



This is to certify that the
thesis entitled

DESIGNING A HANDHELD INTERACTIVE SCAVENGER
HUNT GAME TO ENHANCE MUSEUM EXPERIENCE

presented by

SU YOUNG KWAK

has been accepted towards fulfillment
of the requirements for the

Master of Arts

degree in

Telecommunication, Information
Studies and Media



Major Professor's Signature

8-10-04

Date

LIBRARY
Michigan State
University

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE
JUL 12 2007		

**DESIGNING A HANDHELD INTERACTIVE SCAVENGER HUNT GAME
TO ENHANCE MUSEUM EXPERIENCE**

By

Su Young Kwak

A THESIS

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

MASTER OF ARTS

Department of Telecommunication, Information Studies and Media

2004

ABSTRACT

DESIGNING A HANDHELD INTERACTIVE SCAVENGER HUNT GAME TO ENHANCE MUSEUM EXPERIENCE

By

Su Young Kwak

This production thesis is to create an interactive Scavenger Hunt game for children aged 9 to 13 as a history-learning tool in a museum setting at Chicago Historical Society. The main focus of this project is to develop a usable interface and interactivity for Pocket PC PDA using Macromedia Flash MX 2004 Professional.

The production is based on “stealth learning” and other pedagogy theories that say children can learn effectively while they play games and achieve simple goals.

The software will engage the target audience to answer correctly 10 scavenger hunt questions by finding the matching history artifacts in the museum. It will also help the target audience develop an interest in learning about history.

Copyright by
SU YOUNG KWAK
2004

To my wonderful parents and sister.

ACKNOWLEDGEMENT

This thesis could not have been accomplished without many people's support.

First of all, I thank my advisor Professor Brian Winn for his great guidance and encouragement. He also did awesome programming for the production, sacrificing his personal time till late.

I also thank Dr. Charles Steinfield and Dr. Carrie Heeter for their support of this project. Without Dr. Steinfield and his TC862 eCommerce class, I might not have yet found a thesis topic. Dr. Heeter also helped me a lot with her insightful comments and ideas on each phase.

I appreciate the Chicago Historical Society's staff, especially John Russick, Lynn McRainey, and Jean Feit. This whole project was possible with their superb support and interest in the project.

Looking back upon my 2 years here at Michigan State University, I can't thank enough of my colleagues, Dr. Gill-Chin Lim and Mr. Sungsoo Chung. I also thank my friends Patti Banyas, Haomin Chen, Holly Giesman, Asuka Nakagawa and Luis Rosero for their friendship and sharing fun moments with me for the last 2 years. Finally, I thank Jason Tye for his wonderful love and support.

TABLE OF CONTENTS

LIST OF TABLES	viii
LIST OF FIGURES.....	ix
CHAPTER 1	
Introduction.....	1
Overview.....	1
Theoretical motivations	2
Project objectives	3
CHAPTER 2	
Use of handheld technology as museum education	4
Use of handheld devices in other museums.....	4
Use of PDAs in other museums	6
Use of Scavenger Hunt game as a museum education	9
CHAPTER 3	
Pre-production research.....	12
Secondary research.....	12
Persona analysis	13
Use-case scenario	14
Content design and storyboard.....	15
CHAPTER 4	
Designing applications for Flash in Pocket PC.....	21
Flash in Pocket PC	21
Performance issues	23
Screen size issues	25
User interface function issues	26
CHAPTER 5	
Production.....	28
Interface design	28
Iconography and typography	30
Graphics and illustrations	33
Sound design.....	35
Publishing and creating Flash standalone for Pocket PC	36

CHAPTER 6	
Post-production research	38
Research method	38
User observation.....	39
Interview	41
 CHAPTER 7	
The Future of this project	44
 REFERENCES.....	 46

LIST OF TABLES

Table 1 Demographic data of CHS visitors	12
--	----

LIST OF FIGURES

Figure 1 Flash templates for Pocket PC	22
Figure 2 Template for iPAQ series	22
Figure 3 Pixel guide of Pocket PC Explorer.....	26
Figure 4 Green circle buttons.....	31
Figure 5 Finger buttons	31
Figure 6 Blambot Pro	32
Figure 7 FFF Access.....	33
Figure 8 Digital 2	33
Figure 9 Characters	35

CHAPTER 1

Introduction

Overview

The Chicago Historical Society (CHS) is a history museum devoted to collecting, interpreting, and presenting the rich multicultural history of Chicago and Illinois area, as well as selected areas of American history. Currently, CHS reaches the public through exhibitions, programs, research collections, publications, and websites.

Like other museums and galleries that try to implement high-end technologies to present their exhibitions and collections, CHS is also trying to provide a way of using technology to enhance a museum experience for its visitors especially children, so that they can learn about history in a fun and exciting way.

Scenarios have been proposed by a group of Michigan State University graduate students to help the museum make the best use of cutting-edge technologies. The scenarios include various ways of the display of exhibitions, hands-on activities, museum guide, location-aware exploration of other parts of Chicago, games, kiosks, web-browser interactions, and so forth.

This master's thesis production will demonstrate one of these ideas above: designing a handheld interactive Scavenger Hunt game. The handheld operating system (OS) will be

Pocket PC PDA, and the development tool will be Macromedia Flash MX 2004 Professional, which was released in March 2004.

