

Mixed Reality Technologies for Museum Experience

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Abstract

The goal of this project is to augment the visitor's museum experience using digital technologies. For this purpose, the authors have been investigating and developing several systems which can be classified into two categories: (a) mixed reality displays and (b) experience support systems. As for (a), this paper illustrates three systems to superimpose virtual images onto physical exhibits: ExFloasion, Bousight Table, and FloasionTable. Their key feature is the optical design for providing 3D visual effect without any special glasses. They are useful for giving visitors some intuitive explanations of physical exhibits at museum. In addition, the authors consider that total (before and after) services are very important as well as the on-site (at museum) one. The category (b) includes networked visualization of congestion situation (Breathing Museum), social networking to share visitors' feelings (Post-Visit Board), and personalized mementos for each visitor (Peaflet). They are effective for making people want to visit museums and promoting greater understanding. This paper gives a brief overview of these systems.

CR Categories: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented, and virtual realities; H.5.2 [Information Interfaces and Presentation]: User Interfaces—User-centered design

Keywords: digital museum, mixed reality, floating image, view-dependent display, personalized service, social networking

1 Introduction

Nowadays, we can find anything on the internet, and access the digitized version of museum exhibits at home. The authors consider that museums should give visitors something extra to enrich their understanding. The aim of this project is to motivate people to visit museums by augmenting the visitor's museum experience.

For this purpose, the authors believe that the following six principles are top priority issues.

- Real things (physical exhibits) take precedence. Digital technologies should concentrate on playing a supporting role.
- Digital technologies are good at personalized services which are essential to respond large variety of interests of visitors.

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Figure 1: Concept model of visitor's activity.

- Many visitors observe an exhibit all together. We should not enforce visitors to wear some devices at each exhibit. Digital services limited for a single visitor make a long line.
- Digital technologies should not represent a violation of visitors' privacy. Tens of cameras for interaction purpose are not necessarily applicable.
- Expensive digital equipment is not sustainable. Kids always break the system.
- Digital technologies should make a contribution for collecting feedbacks from visitors which are indispensable for planning the next exhibition.

Based on these principles, the following section describes the concept model of visitor's activity.

2 Concept

Figure 1 illustrates the concept model of visitor's activity. From the viewpoint of timing and location, we can classify the visitor's situation into five categories: (1) before visiting, (2) before viewing at museum, (3) during viewing, (4) after viewing at museum, and (5) after visiting. We can imagine visitor's requirements for each situation.

In situation (1), a system for motivating potential visitors is needed. Breathing Museum in section 4.1 is an online visualization system of congestion situation without cameras. It is helpful for deciding when to visit. In addition, people might be motivated by seeing the visitors' feelings shared by Post-Visit Board in 4.3.

In situation (2), a personalized navigation system is required to respond large variety of interests of visitors. The authors are still investigating this topic.

In situation (3), the authors believe that superimposing virtual images onto real things (physical exhibits) without any special glasses

is effective for intuitive understanding. ExFloasion in 3.1, Boun-sight Table in 3.2, and FloasionTable in 3.3 are this kind of mixed reality displays.

In situation (4) and (5), visitors might want to share their feelings and discuss the exhibits on the internet as well as at museum. Through the discussion, they could explore the next exhibition best suited for each of them. Peaflet in 4.2 can generate a personalized leaflet which reflects appreciation experience of each visitor. Difference between each visitor's leaflets is helpful for the discussion about the exhibits after viewing. Post-Visit Board in 4.3 is a hand-writing questionnaire system using sticky notes, which can share the visitors' comments and illustrations both onsite and online.

The following sections illustrate the above mentioned six systems classified into two categories: mixed reality displays and experience support systems.

3 Mixed Reality Displays

This section presents three types of mixed reality displays. The important point is that none of them requires any special glasses to wear. This feature allows us to realize simultaneous observation of many visitors and non-expensive sustainable systems.

