

Digital Reconstruction of a Historical and Cultural Site Using AR Window

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Abstract— There are many historical and cultural sites which have been demolished due to the reckless urban development projects. ‘Pimatgol’ is one of those with meaningful history and culture. There were many attempts to reconstruct the sites using technology to remember the important places. AR Window is an Augmented Reality application for reconstructing ‘Pimatgol’ for smart phones. User can see the past scenes over the present scenes through AR Window. User can attempt multiple interactions like blowing a breath, wiping with a finger and touching buttons on a phone. We concentrated on how the multiple interactions affect interests and level of awareness of the users. AR Window will open a new path of digital reconstruction for smart phones through the multiple interactions.

Keywords- Case studies; Multiple interaction; Emotional effect; AR

I. INTRODUCTION

Due to the reckless development project in many cities in Korea, historical and cultural sites have been destroyed. ‘Pimatgol’ with over 600 years of history is one of the historical and cultural sites in Seoul that have embraced sorrow and happiness of the people throughout the time. It has been a very meaningful and precious place to our community. The name ‘Pimatgol’ is derived from the word ‘Pima’ which means avoiding horses. The alleys from behind the Kyobo Building in Gwanghwamun to the YMCA Hotel in Jongno that make up Pimatgol have their roots in the Joseon Dynasty (1392-1910). Pimatgol is thought to date back to the Joseon Dynasty when commoners and lower-class government officials had to kneel before passing high-level officials. The alleyway is so narrow that a person can scrape his/her hands along the walls on each side. The air is filled with the tangy smell of grilled mackerel and the stale leftover smell of makegelli, a kind of rice wine. This is ‘Pimatgol’, the alley that runs east-west alongside Jongno in central Seoul. People can feel they’ve stepped back into another generation in this place. But the place was forcibly demolished by the City of Seoul as a part of Jongno Redevelopment Plan launched in 2003. Regular customers and the public mourned the store’s closing as the end of an era. Many of the general public felt sorry for the habitants of Pimatgol and hoped that the site will be preserved.

There have been many efforts to preserve these kinds of historical and cultural sites. There, especially, have been many projects using Virtual Reality technology for digital

recreation of the sites. For example, they measure all the remains from the historic sites and collect all the data to recreate digital images of the past. However, this has some problems like lacking interactions, necessary equipments or lack of reality. Due to these, we need to find another way to recreate our historical and cultural sites.

As members of the part who feels sorry for the disappearance of the historical and cultural site of ‘Pimatgol’, we decided to recreate the place using Augmented Reality. AR [1] is one of the most perspective technologies that could combine real and virtual world to show the combination of



Figure 1. (A) Past photo of one street of ‘Pimatgol’ in 2007,

(B) Photograph of dismantlement of the same street of ‘Pimatgol’ in 2010

ancient and current view of the historical site [2]. Compared to the ordinary instructions like static images, videos, and table etc., AR can provide user with an intuitive and visual experience by digitally recreating the ruins. User can compare past scenes over present scenes immediately by using AR for digital recreation.

There are many iPhone applications using AR. For example, there are ‘ScanSearch’ [3], ‘Layar’ [4], ‘Sekai Camera’ [5] etc. Users usually scan, touch or move around the smart phones. Those are typical interactions for AR applications which are now too simple and common. Through this paper, we suggest AR Window the novel digital recreation application for smart phone which has implicit and interesting interactions that will raise people’s emotional responses.

II. RELATED WORKS

There have been many works in the field of digital recreations. Virtual reality and augmented reality techniques, especially, are the most progressive and leading methods of

digital recreations. Here are few cases of digital recreations using virtual or augmented reality.

A. *Hwang-ryong Temple*

Hwang-ryong Temple was the most representative temple which was built by the Shin-ra Dynasty in Kyong-ju, Korea. It was built by selected master craftsmen and became, very famous for its beauty and magnificence. However, it was burnt down 800 years ago and there, only remain a site for the original temple. To recover the original temple's beauty, Graduate School of Culture Technology (GSCT), KAIST produced a digital 3-dimentional video of the original Hwang-ryong Temple. They collected all the paper and other materials from the past for recreating the temple. Digital recreation of the temple was evaluated as a very accurate and immersive work due to the effort. However, being as it is a digital video; user can only just experience one way interaction of watching the video.