Theoretical motivations

Recent learning theories show that children learn very effectively while they play a game. James Gee, author of *What Video Games Have to Teach Us About Learning and Literacy* (2003) has referred to 'stealth' learning as "an activity where the learners are so caught up in their goals that they don't realize they are learning, or how much they are learning, or where they actively seek new learning." The implication is that children learn by having fun and not realizing the learning objectives.

According to Gartenhaus (1933), a child who visits a museum has a pattern of keying in on something and exploring it for a few minutes. Then she would work up some nervous energy and run off to something else to explore. If grown-ups watch the whole space all they see is the child running around, but she is actually learning from the museum that way.

Kimberly Zern's research (2003) about the use of handheld technology in the Museum of Science in Boston is also interesting. Her observations included that while adults are more reluctant to participate, younger visitors are drawn to this active use of technology.

These theories and findings imply that museum education can be very effective by supporting a non-linear and more personalized way of museum experience through the use of an interactive handheld device, rather than through a traditional way of museum education such as a guided group tour.

Project objectives

The primary objective of this project is to design a handheld Scavenger Hunt game as an effective learning tool of history of Chicago. The product will enhance a museum experience for children aged 9 to 13. It will offer them a unique and fun experience that combines interactive media with artifacts. Throughout these activities, children will discover history facts and find personal meaning and connections through history.

The second objective is to design an effective interface for a handheld device especially for a full-screen Pocket PC. The design challenges include smaller screen size, limited memory and storage, low speaker quality, typography, and other hardware issues.

Beside these typical design issues of designing for a handheld device, the museum environment will be considered into design. Since the device will be checked out to the public, usability issues in the museum setting will be studied and implemented in the project.

CHAPTER 2

Use of handheld technology as museum education

Use of handheld devices in other museums

Traditionally, the indoor and outdoor museum guides have been either personal audio devices or group tours by museum staff. Group tours are usually arranged to a group of more than 10 people by appointments. Group tours can be effective and customizable for a specific group, but they still require museum staff or volunteers to provide the service. In terms of the customization, topics and exhibitions can be selected according to a certain group's interest, but the service can't satisfy every individual's interests. In that sense, customizable handheld guides using high-end technology will lower the operation cost and enhance the individual museum experience.

Many museums still use handheld audio tour guides such as pre-recorded tape players with earphones. Recently, a few museums such as the Tokyo Art Gallery started to provide high-end handheld audio guides using Apple iPod's, in which digital audio clips are pre-recorded and played. The maintenance and updatability of the content are much easier than traditional pre-recorded tape players, but it is more or less just replacing analog devices with digital ones.

Some museums such as Boston Science Museum and Kanagawa Natural Science Museum in Japan introduced a location-based technology called the Remote Infrared Sign System, which enables visitors to get the pre-recorded audio clips from their

personal receiver only when the individual device approaches a certain area with a transmitter. This indoor location-based technology is very effective in delivering a specific audio content in a certain area, but not applicable to artifact-specific content.

To date, the Experience Music Project in Seattle (2004) is one of the most ambitious handheld initiatives currently available and the first to integrate usage as a regular feature. Visitors are provided with an electronic guidebook-type unit comprised of a CD player and book-marking facility that is supported through a Web site.

As far as the outdoor handheld presence, European museums are very active in research and experimentation. The Framework 6 and IST programs of the European Commission have supported a number of initiatives to investigate mobile computing applications in the sector, such as the MATAHARI project (2000) of the Swedish Natural History Museum. An outdoor based project, MATAHARI (Mobile Access to Artifacts and Heritage at Remote Installations), has several objectives which include demonstrating the feasibility of using mobile communication technology to enhance visitor experience of urban architecture, natural environments, and archaeological sites.

Another outdoor scenario was explored by the European Media Laboratory GmbH (2004) in its Deep Map project. It involves the prototype development of a digital personal mobile tourist guide.

Some museums introduced cellular phones as a means of outdoor guides, which enable people to explore other parts of a city near the museum. The London Canal Museum (2004) of the United Kingdom developed content for WAP phones so that anyone with a WAP phone on the GSM network can access text descriptions of historic landmarks of London. The development of tour content for WAP phones is relatively simple and easy. No checkout service is required because people can use individual cellular phones. Users, however, need to pay the airtime charge while they use the WAP service on their cellular phones.

A simpler way using cellular phones would be to call a number and listen to pre-recorded voice clips at each place. The Talking Street project (2003) is a cellular phone based walking tour of New York City. Anyone with cellular phone can choose one of 13 spots in the Lower East Side and call a toll-free number assigned to a certain spot. The project is currently expanding its service to other cities.

Use of PDAs in other museums

Another creative and immersive use of handhelds is the Points of Departure (2001) at the San Francisco Museum of Modern Art (SFMOMA). SFMoMA curators selected great works from the permanent collection and took pilot approaches to enhance the visitor experience in relation to these works. The iPAQ handhelds allowed visitors to access original video footage or archival clips of artists in the exhibition.