3.1 ExFloasion

ExFloasion is an exhibition with floating vision system[Nakashima et al. 2010]. Figure 2 illustrates its system configuration. It is composed of half mirrors, lenses, and compact displays and is capable of superimposing four-layered floating images of the displays on an exhibit. In order to provide a correct anteroposterior relation between the exhibit and the images, two-layered images appear in front of the exhibit and two more behind. We can adjust the 3D position and the size of the images by changing lens parameters.

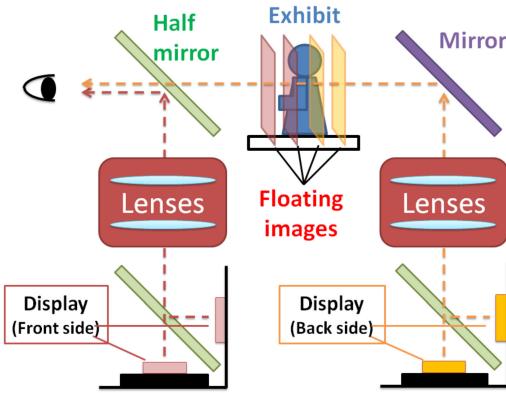


Figure 2: System configuration of ExFloasion.

Figure 3 shows experimental results exhibiting a Japanese automaton. We can see the 3D pointing effect: explanation messages appear at spatially correct positions on the automaton. While we have just four layers, our moving around animation effect is good enough for attracting visitors.

3.2 Boun-sight Table

Boun-sight Table is a view-dependent tabletop display which can provide different information to each observer around it without any special glasses. Figure 4 illustrates its system configuration[Oshima and Kakehi 2010]. In order to realize a compact sys-



Figure 3: ExFloasion: Physical exhibition (Japanese automata) with 3D floating images.(a) 3D pointing effect, (b) Moving around animation.

tem, we use just a single overhead projector and a Lumisty film which has the direction-dependent optical characteristic.

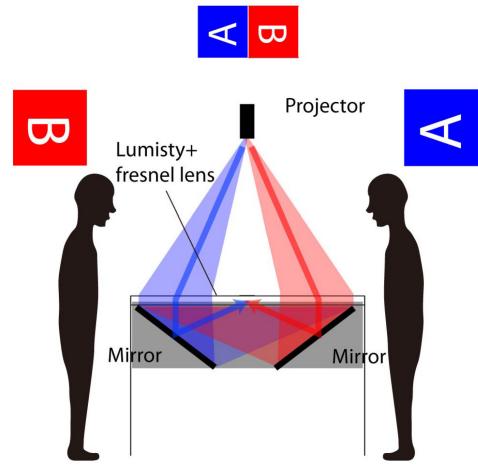


Figure 4: System configuration of Boun-sight Table.

Figure 5 shows experimental results. We can see the descriptions of the exhibit in different languages according to the observer's standing position. This feature is applicable for the personalized service for each visitor.

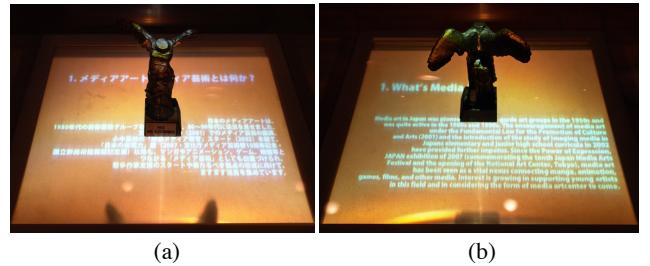


Figure 5: Boun-sight Table: (a)Front view with Japanese description, (b) Behind view with English description.

3.3 FloasionTable

FloasionTable provides four different upstanding floating images to each observer around it without any special glasses (See Fig. 6)[Wada and Naemura 2010]. It consists of four displays, an afocal

system for forming upstanding floating images of the displays, and four mirrors to upgather them at the center of the tabletop.

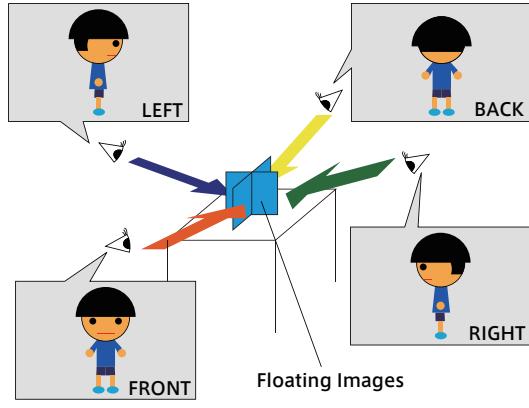


Figure 6: Concept of FloasionTable.

