AR Museum Tour w/ Google Glass Prototyping

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Introduction

The museum experience provides a type of learning that extends beyond the classroom. Within the museum, students are introduced various exhibits in which they are exposed to new truths that allow their minds to explore in a creative matter.

In the world that we live in today, the use of mobile devices is common for everyday necessities. In the educational setting, these devices have become an extension of the learning experience.

What happens when you merge mobile technology with the museum as a learning environment? We seek to do just that, in order to further the learning potential within the museum space.

The problem space

The Creative Alliance is made of artists, educators, community organizers and audiences who believe that art is the key to understanding how other people think, and the perfect ways to bring them all together. The building space of the Creative alliance is one that is very unique; it holds an art gallery, a theatre, classrooms and living facilities for local artists. Located in Baltimore Maryland, the alliance provides several programs, exhibits and events that encourage people of all age to experience art in many different mediums. In fact, the Creative Alliance organizes hundreds of events each year that connect artists and audiences with one another (Creative Alliance).

In particular, the Creative Alliance offers an amazing after-school program, KERPLUNK, which allows children of all ages to visit the Creative Alliance art gallery and create art. Meeting twice a month over a period of four months, the children have the opportunity to tour the art gallery, engage in conversation with instructors, and leave the program with a completed art project. Though the artwork within the gallery often serves as inspiration for their fabulous creations, there is one major piece that is missing from the equation: students often leave the gallery without any information about the artwork or artist.

<u>Purpose</u>

Our goal is to enhance the involvement of the user into the cultural discovery process, challenge her to imagine the social, historical and cultural context and align them to a meaningful and worthy visit experience. We aim to extend the visitors' perception and memory and to increase their consciousness level, in order to create new expectations, new demand and consequently new business and opportunities. Our purposes will be achieved by strengthening the cultural objects readability, their contextualization and their thematic analysis.

Pre-prototype groundwork

<u>The Logistics</u>

Who is the target audience?
Though the Kerplunk program is open to children of all ages, we intend to focus on a specific age group, 7-10 years old. From observation, these children have the desire to discover more about the artwork, but are not formally given the tools to learn basic information.

How to engage the audience?
With the use of technology, we seek to enhance the museum experience. Considering that the use of mobile devices encourages "anywhere, anytime learning" (Attewell, 2004), we believe that this is the answer to our museum challenge. Children will continuously interact at any location within the gallery to create a much more stimulating experience. We will explore the possibility of the use of both a handheld device and an eyewear device. With the use of augmented reality, these devices would give the users a realistic experience, which in turn would lead to a more memorable visit.

<u>Research</u>

In order to cover all areas of question, it was important for us to use models from research cases and guidelines in the following areas:

1. Designing e-learning tools for children.
2. Mobile devices for museum learning.
3. Heuristics for augmented reality.

Designing e-learning tools for children

C. Coleman, (2012) used several premises leading up to her study of creating an effective e-Learning program, TechMadnezz (a Science, Technology, Engineering and Math STEM-based computer game designed for children grades K-8): In order to understand the way in which technologies are taught and utilized in the classroom, it is necessary to dissect the interaction design of the application and technologies, and to justify the design measures taken to ensure that effective learning and engagement is taking place. She also set the premise that to properly assess the effectiveness of children's interactive technologies, user testing must take place in order to determine the validity of a particular design to educate and engage the user (C. Coleman, 2012). These two premises became assessment tools in Coleman's design of TechMadnezz. It was necessary to research e-Learning tools that already existed and find ways to prove their ability to create a learning environment based on the application's design. Coleman also found it important to implement user-testing with the actual audience the program was intended for.

Coleman took into account the most common access children would have to use TechMadnezz and designed the program accordingly for a PC. A lesser amount of children have access to other devices such as MP3 players and iPods. Coleman also considered the design of the learning experience appropriate for each age group between 0-18 years. A game designed for infants-toddlers would need to be inspired by tools like Fisher Price and respond to any key the user pressed on the keyboard. TechMadnezz Junior was designed to to teach children 8 months to 5 years basic computer technology vocabulary. Graphics linked to audio that would assist the user in recognizing shapes, colors and words. TechMadnezz also contained levels of programs that would engage older youth in their pre operational to concrete stages of cognitive learning. These levels provided more challenging activities and less checking for understanding or re-capping. Gender was also a factor in designing the TechMadnezz. Because statistics show more males succeeding in areas of technology it was important to apply a feminine style to the graphic design. This would allow the tool to reach and retain girls. The main character in the game is a girl. Opens with a story. Prompts to move on arrows, etc.

The game was actually designed and testing for 5 to 12 year olds, 4 females and 1 male. The three female participants who were ages 5 to 8 appeared to quickly become engaged and enthusiastic about the story and could easily read or at least attempt to decode the story (Coleman, 2006). The youngest user actually navigated the game more quickly than the older users. The tester believes this was was a result of the student's regular use of the comparable LeapPad e-Learning tool. Older kids appeared to navigate through advanced levels more quickly. Coleman also recognized that a majority of the kids did not effectively associate the correct image of characters with their names. She suggested that this part of the game should be re-designed. There were also instructions that students found challenging considering more details about the functions were included in the pre-game tutorial.