A special case study has been made of San Francisco's Exploratorium (2001), which teamed up with Hewlett Packard (HP) to test ways to integrate the physical world of a museum with the virtual world of the wireless Web. Twenty five Exploratorium exhibits were connected to a museum network and handheld portable computers through infrared connections. By creating a guidebook for visitors, the project attempted to enable visitors to 1) capture their museum experience through online records; 2) provide context for exhibits through computer-based orientation; and 3) extend their interaction with exhibits to engage in measurement, data collection, and other experimentation to better understand the phenomena demonstrated by the exhibits.

The work of Hewlett Packard (2004) has involved several museum initiatives, including the creation of its own "Cooltown" museum. In the Cooltown Art Gallery implementation, HP developers laid out a room with pictures on the walls and implemented a Web presence for these entities using active, URL emitting devices (beacons) that allow for a type of discovery direct sensing. Next to each painting is placed infra-red beacons that supply PDAs with the URL of the corresponding point of Web presence.

The Field Museum (2004) in Chicago is undertaking an assessment of handheld applications to enhance visitor experience with its 'Stanley' initiative. The aim of the trial is to see how handhelds can make information fit where people are in the museum, as well as in each phase of their visit. The way a mobile device can promote interaction among visitors is an important part of the trial.

The Information Society of the European Commission wrote a report in June 2002 specific to museums and multimedia. The report summarizes trials in the European museum community. The Tate Gallery in London, the Mercedes Museum in Munich, and the Botanical Garden in Berlin all have started experiments with PDAs and the development of systems for providing information on demand. According to its report on trials and experiments, visitors usually walk and stop if they find something interesting and they can be expected to want further information. This visitor behavior has been positively evaluated with PDA units. Aspects of personalization could also prove to enhance a visitor experience if, for example, a PDA unit can log a visitor's trail and offer selections of favorite objects, etc. which could be printed out at the end of a visit.

The Handscape project (2002) conducted by CIMI, a consortium of cultural heritage institutions and organizations, and the Human Computer Interaction Group at Cornell University, and involving the American Museum of the Moving Image, the Royal Botanic Gardens, London, and the Field Museum, Chicago, is concerned with exploring potential use scenarios for mobile and handheld computing in museums. The initial hypothesis is that mobile technologies present an opportunity to evolve radically the way museums relate and communicate with visitors and that new applications and services designed for these devices can positively influence the visitor experience.

The Copley Society of Art in Boston featured the Invisible Ideas project during the Boston Cyberarts Festival 2003. The Invisible Ideas (2003) was the first project of its

kind to combine GPS, Macromedia Flash and Pocket PC OS. Participants discover this landscape of ideas by using GPS-enabled Pocket PC PDAs available to check out at the museum. Visual tracings of the individuals' walks were also displayed at the main gallery.

The eDocent (1999) presents information to the visitor automatically, based on the visitor's proximity to an object. The visitor's location is determined by the device's infrared contact with "tags" placed near selected objects, or demarcating the various sections of the Museum. Once eDocent downloads information relevant to the visitor's position, the visitor can explore a variety of topics related to the artifact, or section, at their own pace and according to their own interests. During their explorations, visitors may also bookmark information that interests them for further Museum-guided study via the Web at home. The device used in the first prototype, a Casio Cassiopeia Fiva, is much larger and heavier than the device planned for the future. A smaller device, the Compaq iPAQ Pocket PC, was also part of this month-long demonstration. In the future, visitors will be able to use their own Palm Pilots, telephones, or other personal digital assistants to access information about artifacts in the Museum.

Use of Scavenger Hunt game as a museum education

Even though there have been many experiments using PDAs as a guide and exhibition learning tool, there have been trials and errors in the operation or content development, thus not many museums maintain the service permanently. SFMoMa, a museum with the

most active use of PDAs, conducted a visitor evaluation and was able to report important findings. According to SFMoMa, any use of a PDA system, such as an electronic guidebook or other handheld device, must be designed to fit appropriately into the visitor's desired experience.

SFMoMa defined 4 critical issues to be considered to design applications for a handheld device.

- What the visitor thinks
- Impact on visitor behavior
- What device is best for a given target audience
- What application is best for a learning outcome

Consequently, SFMoMa concludes that certain criteria must be assured to make the product more effective, namely:

- Make prototyping part of the museum or general learning experience
- Plan for user/visitor studies
- Be clear about what the objective is (and who your audience is) and only use the application when and where it is most effective
- Do not use PDAs to replace or take the place of things that already work well
- Be prepared for potential malfunctions and maintenance challenges

In this context, a Scavenger Hunt game can be an effective content to enhance the museum learning experience specifically at a museum like Chicago Historical Society. Scavenger Hunt game is originally an outdoors activity game developed for children to play around and find a list of items. With the widespread use of the computer and the Internet, it often refers to a game in which people can find an answer using the Internet search engines.

In this project, the Scavenger Hunt game will place participating children in the role of a history detective, provide them a Pocket PC with 10 customized questions to solve, and guide them to find the answers inside the museum with 2 types of hints. It will also have some simple game features such as game points and encouragement system.

CHAPTER 3

Pre-production research

Secondary research

The education department staff of the Chicago Historical Society has been doing a demographic analysis of its visitors to improve the service and get a hold of the target audience for new exhibitions. Throughout surveys and observations, the museum discovered that most of visitors are family groups of 2 to 3 people. Children between the ages 9 to 13 took a major part of the visitors. Below is the demographic data of the museum visitors in 2004.