B. *Sungnyemun in Second Life*

Sungnyemun is the Number One National Treasure of Korea. It was destroyed by fire in 2008. Every Koreans felt sorry for the disaster. A developer company called 'Acid Crabiz' [6] recreated Sungnyemun in 3-dimentional virtual reality game 'Second Life' as an effort to recreate Sungnyemun. It was built accurately following the same blueprint of the original building, so user can see the realistic and immersive recreation of Sungnyemun. Many people from all around the world can visit and interact with the Sungnyemun in the virtual world. Users have to go into the virtual world 'Second Life' to visit the building. Moreover, it only exists in the virtual world so there is no reality.

C. *AR-View: an Augmented Reality Device for Digital Recreation of Yuangmingyuan*

Yuanmingyuan was a vast and magnificent royal garden built by several emperors over a period of time during the Qing Dynasty. It was burnt down by the Anglo-French forces in 1860 and suffered continual damages later on. Beijing Institute of Technology digitally recreated Yuanmingyuan by designing and manufacturing a fixed-position device AR-View to provide a combined real and virtual image of Dashuifa (Great waterworks), a symbol of Yuanmingyuan. With the help of AR-view, the original exquisite architectures and fountains are superimposed upon the current ruins. However, user needs special equipment for AR-View to see the beautiful garden. User's sight is also very limited because the AR-View is fixed in one place that cannot be moved around.

III. OUR WORK

We created AR Window to recreate the historical and cultural site of 'Pimatgol'. AR Window is an application for iPhone. AR Window is using AR for combining past scenes over present ruins of 'Pimatgol'. AR Window provides user with immersive, intuitive and entertaining experience.

A. *System Concept and Design*

There were many cases of digital recreations, but none concentrated on responses from the user. Maybe it is because they surveyed the satisfaction from the user after experiencing the recreations. However, we concentrated on how this case affects user's emotion. We wanted to raise the level of attention and affection to our historical and cultural site of 'Pimatgol' from the users. Interactive input interactions were given to users to give implicit meaning. The interaction is called 'window wiping' comprising of actions of wiping the AR Window. This is a metaphoric interaction of wiping the actual window to see the outside well. Novel interactions include the blow-and-wipe transition between the current camera views. A user blows a breath to the scene shown at 'Pimatgol' where the user is now on a smart phone. The AR Window will bring the "fogged-up" view of historical photos of the site with the blow. Then the user wipes the blurry view with his/her fingers and the past photos become clearer. Finally, the user can see the past scenes of the site clearly. User needs to perform 'window wiping' interactions to see the past photos of present ruins. Norman [7] proposed the theory of seven stages of action.

- Forming the goal
- Forming the intention
- Specifying an action
- Executing the action
- Perceiving the state of the world
- Interpreting the state of the world
- Evaluating the outcome

It is important to notice that Norman's theory of action focuses on user cognition. User can get used to the idea of blowing and wiping easily because they already know the why. It is called Expressive Representation(ER) according to Ulmer [8]. We 'read' and interpret representations, act on, modify, and create them in interactions. In restricted or mobile circumstances like in this case, it integrates complementary modalities, by having multiple interactions like seeing, blowing and wiping, [9], in a manner that brings a synergistic blend in such as way that each mode can be capitalized upon and used to overcome weaknesses in other modes.



Figure 2. Exact address of the marked spot

Through this implicit input, user can get explicit outcomes that are photos from the past. Those photos are from blogs of general public. They also feel sorry for the disappearance of ‘Pimatgol’ or having their personal memories for the place. We can find the fact from their texts and photos from blogs of users. We manually selected photos from the community sites like ‘Naver’, ‘Nate’ and ‘Daum’ which form over 70 percent of Korea blogs. Due to this, user can interact and share thoughts through the photos. User can get information awareness from their sites which have text and photos of the place.

Using augmented reality for AR Window application, user can get context awareness in outdoor environment and location awareness (GPS) like in ‘Human pacman’ [10], because user can see the exact addresses and a map where they are seeing. They can see the outside environments over the current photo of the smart phone.

