HCI, context-aware, tabletop, virtual panel.

1 Introduction

The National Palace Museum holds a great quantity of Chinese artifacts and artworks as part of its world-leading museum service. With around 655,713 objects in collections, many artworks are masterpieces of Chinese emperors' treasures. To share the invaluable cultural assets to the public, the museum has continually sought to make its collections accessible to greater and more diverse audiences. Nevertheless, museums in the 21st century have been confronted with many challenges from sifting societies. With the exception of modernist practices, museums need to be more aware of the power of learning, and engage audiences with more sophisticated and complex approaches [1]. In order to present stories or learning resources in galleries, interpretation is required to transfer material cultures into philosophical and historical narratives. In the last decade, new media have been widely implemented in galleries as means of interpretation. Besides, the *American Association of Museums* has given the

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following definition “Interpretive Interactive Installations are made up of multiple kiosks or a full gallery installation and are interactive and educational.”[2] Human-Computer Interaction (HCI) has made interpretation strategies more versatile. As HCI technology is interactive computing systems designed against human behaviors, it can practically provoke conversations between museum objects and visitors. To foresee the new trend, the pilot project “Treasure Transformers”, in partnership with the National Taiwan University, was initiated to develop four interpretative installations exhibited in the IT Expo at Taipei World Trade Center in 2008. Four HCI systems are utilized to accommodate the different nature of the collections, including artifacts, paintings and documents. The context-aware system is employed to develop *uPoster: Ladies, people are coming*; the *i-m-Top* tabletop system is for *Livening up paintings on the Tabletop*; the virtual display system is for *Magic Crystal Ball*; and the virtual panel is for *Animals of Fantasy*.

2 Related Works

The following definition has been offered**:** "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." [3] In a museum context, HCI would be applied to reshape a knowledge place as an interactively intelligent environment. The project-related studies are discussed as below.

Context-Aware. Context-Aware was first introduced in 1994, when Schilit and Theimer stated “context-aware computing is the ability of a mobile user’s applications to discover and react to changes in the environment they are situated in.”[4] Similarly, Dey and Abowd stated that context-aware is very important in interactive applications, particularly when the users’ context changes rapidly in the environment [5].

Interactive Tabletop System. During the last decade, interactive tabletop systems have been gradually implemented in galleries. According to Geller’s survey, there are many examples to prove that tabletop systems are successful applications in museum settings [6]. The main reason is that the natural interface of tabletop systems can tackle the different levels of computer literacy of diverse visitors. Hence, the project employed the tabletop system *i-m-Top* developed by Hu and Hung. The system features multi-touch and multi-resolution display, which accommodates the multi-resolution characteristics of human vision [7].

Virtual Display System. Displaying three-dimensional images of museum artefacts requires a volumetric display technique, such as i-ball system [8]. i-ball is a transparent ball, which can display produced images through a special optical system. Based on the display module of i-ball2 [9], the Magic Crystal Ball, a gesture-based interaction system, was developed by Chan and Hung. Users can see virtual objects appearing within the transparent sphere, and manipulate them with barehanded interactions [10].

Virtual Panel. The virtual panel is a privacy-protected virtual screen, created by a special optical mechanism. As the virtual panel is intangible and floats in the air, apparently all interactions must be taken in the air. However, without tactile feedback,

users might not perceive whether interactions have happened or not. To solve the problem, a water ripple is used as a metaphor to personify the virtual interaction [11]. In this project, the intangible interaction in the air is applied to the design as a game scenario.

3 Design Principles

To consider the feasibility of interactive multimedia in museum settings, the team has defined four criteria as design principles: novelty, accessibility, reliability and learning potential, which are discussed below.

Novelty. As modern societies have shifted dynamically with innovations of new technology, the traditional interpretative devices may not fulfil the diverse museum visitors any more. For example, research conducted in SFMOMA (2006) indicated that visitors under 40 years old prefer to download a gallery tour to their own mobile devices rather than to rent an audio tour device [12]. In other words, the development of new technology inevitably influences visiting patterns in museums. That is to say, museums have to consider the novelty of new interpretation devices, which not only retain existing museum audiences, but also attract potential new ones.