Demographic Breakdown		Percentage
Type of Group	Family	60%
	School	20%
	Individual	20%
Age of Visitors	0 – 8 years	8%
	9 – 13 years	28%
	14 – 17 years	22%
	Adult	42%
Number of Visitors per group	1	20%
	2-3	60%
	4+	20%

Table 1 Demographic data of CHS visitors
(Source: Chicago Historical Society 2004)

The museum has been working on ideas and ways to provide a new technology to this target age group, usually accompanied by parents in family visits, to enhance the museum experience. Further, there have been frequent requests from parents as well if the museum can provide any specific activities for children while parents enjoy the museum tour on their own pace.

Persona analysis

Based on the secondary research result from the museum, primary persona was created. Persona analysis helps design of the interface and the content to fit specifically the target audience.

Primary persona

Sally (10, Female, Student)

Sally is a fourth grader in an elementary school. She lives in the outskirts of Chicago with her parents and an elder brother Jacob, 16 year old.

On weekends, her parents take the children to movie theaters or public parks or occasionally to museums. Since Jacob has already been to most of the museums in downtown Chicago several times through school trips or family visits, her brother rather stays home or brings a Game Boy Advanced to the museum.

Sally's favorite class at school is the art and the creative writing. She is not a big fan of history class because she thinks her history class is not fun. During history classes, she likes to draw and visualize about things her history teacher explains. She hates memorizing dates of historical events. She thinks history should be as fun as the art or the creative writing classes she takes.

After school, Sally does homework with or without friends, and then watches TV till dinnertime. It's been 2 years since the family installed a DSL Internet cable modem. Late at night, she chats over instant messengers with her best friends. She usually talks about what she did during that day and what she heard from other friends at school. If there is no one on her instant messenger lists, she plays free casual games on Yahoo or PC games such as Hearts or Mind Sweeper.

Use-case scenario

The use-case scenario is based on the hypothesis that children aged 9 to 13 who visit the museum will use this product. The handheld device will be available for an individual check out at the ticket office with a deposit of a driver's license of either a parent or a guardian.

The product was designed to answer 10 customized Scavenger Hunt questions. Users are able to find the answers somewhere inside the museum. The Scavenger Hunt game only applies to 3 galleries in the museum: the Children's Gallery on the first floor, the Chicago

History Wing and the American History Wing on the second floor. The reason the product didn't include several other galleries in the museum is that temporary exhibitions change every 3 to 6 month while these 3 galleries are quite permanent. In the future, the product might be able to include the whole museum area once regular update and maintenance is available.

It may take about 20 minutes to complete the game. The order of the 10 scavenger hunt questions is designed to follow the flow of a normal visit of the museum, starting from the Children's Gallery in the first floor to the Chicago History Wing through to the American History Wing in the second floor, from the entrance to the exit in each room. The device should be returned within an hour.

Content design and storyboard

The content for this project, mostly pictures and history texts, was collected from two different trips to the Chicago Historical Society in Chicago. Since the Scavenger Hunt game is based on the museum setting and all the answers to the questions should be present within a museum, artifacts and accompanying descriptions were the primary source of content. Three galleries – the Children's Gallery, the Chicago History Wing, and the American History Wing - were chosen for this project, because these galleries are permanent exhibitions while other galleries rotate 3 to 6 months temporary exhibitions.

After reviewing the collected content thoroughly, I figured out there can be three types of question-answer matches: 1) text questions with text answers, 2) text questions with graphic answers, and 3) graphic questions with text questions. For example, a text question with text answers will ask, “In 2004 now, what rank is the Sears Tower in the World’s tallest building record?” with three multiple choices in text. A text question with graphic answers will ask, “Which building below beat the Sears Tower in the World’s tallest building record?” showing three silhouettes of world’s skyscraper buildings. A graphic question with text answers will ask, showing the illustration of the John Hancock Center, “I’m the third tallest building in Chicago. Who am I?” followed by three multiple choices in text. Due to the small screen size, another possible match, which is graphic question and graphic answer, was not considered.

The next step was to create a worksheet with all the content, which will serve as a database for the game. The database fields were Index number, Question, Answer, Genre, Location, Order, Hint 1 and Hint 2.

“Index number” is an identifier of each question associated with all the other information.

As it was mentioned in the storyboard, 10 “Genres” are available to select:

- Lincoln and Civil War
- Chicago Architecture
- Chicago and Water

- Great Chicago Fire
- Neighborhood Story
- Transportation
- The World Expos
- Al Capone and the Prohibition
- Shopping in History
- Business and Commerce in Chicago

Users can select as many genres as they like to explore and the Action Script customizes a set of these genres for them. They can also pick a random play option.

“Location” refers the spot where users can find an artifact and the accompanying description that show the answer very explicitly. There are 13 locations in this game:

- 3 spots from the Children’s Gallery
- 5 spots from the Chicago History Wing
- 4 spots from the American History Wing
- Lobby

“Order” is based on the flow of the museum visit. It assumes that a user would walk from the first floor to the second floor, moving from the Children’s Gallery to the Chicago History Wing through to the American History Wing. Once the categories are

selected, 10 questions are automatically sorted ascending by this order. This feature keeps users from moving back and forth across the museum and getting frustrated.

Based on these data base fields, each screen's storyboard was created.