Coleman's study proves that it is absolutely necessary to consider all elements of design when creating an e-Learning tool for students. Multiple aspects of graphic and educational design has to be taken into account. She also proved that all education-based technologies must be tested by a focused group of users- the audience who will use the program.

Mobile devices for museum learning

Tesoriero, Gallud, Lozano, & Penichet (2008) designed a method for using radio frequency identification (RFID) which supports automatic location positioning of mobile devices for use in art museums. The method would allow visitors to use their PDA's to retrieve location aware information about a piece, artifact or space in the museum. In order to use these features, the visitor would first have to download the client in the museum when he arrives. Next, he would have to choose if he wants to manually navigate the building or auto navigate. Manual navigation would allow the visitor to use the navigation keys on his device to help guide him navigate through the museum space. If using automatic navigation, he would not have to manually select anything. This study also concluded that information would be presented based on devices based on different levels of attention from the user. The lower level of attention would be someone who does not have to constantly pay attention to the device in order to retrieve information in the museum. He may be paying attention to several things in his environment but would be alerted about a specific exhibit, if he is in close proximity of an important or featured object. This does not require any input from the user. The medium level of attention is for someone who is a bit more engaged with using the device in the museum experience. It would require input from the user, in which they would have to perform a gesture to gain further information about that piece. One example would be for a user to position their device 5-8cm away from an RFID tag (which is behind a label) to learn more about the exhibit associate with it. The higher level of attention would refer to a visitor who is fully engaged with using the device. He would be able to not only point to a label that has a RFID tag behind it, but he could also point to an object to retrieve more information. This would especially be helpful for museum exhibits that may be further away from reach that may be hanging from the ceiling. This technology presented a step forward in the advancement of mobile technology in the museum space.

Let us now examine the Phone Guide (Föckler, Zeidler, & Bimber, 2005) project. The aim of this study was to enhance the museum guidance approach with the use of camera-equipped mobile phones and on-device object recognition. Prior to this study, museums were using audio-guided technology and RFID technology. Audio-guided technology was problematic because it only allowed for audio output and it did not include the use of visual tools such as pictures and written text. They also required visitors to constantly have to look up information and key in information in order to gain desired results, which could get annoying after a while. In addition, costs for the devices were incurred by the museum. With the focus directed towards the indoor museum experience, the concept of Phone Guide desired to solve these problems. The idea is that a museum visitor would be able to take a picture of an exhibit and in turn, they would receive information about that exhibit. This was challenging because they had to consider various environmental circumstances such as lighting and shadows during different times of the day. Also, various phones have different resolutions and settings. To develop this technology, developers first took pictures of a variety of museum exhibits from numerous angles. They also used very high resolutions images to account for the varying colors within an object. Then they combined this data with the use of several computations to further develop object recognition with the use of single layer perceptron networks. They later conducted a field study using three different cellphones and 50 different exhibits. Their findings showed that the Phone Guide system was ninety-percent accurate.

Heuristics for augmented reality

Augmented Reality (AR) also known as Mixed/Mediated Reality (MR) is a method of annotating life as it happens by adding an extra layer to our sensory experiences. This addition is often made to what we see, and in some cases, what we hear and feel[1]. There are many ways to implement and display AR; methods include: head-mounted display (HMD), eyeglasses, contact lenses, virtual retina display, handheld and Spatial Augmented Reality. For the purposes of this study, we focused on handheld methods, and AR as a form of wearable computing; specifically head-mounted displays and eyeglasses. Despite the fact that AR has been studied, implemented and prototyped for over forty years, the factors of human computer interaction have only recently been considered in a persistent manner. Because of this, there are no universal standards for augmented reality device; however, the guidelines as set forth by Dunser et al appear to be most suitable:

Affordance

Affordance refers to the connection between and interface and its physical and functional characteristics. In other words the interface should feel natural, and match real-world conventions in as many ways as possible. Other guidelines for maintaining naturalness include:

- Providing visual feedback for creating a feeling of spatial awareness.
- Minimal use of intrusive devices, i.e. use eyeglasses instead of such as head-mounted displays.
- Use of wireless props and peripheral devices over wired ones.

Reducing Cognitive Overhead

An interface that follows natural conventions usually reduces cognitive overhead. The idea behind AR is to annotate the real environment. These annotations are layered atop the real scene, and can take the form of text, icons, wireframes, video, and 3D objects. In AR interfaces, the type of background scene and the type of annotation contribute to the amount of cognitive load experienced. The "sweet spot" or point of lowest cognitive load is experienced when the annotation takes the form of 3D ungrouped objects atop a real-scene realized through an optical see through head mounted device (i.e. glasses)[2].