Accessibility. Museum visitors generally with diverse backgrounds in age, language or education might have different computer literacy to interact with multimedia installations. Take the Churchill Museum for example, the evaluation undertaken in 2005 indicated that visitors required more guidance on how to operate the interactive initiatives, although less than a half the visitors actually used guidance in the gallery [13]. Therefore, it is important to bear in mind how to make multimedia interactives accessible to all visitors. In this respect, the concept of "Natural Interaction" [14] is utilized to increase the accessibility of the initiatives.

Reliability. IEEE defines reliability as "the ability of a system or component to perform its required functions under stated conditions for a specified period of time" [15]. From this point of view, the quality of system services can be evaluated to indicate the reliability. For example, theme parks like Disneyland must provide reliable entertaining facilities to sustain visitors' repeat visits in the future. Similarly, to provide high-quality museum services, the new media installations must achieve a high degree of reliability before implementation.

Learning potential. In museum education provision, multimedia installations can be utilized to accommodate different learning styles and levels of learning. So far, the effectiveness of interactives is constantly being evaluated and proven in galleries. For example, the study "Interactive and Visitor Learning" [16] conducted in Australia (2001) illustrated that interactives contributed both short-term and long-term impacts to visitors, whether in a museum or a science centre. Later, the study undertaken in the Churchill Museum (2005) indicated that multimedia and interactive featured exhibitions encourage visitors to learn in different ways [13].

4 System Implementation

4.1 uPoster: Ladies, People Are Coming

Hardware configuration. The uPoster employs the concept of context-aware. Two major parts of the hardware are the multimedia display module and the web camera sensing module. The web camera is used to detect the location of visitors; then, the multimedia workstation is triggered to response the different location of visitors with video content displayed on a 42-inch screen.

Content scenario. The T'ang Dynasty painting "A Palace Concert" shows ten ladies from the inner court, sitting around a large table, sharing tea, or playing music. It seems a merry palace concert. Therefore, the scenario is designed to make people aware of the content of the painting. While there is on one around, the ladies will be animated. On the contrary, ladies will be static as in the normal painting when people walk into the detecting area. (Fig.1) The scenario is set out to cause the psychological effect of cognitive inconsistency, and then provokes people' imagination towards the court life of the T'ang ladies.

Fig. 1. Scenario of the uPoster. (a) Ladies are animated while there is on one around. (b) Ladies are static while people walk into the detecting area of web camera. (c) Ladies are playing again.

4.2 *i-m-Top*: Livening Up Paintings on the Tabletop

Hardware configuration. The architecture of the *i-m-Top* system is shown in Figure2a. The major components of the installation are multi-resolution display module and multi-touch sensing module [7, 17].

Content scenario. For the reason that paintings cannot be displayed in galleries under long periods of exposure to lighting, the installation has offered the best solution to this concern. The user interface is designed as a handscroll of Chinese paintings with a magnifier in the centre and the paintings arranged inside (Fig.2b). The area of the magnifier is a spotlight reflected by the foveal projector, which provides higher resolution than the peripheral area. Paintings can be selected by the use of hand gestures, zooming in/out or moving to the magnifier for careful appreciation. Moreover, colours following the fingertips make users more aware of multi-touch on the tabletop (Fig.2c).

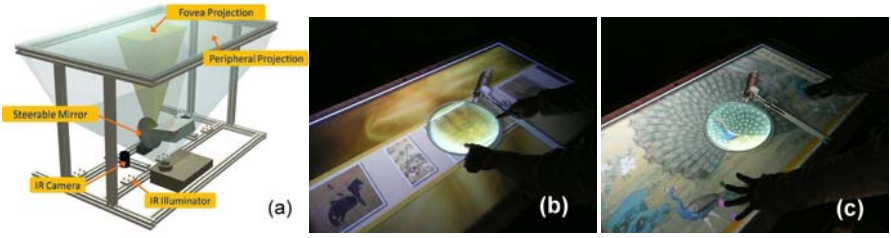

Fig. 2. (a) The architecture of the *i-m-Top*. (b) The handscroll-shaped menu of the paintings. (c) Multi-resolution display and multi-touch of colors following fingertips.