B. System Description

It has three menus, the first is a map view, the second is a camera view and the last is the list of the places. There are two methods of using ‘AR Window’. User can visit the place and connect to the application with the first method. User will select a camera view and they will see the markers by scanning the site with their phones. The markers contain the past photos of the marked spots. By touching the markers, the user can start the multiple interactions with the application. It will ask the user to blow on the window to see the past scenes of the spot. When the user performs the blowing action, the screen on the phone will show the past photos taken by other community members. The blurry scenes will clear by wiping the screen with their fingers like wiping the window. The clear past photos overlay the present ruins or newly constructed buildings. User can enjoy more past photos of the place taken from 2004 to 2010 by repeating these interactions. For the second way, user can explore the site without going there. User just stays where they are, and they can use the application by using the ‘Map View’ of the application. In the map view, user can see marked places where they can see the past photos on the Google map. User can see past photos of the markers by touching the markers.

In addition to that, if the users want to know about the place more, they can visit the source blogs where the photos came from by touching the ‘visit blog’ button on the menu.

They can read and see more information and share thoughts about the place on the blogs. Through this, users can get information awareness.

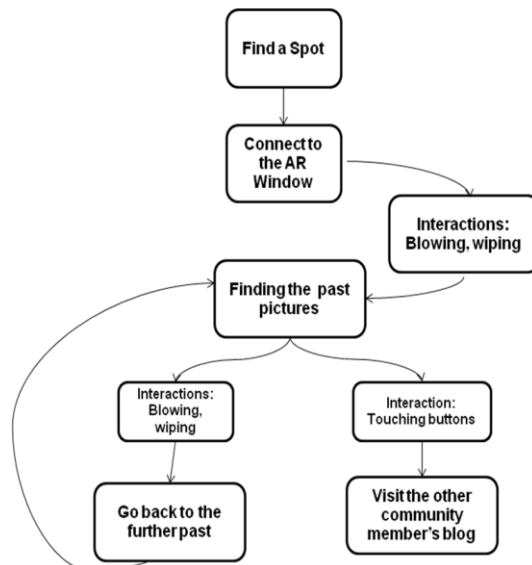


Figure 3. System flowchart

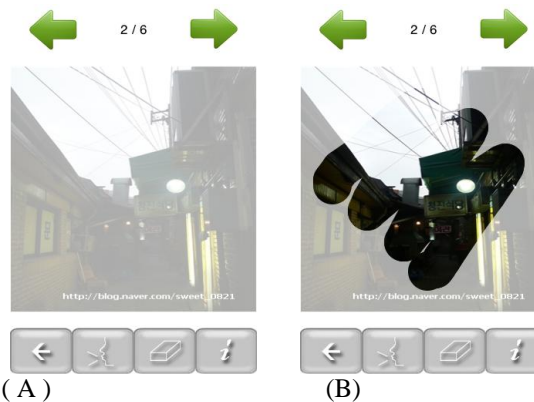


Figure 4. (A) Blurry photo by blowing a breath, (B) A photo wiped with a hand

1) Spot Selection

There are 20 spots in ‘Pimatgol’. Selected spots were mostly popular restaurants in ‘Pimatgol’, because they were well known street for restaurants for general public. Most of them have over 50 years of history, but some of them moved to a new building and others disappeared.

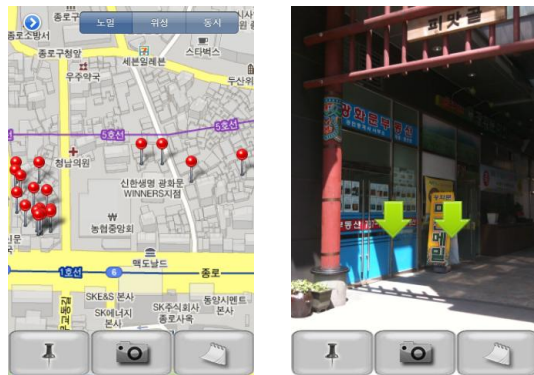
2) Photo Selection

We selected photos of this system manually. There are about 6 pictures in average for one spot. We put the word ‘Pimatgol’ in web search engines like ‘Naver’ and ‘Daum’ which are the top two in Korea for searching for photos. And we only picked photos from personal blogs where the community members expressed their thoughts and emotions. We got necessary permits from the bloggers for using the pictures. The blogs only have photos from the year 2004, so we picked the best photos that show the exterior well. Also,

the blogs that we picked include their information, memories and thoughts about ‘Pimatgol’ which the other user can view and share their thoughts.