Low physical effort

Tasks should be accomplished with as little interaction as possible. In the case of head mounted AR systems, Hinckley[3] recommends voice input as a more natural form of interaction over traditional mouse and keyboard methods.

Learnability

The interface should be consistent by following its own conventions. We established earlier that annotations that take the form of 3D ungrouped objects are typically easier to register for users; the designer should ensure that each representation is distinct and clear.

User Satisfaction

The proprietors of the system should see to it that users are able to provide feedback on their experiences with the system so adjustments can be made.

[1] (Wearable Computing)
[2] (Wang & Dunston, 2008)
[3] (Wang & Dunston, 2008)

Flexibility of Use
The AR system should provide customization/personalization options that satisfy the various types of users as well as users with different experience levels.

Responsiveness/Feedback Error Tolerance
Ideally, a well-designed system should prevent errors or provide easy undos. Since AR faces issues with automatically detecting the subject to augment, depending on factors like lighting, and level of subject reflection, the system must automatically correct itself before it interferes with the user.

Personas

Personalities of Museum Visitors
Our findings showed that it was important to note the different ways in which visitors engage and interactive within the museum environment. In order to design a mobile interface that would be appealing to all, we must consider the following roles that are played by our users:

- ANT: visitors who follow a specific path and spend a lot of time observing almost all the exhibits
- FISH: visitors who move most of the times in the center of the room without looking at exhibit's details.
- BUTTERFLY: visitors who don't follow a specific path, are guided by the physical orientation of the exhibits and stop frequently examining their details
- GRASSHOPPER: visitors whose visit contains specific pre-selected exhibits, and spend a lot of time observing them

Pre-interviews with museum visitors

In order to gain more direction in our design process, we interviewed several museum-goers between the ages of 5 and 12. We also interviewed one adult parent. Majority of the visitors were much more interested in the idea of a wearable glasses device versus a handheld device. One parents stated that expressed that since we often use handheld devices every day, it would be nice to have something different (appendix 1). The remarkable results from the interviews lead us to consider five primary features for the mobile device.

1. Take Picture: The device would allow users to take a picture of the artwork.
2. Learn More: Visitors were very interested in learning how the artwork was made and wanted to learn more about the artist.
3. See picture: Visitors wanted to see a gallery of the pictures that were taken.
4. Interact: Visitors wanted the ability to interact with the artwork, by possibly making a game to move the pieces of the artwork like a puzzle.

5. Send email: Visitors wanted the ability to communicate with the artist by sending him an email to tell him how much they loved the artwork.

Pre-prototyping outcome: Google Glass

After careful examination, it was deemed necessary to narrow down the scope of the project. The major thing to determine chooses which type of device we would design, handheld or eyewear. The handheld device has its benefits, it was very familiar to most people, there were also dozens of programs and games that use mobile platforms and

Designing the eyewear device was much more appealing not only to us, but also to our interviewees. There were several things that posed questions. We decided to model our prototype after the Google Glass functionality.

Paper Prototyping

Our initial prototype sketches:

The Design
Designing the paper prototype was a big challenge. As we began to dive into the features, there were several things that played a major role. We first began to examine how the users would interact with the Google Glass device. Would they interact with it by voice, touch, gestures or a combination of the three. Once we established voice activation as the best method, we began drawing designs and testing the features ourselves. In the ended, we decided that it was best to keep three main features: take picture, see pictures and learn more. There would also be an introductory video in which the artist would speak to the students to give instructions

The Testing
We tested a total of 7 users between the ages of 6 and 12 in two separated settings. From the first set of testing, it was clear that we had to modify the features for learning more. We found that there were some students that found this feature to be interesting, while most were disengaged. We modified the prototype in the second set to include a video for the "learn more" feature. We also found that there was a need for clarity with the see pictures functionality. With a simple "error" state, we were able to make the prototype seamless for our users.

Technical Prototype

We developed our technical prototype to reflect the changes we saw necessary for our audience and the use of the device. We limited the amount of options and also included features that would help users troubleshoot any problems. The technical prototype was created with Axure. Our initial draft included basic functions and visuals. We quickly enhanced the look of the prototype with the actual font used for Google Glass, Roboto. This gave the prototype a clean and defined look.

We tested the prototype on 3 users. They went through all steps with ease. Despite the users possessing different characteristics, they all picked up on the instructions and use of the glass prototype. Only one user forgot to say "Ok, glass" before a command. They instructed the program to go to help and was able to solve the problem. As long as the "Get Help" feature is a part of the program, users will have little to no problems using Glass to enhance their museum experience.

Moving Forward

Using Google Glass technology to enhance the gallery experience is a plus. If programming for the device is made simple and clear for young people, they will benefit from the program. Creative Alliance could benefit greatly from this technology and should consider investing in a programmer who could develop this further in time for the glass release to the general public.

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