1. The greetings and the instruction of the game will be given first. The goal of the Scavenger Hunt game is to answer all the 10 questions correctly so the children can complete their mission as history detectives.

2. Users will choose among 10 categories according to their interest of Chicago history themes. These 10 categories are based on the museum's previous research about the history themes that elementary school children can easily understand. They can also choose random questions, which will generate 10 random questions, one from each category.

3. Each category has 1 to 8 questions. Most questions will be simple text-based questions with or without a help of visual elements. Some questions can be more interactive and richer in graphics and animations

4. 3 multiple choices will be given. One question is consisted of 10 points. Users may guess, but once they hit a wrong answer, they gain nothing out of 10 points. The first hints reveal related history facts or clues to the right answer. The second hints directly show a flashing light on a floor map where users can find the matching artifact. Skip

option will be also globally available, passing the screen to the next question. Each Skip option, however, will have them give up the whole 10 points from a question.

5. Game rules are quite simple. After users choose categories of their interests and are given 10 questions, they can gain up to 10 points from each question. If they skip the question or guess wrong, they earn no points at all. They may use 2 hints, but with each hint, they gain 4 fewer points even though their answer is correct. For example, if they use all of these 2 hints and finally answered right, they will only earn 2 points out of 10, which is relatively small but better than zero points from one question. With these rules, children could be motivated to explore the museum and try to find the answer instead of staying somewhere at the corner and play around the device.

6. Once the answer is correct, it shows “OK” message and moves to the next question. If it’s wrong, it shows “Wrong” message and also jumps to the next question.

7. Upon the completion of the whole 10 questions, users will be given the result of the Scavenger Hunt game and the level of their achievement. The goal of this game is to gain the full 100 points or as many points as possible. The achievement tells 3 different levels depending on their points. This feature encourages the children to try the game once again and gain more points.

- 81 or up: Wow, you must be the master detective of history investigation!
- 51 to 80: Good job! You have the quality to be a good history investigator.

- 50 or below: Hmm... Looks like you guessed too much! Why not try again and ace out?

8. Then, users will be given a choice of trying another set of Scavenger Hunt questions or finishing the game. Information on how to return the handheld device will be given when users select to finish the game.

CHAPTER 4

Designing applications for Flash in Pocket PC

Flash in Pocket PC

With the release of Flash MX Professional 2004, Macromedia has significantly improved and enhanced the mobile development environment, making it easy for developers to create Flash content for a wide range of platforms, including several types of mobile phones and PDAs such as HP iPAQ series, Sony Clie and iMode phones.

Some of the new features are the built-in templates for mobile devices, the ability to embed MIDI, WAV, and MP3 sounds into content, and the ability to test and publish into the template directly from the authoring environment. A list of templates for mobile devices is one of the great advantages of Flash MX 2004 Professional. Now developers can choose one of those templates, which automatically defines the pixel size and also compare the look and feel of their flash movie upon the device.

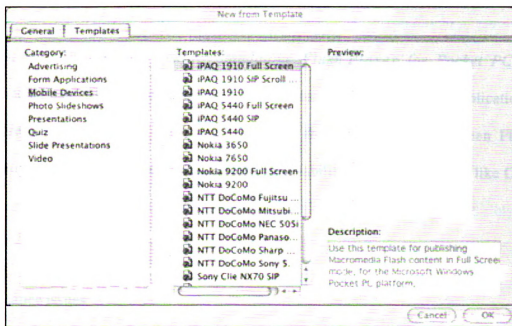


Figure 1 Flash templates for Pocket PC

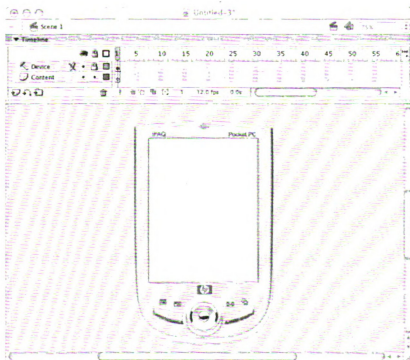


Figure 2 Template for iPAQ series

Besides, recently released software *Standalone Flash Player for Pocket PC* by Macromedia enables developers and publishers to create full-screen Flash applications. There are also a couple of third party software that can create full-screen Flash applications. Full-screen content will increase the usability in a public setting like CHS museum.

Performance issues

Not to mention of the network related issues when hooked up in the Internet, the limitations of designing for PDA device are typically smaller display, slow processing power, less memory and power constraints. Limited Action Scripting and version management can be issues too, depending on the makes of PDAs. While there are different specifications from different models and makes, the latest Pocket PCs run the following characteristics:

- Intel X-scale 400 MHz Processor
- 32 to 64 of RAM
- 240x320, 5" transfective TFT display with 64,000-color
- Microsoft Pocket PC 2003 Operating System
- Built-in expansion slot(s) for Compact Flash, S/D and MMC,

Unlike some Giga Hz desktop or laptop computers these days, processors have relatively slow computing power with speeds up to 400 MHz on the latest Compaq iPAQ 4,000 series. As a result, there are certain things to be aware of for the Flash movie to perform optimally on these devices.

The first thing to be considered is the frame rate. The higher the frame rate is, the higher the quality of the Flash movie because it makes the movement smoother. Higher frame rate, however, increases both the file size and the demand on the computer's processor. To avoid a crash and a burden in the Pocket PC processor, the frame rate should be no more than 12 or 15 fps.