IV. TECHNICAL DESCRIPTION

We collect all the location information including latitude and longitude from ‘Google maps’ for places that we picked for reconstruct based on their addresses. The two



(A) (B)
Figure 6. (A) Map View, (B) Camera View

different views in the ‘AR Window’ are map view and camera view.

Map view is based on the Google map and the camera view shows the current views with markers indicating the presence of photos of the past. SDK ‘Mapkit’, a basic framework for i-phone, was used for the map view. Pin markers were assigned to the spots on the location information. For the camera view, we used an open library ‘ARKit’. Location information was assigned as in the map view, and UIButton was designed. The size and direction of UIButton is updated in the camera view according to the user’s current location and direction.

For the blowing action, the microphone checks the decibel of the user’s breath. When the decibel is over -5DB which means light breath, the screen will bring blurry past photos. Then, by wiping the blurry photo with fingers masking technique will make the photos clear.

V. USING THE TEMPLATE

Testers were selected randomly from near ‘Pimatgol’. They were divided into two groups to compare the effects of different interactions. Each group consisted of thirty different users. First group (A) did multiple interactions like blowing a breath, wiping with a hand and touching buttons on a mobile phone. The second group (B) just touched the buttons on a mobile phone. There was no time limit, so that users can experience the AR Window as much as they wanted. We concentrated on how the multiple interactions affect interests and level of awareness of the users.

A. User Interest

We measured how much time they spend to explore the application, how many spots they visited, how many blogs they visited to get more information about the place and we

measured the degree of testers’ interests by measuring how many places they remembered.

The first result for performing time showed that the average time for the first group (A) was 175 seconds and the second group spent 91 seconds. Even though, multiple interactions originally take more time to perform, 84 seconds of difference means that the users took much more time for exploring the past ‘Pimatgol’ through the implicit interactions.

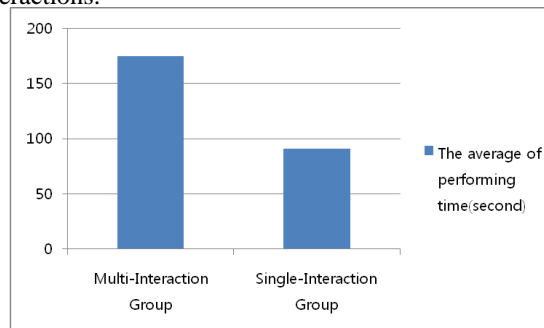


Figure 7. Result of Performing Time

The results for visiting places, the first group (A) was a little bit higher than the second group (B). Group A visited 4.8 places in average. Group B visited 4.4 places in average. The result showed that multiple interactions affected people to visit more places.

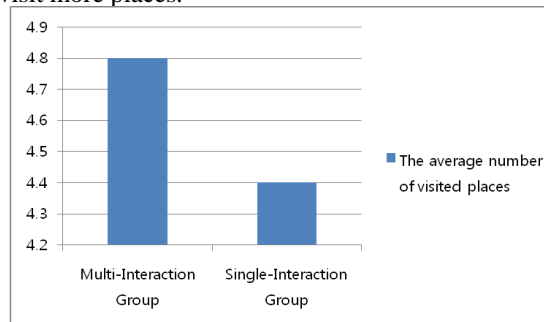


Figure 8. Result of visiting places

For the results for visiting blogs, the first group (A) visited 2.3 blogs in average and the second group (B) group visited 1.7 blogs in average. A group who experienced various interactions had more interests on the place, so they visited the blogs where the photos came from.

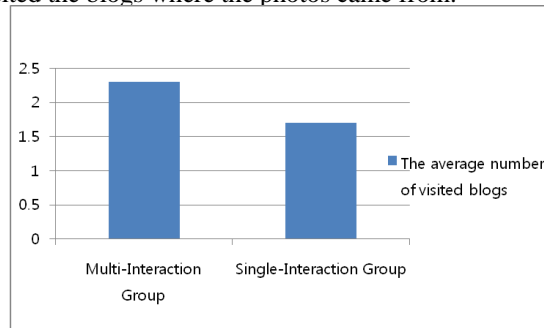


Figure 9. Result of visiting blogs

The number of places remembered by the first group (A) was 3.7 places in average and the second group (B) remembered only 2.1 places in average. This showed that testers can remember more places through various implicit interactions than simple touching. While they experienced various interactions to see the photos, they were more affected by the places.