4.3 Interactive Virtual Display: Magic Crystal Ball

Hardware configuration. The architecture of the Magic Crystal Ball is shown in Figure3a. There are two major modules of the construction: one is the display module to which the optical system of i-ball2 is applied; the other is the detection module composed of an infrared camera and three pressure sensors [10].

Content scenario. It is said that crystal balls contain incredible power to make prophecies, tell fortunes or see into the past. With this fantastic nature, the stories of five artifacts from the National Palace Museum are told in the Magic Crystal Ball. The installation is designed as a small booth with a mysterious atmosphere created by special lighting (Fig.3b). While an artefact is selected from the display panel, a virtual 3D image appears inside the crystal ball. Every finger motion on the crystal ball will be computed and translated into changes in the viewing direction. As a result, it enables users to feel as if they are acting with magic power (Fig. 3c).

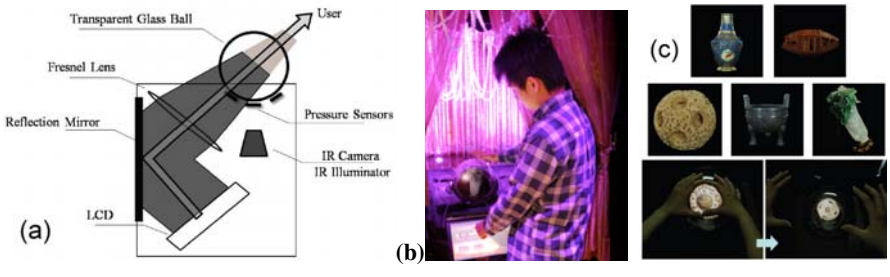

Fig. 3. Magic Crystal Ball. (a) The architecture of the Magic Crystal Ball system. (b) The layout of the installation (c) Five artifacts and a user manipulates the 3D virtual image.

4.4 Virtual Panel: Animals of Fantasy

Hardware configuration. First, in the display module, a real image forms in the air. Then, in the finger-touch detection module, an IR line illuminator is set out to create an IR plane aligned with the virtual panel. The architecture is shown in Fig.4a [11].

Content scenario. Inspired by the 2009 Chinese New Year of the Ox, the scenario is designed as a game *Animals of Fantasy*. The ox is selected from an ancient Chinese painting as the main character, accompanying other animals. It is a guessing game. At the beginning, visitors must concentrate on the location of the ox. Then, the tree cups will cover over the three animals, randomly moving around in the surface. Once the cups stop, visitors must point out where the ox is in the air. Finally, a mark will be rewarded to visitors as feedback (Fig. 4b).

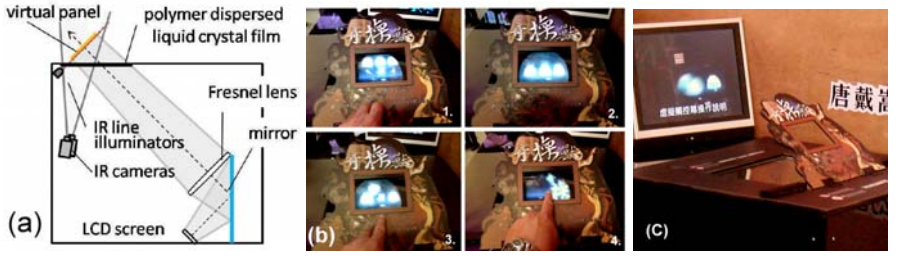

Fig. 4. (a) The architecture of the Virtual Panel (b) User interactions of guessing where the ox is. (c) The side of the installation and an instructional film standing in front of the frame.