Another limitation is the use of the Action Script. When someone is viewing a Flash movie on desktop, the Action Script is usually the least thing that affects the performance. Given the fact that the mobile devices have the processor limitations, the Action Script in Flash for mobile devices should be as lean as possible. The more Action Script is used, the more slowdown the movie will experience. To avoid this, Ethan Watrall (2004) suggests that the Action Script should be optimized as following:

- Avoid any unnecessary characters
- Keep the variable, method, instance, and function names as short and as compact as possible
- Use Functions for menu and button events
- Use Functions for repetitive events in the movie

- Use Unload after the use of Load.

Screen size issues

The largest display size for PDAs is 240 by 320 on the Pocket PC platform. The SWF file, however, cannot be displayed standalone without the help of special software. Generally, it is published being embedded in HTML, so that the Pocket Internet Explorer can display the SWF file. The Pocket Internet Explorer has its caption bar in the top and the menu and address bar in the bottom, each of which takes 26 pixels vertically. The address bar can be removed, but the others can't. The Pocket Internet Explorer, however, has a bug that only allows you to use 263 pixels in height instead of the actual 268 pixels. Therefore, if you carefully design the content so that the movie clip won't have any scroll bars, the optimal area will be 240 by 263. If you use a standalone player, you can use the whole area of 240 by 320 pixels.

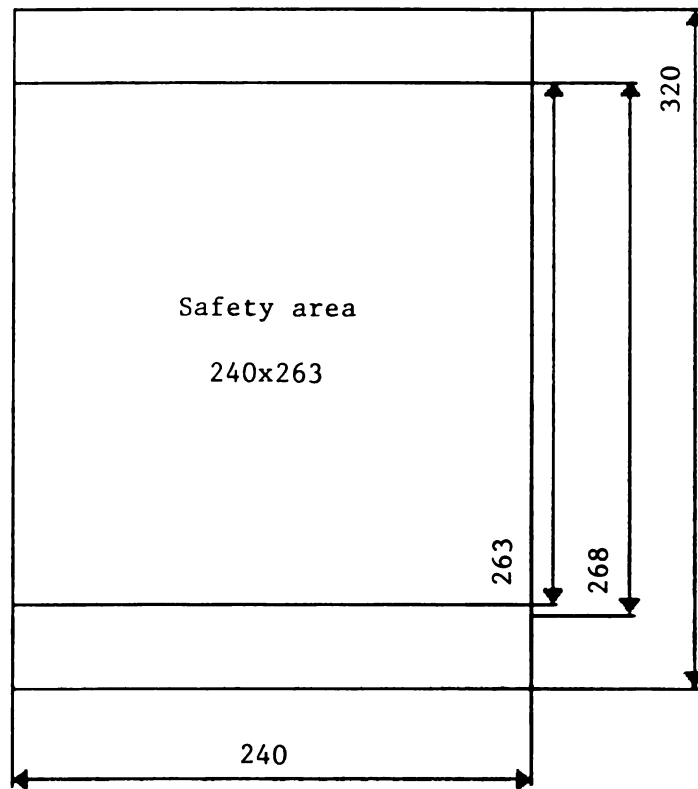


Figure 3 Pixel guide of Pocket PC Explorer

There is another design issue of the Soft Input Panel (SIP) area. This is a small keyboard area in PDAs typically with the height of 80 pixels. If your content requires the use of the SIP keyboard, then you have to consider this area, under which your content will be hidden.

User interface function issues

The biggest characteristic of the user interface design for PDAs is the use of stylus pen and touch screen. Unlike a desktop computer screen, it has a sensor right on the screen so that users navigate either by stylus pen or touch screen.

Stylus pen is a small pen input device for PDAs. It is extremely useful because PDAs have small screen size and thus smaller buttons and hyperlinks to hit precisely. Alternatively, users can use their fingers on the touch screen, usually by an index finger. This can be an issue when designing for Pocket PC software for children, who are typically not familiar with stylus pens and also with a bigger possibility of losing the tiny pens.

Another related user interface issue is that the mouse rollover event is not handled at all. In PDAs, after a button is pressed, the onRollOver event is processed when the stylus is released. A stylus press on the screen is treated as the equivalent of a mouse click on the desktop.

CHAPTER 5

Production

Interface design

In this product, the interface has 7 different screens as following:

- CHS Logo intro
- Welcome
- Instructions
- Select questions
- Questions
- Result
- Start over

The “logo intro” is made from the original Chicago Historical Society logo, adding only a splash animation on it. Since the museum’s brand colors are orange and white, orange, white, black, and variations of orange were used as key and supporting colors. The logo intro provides a strong impression of these colors and eventually of the museum’s brand identity.

The “welcome” screen starts with Jack’s welcome message. This screen is very important in a sense that users interact with the device for the first time. Jack says,

“Touch the finger” and the finger button moves upward twice giving a message that this is the button to press. Finger buttons are used as main interaction buttons in the rest of the game.

The “instruction” screen has Sally explaining the instructions and the rules. In this screen, the finger buttons are used both for the next and the back interactions. Unlike the welcome screen, the users might need to go back to make sure of the game rules.