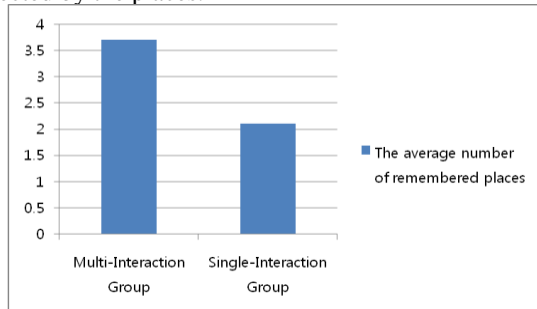


Figure 10. Result of remembered places

All the results from measuring interests showed that more than average experienced multiple interactions from the first group. These results showed that user who performed various metaphoric interactions like blowing a breath, wiping the window with their fingers were more interested on the place. The more involved interaction seems to have had much many positive effects on user interest.

B. Level of Awareness

Two questions were asked to two groups to compare the changed awareness on ‘Pimatgol’.

- (1) How much money will you contribute for preservation of the ‘Pimatgol’?
- (2) If you were the mayor of Seoul, how much do you agree to preserve the ‘Pimatgol’? (in percent)

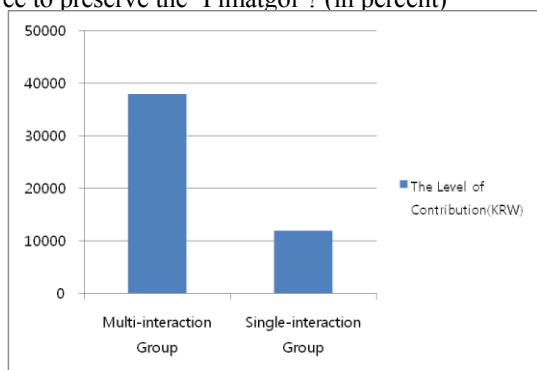


Figure 11. Result of contribution

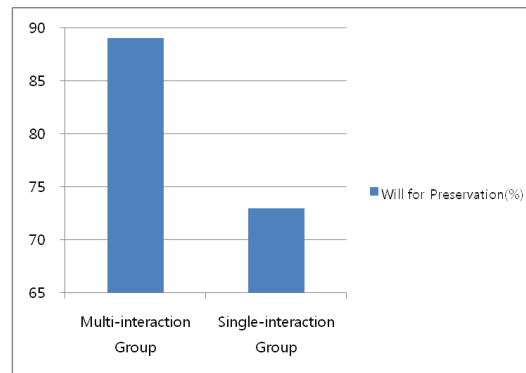


Figure 12. Result of preservation

From the result, we can see that the group who experienced multiple interactions was willing to contribute more money than the simple touch group. The first group was willing to contribute 38,000 Won for preserving the ‘Pimatgol’ but the second group was only willing to donate 12,000 Won which was significantly less than the first group. Also 89 percent of the multiple interactions group were willing to preserve the ‘Pimatgol’, while 73 percent of the single interaction group agreed to preserve. It means that metaphoric multiple interactions raised the level of awareness on ‘Pimatgol’ more besides the user interest. The metaphoric interactions reinforced people to remind the importance of historical and cultural site of ‘Pimatgol’, so it made the testers to contribute more to preserve the place.

VI. CONCLUSION

We have presented the design of an AR application for digital reconstruction of ‘Pimatgol’. Experiments in the site showed that multiple and implicit interactions of ‘window wiping’ gave more entertainment and emotional effects on the user compared to simple operation of buttons. It also raised more awareness on the historical and cultural site by blowing a breath and wiping the screen with a finger like window wiping. Also, user can see the past scenes over the present ruins or newly constructed through past photos of the spot from other community member’s blogs. Also user became more aware of the location through the map which showed where they were. In addition to that, user can get context awareness through their outdoor environment. Lastly, they got information awareness from texts and photos from the blogs of other community member on the place. Although the AR Window application should be improved further, especially by adding more sites and photos; it opened a novel way of digital reconstruction by raising the level of attention and affection to our historical and cultural site.

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