5 Evaluation

The evaluation objectives are set out to explore the effectiveness of each installation against design principles. Mini-survey, semi-structured interview and observation were employed to generate quantitative and qualitative data. The executive findings are summarized in Table 1. If the accessibility is described with absolute statistics, the other three indicators are described with relative statistics, which can be summed up to 100%. The reason for that is that it is easy to compare the merits and shortcomings between each installation. Then, according to the performance ranking in each indicator, the overall effectiveness of installations is ranked from 1 to 4 (1= the best).

Table 1. Executive findings of the evaluation

Indicators	Ladies, people are coming	Livening up Paintings on the Tabletop	Magic Crystal Ball (MaC Ball)	Animals of Fantasy
Novelty Ranking	12.4% 4	36.0% 1	34.8% 2	16.9% 3
Accessibility Ranking	Mean=4.05 3	Mean=4.39 1	Mean=4.13 2	Mean=3.97 4
Reliability Ranking	13.0% 3	47.8% 1	29.3% 2	9.8% 4
Learning Potential Ranking	17.4% 3	30.4% 2	49.3% 1	2.9% 4
Overall Effectiveness Ranking	3	1	2	4

Novelty. Visitors were asked which installation surprised them most in the exhibition context, both around 35% of respondents indicated that *the Tabletop* and *Magic Crystal Ball*. One respondent commented that it is a very fresh thought to integrate ancient artifacts with high technology, which creates a new sensational experience.

Accessibility. Visitors were asked to rate the interpretative devices on a score from 1-5 (5 standing for the highest score) according to their experience when operating each installation. The tabletop had the highest mean score of 4.39.Visitors commented that the tabletop enabled the users to feel authentic interactions with real objects without a mouse or keyboard. On the contrary, *Animals of Fantasy* reached a rather low mean score. In observation, the majority of visitors required guidance from instructors. The likely reason for this is that the user interface is lacks of an appropriate metaphor of human thinking, resulting in many users not knowing how to operate it.

Reliability. To indicate the reliability, the quality of services was evaluated from end users' perspectives and stability of computer systems. It is significant that 47.8% of respondents indicated the tabletop system providing the highest quality of service in operation. Most of them commented that high-resolution displays gave them very clear images of paintings rather than unclear images in dim galleries. On the other hand, according to maintenance record of the systems, the *Magic Crystal Ball* was the most stable system that it never crashed during the exhibition period.

Learning Potential. Visitors were asked which object in the installations is the most memorable. The main reason is that visitors will recall the information, which had entered their Short-Term Memory while operating the installations. Significantly, nearly 50% of respondents answered that the objects shown in the *MaC Ball* were the most memorable. The likely reason for this is that artefact descriptions allow visitors to acquire more concrete knowledge. Compared with the tabletop, its learning potential is second to the *MaC Ball* at around 30%. There is sufficient evidence to prove that learners preferred different learning styles associated with different interpretative devices.

6 Conclusion

The paper presents how the team developed interpretive installations to accommodate different collections and learning styles via innovative HCI technologies. The pilot project has provided invaluable experience to museum professionals. First, the most effective application of the tabletop would be implemented as interpretative devices in galleries, information kiosks or educational programs in public area. Second, the *Magic Crystal Ball* can contain more high-quality images and develop more functions, e.g. magnify. Third, the *uPoster* is simple, economical and easy to be adjusted into any scenario or theme setting. Finally, as the virtual panel is too innovative to users; it requires more user studies in the future. Also, the project led to the conclusion that interpretative installations of HCI indeed facilitated meaningful interactions between visitors and museum collections. In the future, we would like to explore more interpretative multimedia based on what has been achieved and the barriers encountered. The ultimate goal is to create a positive and joyful museum learning environment, inspire creativity of the society, and play a leading role in the museums in Taiwan.

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