Once users press the game start button, the screen moves to the “select questions” screen, showing Jack again. In this screen, users choose between two green circle buttons, which decide whether they want to customize their game play, or to use random questions. In case users choose to select categories of their own interests, the screen shows ten different themes with visual aid, along with yes or no finger buttons to press. After ten different screens are past, it confirms all the categories they selected and asks again with green circle buttons to choose between modify and OK.

The main interface for “questions” is identical throughout the game. A typical screen has one question, 3 multiple choices in the middle, 3 finger buttons, a hint button, and a skip button at the bottom, and current score at the top. The product uses simple finger buttons, which the users are already familiar with from the “welcome” and “instructions” screen. It doesn’t use buttons directly on the text because pressing a tiny text button is too difficult without the use of a stylus pen. Jack holds the buttons for hints and skips. On click, the hint 1 pops up on a blue bubble with a close button, which follows a consistent

comic book art style. The hint 2 was created with a mask that looks like a scavenger hunt map. It moves till the right spot of the exhibition where users can find the answer. A “skip” button changes to a “next” button after the users hit any of the finger buttons.

Result screen shows the total accumulated points and some message from Sally. Once again, the buttons are green circle buttons to select between No and OK. If they choose No, it shows the information about where to return the device as well as the credits of the product. If they choose OK, it jumps back to the “logo intro” and starts the game over.

Iconography and typography

The target users of the Scavenger Hunt game are children aged 9 to 13. Designing for them is a big challenge especially for a handheld device like PDA. Since they may not be familiar with a sensitive use of stylus pen, the iconography for a small touch screen must be intuitive and effective enough to deliver a message of possible interactions. The product only has two sets of simple buttons – green circle buttons and finger buttons. As it was mentioned in the interface design section of this chapter, limited set of buttons is effective for children to learn quickly how the interaction works.

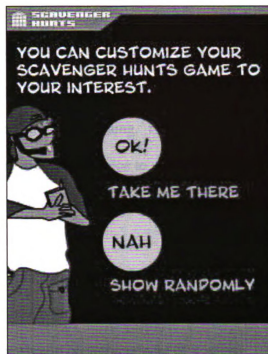


Figure 4 Green circle buttons

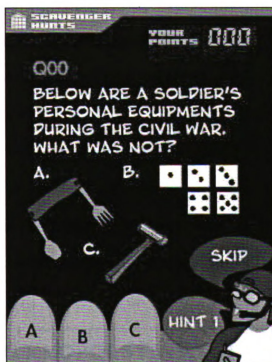


Figure 5 Finger buttons

Typography is a big design issue, too. Pixel fonts are commonly used in Flash for display in handheld devices. Pixel fonts are typefaces that exactly fit in pixels thus automatically display without any anti-aliasing. Pixel fonts have good legibility despite of very small font size. They are a nice choice to use for small display screens especially when a page has much text information to display.

There are a few things about pixel fonts to be aware of:

- Pixel font size should be an increment of 8 points.
- Pixel fonts must be placed on whole X and Y coordinates such as 20.0 instead of 20.5.
- If they are input or dynamic text, the font should be embedded in the movie.

Pixel fonts work great for information intensive software. For this project, however, considering the target audience, the size of content in a screen, and the purpose of the product, the use of pixel fonts was restricted. More over, in order to match the cartoon-style characters, main font was chosen as “Blambot Pro.”



Figure 6 Blambot Pro

“FFF Forward”, a pixel font, and “Digital 2” were used as well to indicate the global title and the score.



Figure 7 FFF Access

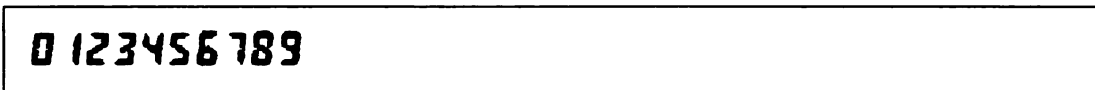


Figure 8 Digital 2

Another issue about fonts in Flash is to embed device fonts. If a text area is not a static text but a dynamic or input text, fonts not installed in the device should be embedded within the SWF movie.

Graphics and illustrations

Graphics created in Flash are vector-based. Vector graphics define the creation of digital images through a sequence of commands or mathematical statements that place lines and shapes in a two-dimensional or three-dimensional space. One advantage of vector graphics over bitmap graphics (or raster graphics) is that they make it possible to change any element of the picture at any time since each element is stored as an independent

object. Another advantage of vector graphics is that the resulting image file is typically smaller than a bitmap file containing the same image. Examples of vector-image file types are PDF, encapsulated PostScript (EPS), scalable vector graphics (SVG), and graphics created in Flash. Due to its small file size and scalability without being pixelated, vector graphics work best in Flash.

Flash supports its own drawing tool, but sometimes it creates unnecessary Bezier points. Adobe Illustrator is the most used vector graphics software ever since it came out to the market. I drew these vector graphics in the Illustrator first, then dragged and dropped into Flash. It only creates groups of graphics, not adding extra file sizes or other Bezier points. The only pitfall is that this drag-and-drop only works on the Macintosh platform. If one tries to drag-and-drop or import/export from Illustrator to Flash on the PC platform, she will only get a frustrating message that recommends her to purchase the Macromedia Freehand, another software to draw vector graphics.