Figure 7 shows experimental results. We can see four aspects of a clay doll upstanding on the tabletop. When we put a physical exhibit on the tabletop, these floating images can be seen as superimposed information from backside of the exhibit. FloasionTable provides the superimposed visual effect like ExFloasion, and is view-dependent like Bounsght Table.

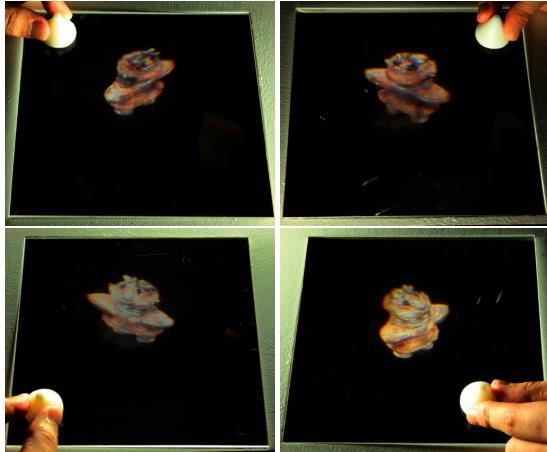


Figure 7: FloasionTable: Four different upstanding images.

4 Experience Support Systems

This section presents three systems for supporting museum experience both onsite and online.

4.1 Breathing Museum

Breathing Museum visualizes the congestion situation of a museum[Nariya et al. 2010]. For this purpose, we can introduce tens of cameras to count up the visitors. From the consideration of privacy protection, however, the authors decided to develop a system without cameras, and focused on the spatio-temporal distribution of CO₂ concentration. This is because the concentration increases by the people's breaths.

Figure 8 shows experimental results. Five sensors are installed in the exhibition space. Deeper red indicates higher concentration in the visualization result. By the calendar mode on the internet, we can see which part of the exhibition was crowded, and when we can avoid the crush. This is helpful for motivating potential visitors.

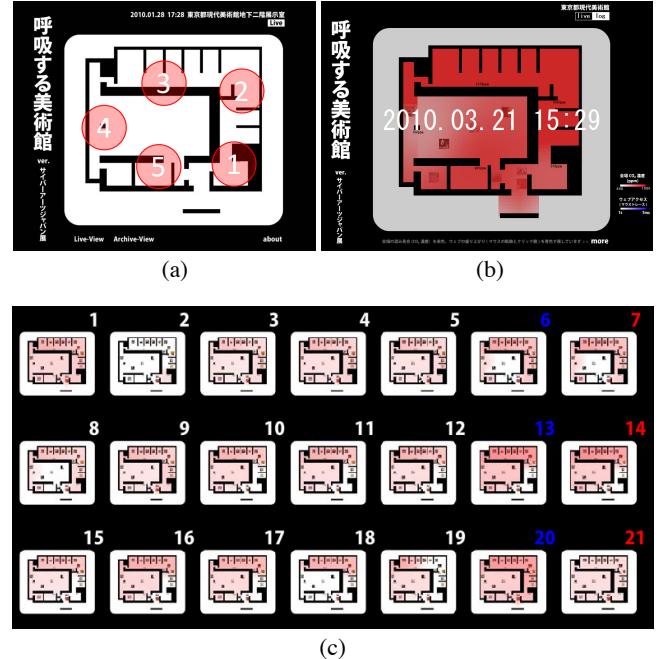


Figure 8: Breathing Museum: (a) Measuring points in the exhibition, (b) Visualization result of CO₂ concentration distribution, (c) Calendar mode from which we can see the congestion situation of each day.

4.2 Peaflet

How to get feedback from visitors has remained as an important issue of museums. In order to motivate the visitors to record their own appreciation experience, the authors focused on the leaflet as a memento. Peaflet is a personalized leaflet service which reflects the visitor's preferences[Seong et al. 2010]. The visitors vote their favorite exhibits while viewing using an iPhone/iPod touch interface. At the end of the exhibition, they receive their own leaflets in which selected exhibits appear in bigger size. This service is helpful for discussing the exhibits after their visit, and planning the next exhibitions by the museum attendant.

Figure 9 shows experimental results. We can see large variety of interests of visitors.

4.3 Post-Visit Board

Post-Visit Board is a system for sharing visitors' feelings both onsite and online[Kuno et al. 2010]. Visitors represent their feelings on sticky notes (Post-it) and paste them on a board. These notes are scanned and released on the internet. At museum, the other visitors who read the pasted notes are motivated to join this activity. On the internet, people who read the online version are motivated to come to the museum. In addition, the visitors who left their comments and illustrations can access their own notes and feedbacks from the readers on the internet after their visit (post-visit access).

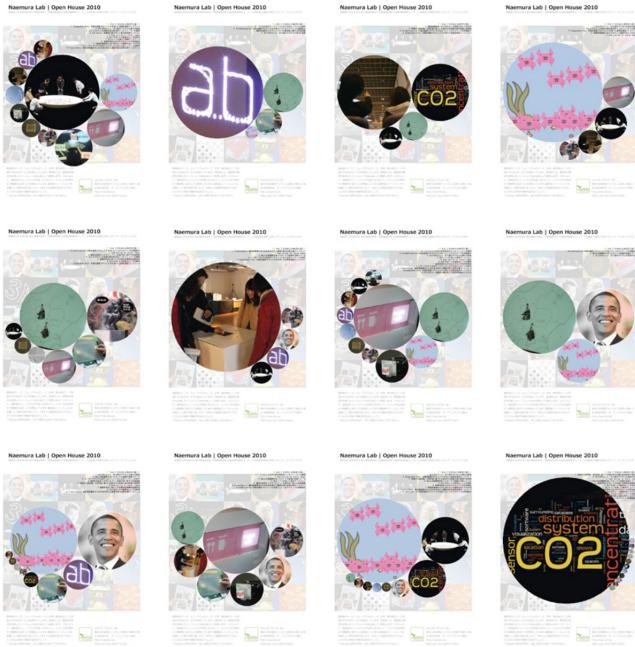


Figure 9: Peaflet: some examples of personalized leaflets which reflect the visitors' viewing records.

Figure 10 shows experimental results. For 5700 visitors, we obtained 979 notes and 527 feedbacks on the internet. This means that Post-Visit Board is an attractive questionnaire system in comparison with existing ones.

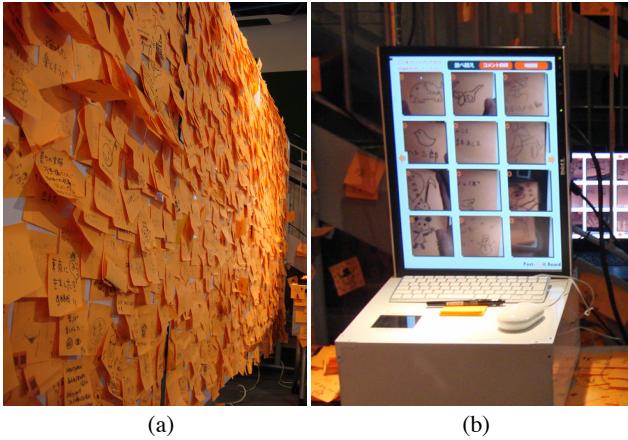


Figure 10: Post-Visit Board: (a) Hundreds of sticky notes in the real world, (b) Web application for sharing the comments.

5 Conclusion

Digital technologies are powerful for enhancing the onsite museum experience and motivating people to visit museums. This paper has given a brief overview of the authors' challenges from the viewpoint of visitors. It is important to deepen these considerations from the viewpoint of museum attendants and owners of the exhibits. Future research includes design of social networking among all the people concerning museums, robust implementation of proposed systems, and field researches at several museums.

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