Two cartoon-style vector characters were created to facilitate the game. Jack, male pre-teen character, and Sally, female kid character, take turns in presenting an introduction, directions, right/wrong messages, and so forth. They both represent the primary persona in different styles. Jack, dressed in jeans and shirts, carries sunglasses, a microphone, a PDA, and a cell phone with him, which represents urban techie children of these days. Sally, meanwhile, is dressed in a traditional detective fashion of a big hat and an oversized raincoat, holding a magnifying glass in a hand. Sally represents curious and challenging children.



Figure 9 Characters

For bitmap graphics, it is best to export in the PNG format. PNG is an acronym for Portable Network Graphics. It is a file format for bitmapped graphic images, designed to be a replacement for the GIF format, without the legal restrictions associated with GIF. It features compression, transparency, and progressive loading, like GIF.

Sound design

Sound was recorded in an audio lab in AIFF format. Sally's voice was intended to sound like a little girl's voice.

Using Peak, it was edited for each sound clip for each movie clip. The sound clips were exported as AIFs in Mono, 16 bit, 44.1 KHz setting because most Pocket PCs has only one speaker.

When importing sounds to the library, Flash automatically optimizes for a delivery in Flash. The publish setting has several options for the sound. Flash works best with MP3 option rather than Speech option even though the audio type is speech.

Publishing and creating Flash standalone for Pocket PC

Macromedia haven't yet announced the Flash Player 7 for Pocket PC, even though the latest Flash Player version for regular desktops and laptops is 7 as of summer 2004. Flash Player 6 supports most of the latest Action Script features though. Therefore, when publishing Flash content for Pocket PC, the Flash Player version should be set to Flash Player 6 or earlier.

For JPEG quality, it has been widely recommended to set it around 70 to reduce the file size. This recommendation, however, is negligible in this project because 1) it does not use download from the Internet; 2) it uses an external 64 Mega bytes SD (Secure Digital) memory card; and 3) as JPEG quality is reduced, the texts get anti-aliased and the quality drops drastically.

Once the Flash movie is published, the project still needs software to convert a regular SWF into a full-screen play on Pocket PC. If a Flash movie doesn't need full size screen, it only needs a HTML file that embeds the SWF movie and can skip this step.

Standalone movie in PDAs has a great deal of advantages. First, the full-screen obviously adds more pixels to this small device. Second, it gives the interface design an independence from the default Microsoft Pocket PC interface. Third, it keeps users from clicking other unnecessary buttons but the product and thus helps them focus on the game play. Considering that the target users are children, it is especially important to set the device for the project's purpose.

There are a few software vendors that can do this job. The software I used for this product was SmarHands Flash Pack 1.5 and Bryht Flash Player. Flash Pack creates a standalone executable file (.exe) that any Pocket PC with Flash Player 6 for Pocket PC installed can view it without any additional installation of software. Bryht Flash Player, meanwhile, should be installed in every single Pocket PC for anyone to view the content. Considering that anyone who downloads the executable file can view the content, Flash Pack is more attractive. The executable file from Flash Pack, however, doesn't work correctly on some older OS versions of Pocket PC, while regular SWF file works on full-screen on Bryht Flash Player regardless of the OS versions.

CHAPTER 6

Post-production research

Research method

The purpose of this user test is to observe how the target audience will use the prototype in the museum and to gather feedback from them on how the product can be improved.

The target audience is an age group of 9 to 13 who are students and museum visitors to the Chicago Historical Society, accompanied by a parent or a guardian. The software was tested on July 28, 2004 by a group of 11 children who are either 9 or 10 years old. They visited the museum as a part of activities of a children's summer camp.

The user test was composed of two main parts. In the first part, 3 groups of 3 to 4 participants were given a Pocket PC PDA and oral instruction. The researcher observed the participants at a distance as they used the software and explored the exhibitions. In the second part, the participants were interviewed as a group on how they used the product, what they liked, what they didn't like, and so forth. The observation took about 30 minutes and the interview took 10 minutes.

The research was approved from the University Committee on Research Involving Human Subjects (UCRIHS) and followed the rules and guidelines.

User observation

I met 11 subjects at the group meeting room and gave them general instructions first. I asked the subjects if they were familiar with a “Scavenger Hunt game.” They seemed to already know what a “Scavenger Hunt” game meant. For those who didn’t know about a Scavenger Hunt game, I asked one subject to explain what it was.

After the instructions, the subjects were divided into 3 groups of 3 to 4 children: group A of 2 females and 2 males, group B of 2 females and 2 males, and group C of 2 females and one male. Upon each group’s departure, I gave them the instructions again, and they started off in the order of group A, B, and C.

Subjects in all the 3 groups were very excited to use the device and everyone competed to be the device holder at the beginning. Surprisingly, they took a democratic decision by agreeing with each other that they would take turns to be the device holder.

Group A left the meeting room first, followed by group B and group C in order. The reason each group left with about a minute interval was that the researcher had to turn on the device and give each group additional instructions about how to handle the device.

The three groups started the game off by playing the “welcome” and “instructions” at the outside of the room. They focused on listening to the narration from the speaker rather than reading the instructions on the screen. When choosing the categories, subjects were very careful discussing with each other in the group. Everyone participated in this

decision making process. When the first question appeared, they hurried themselves to find the answers faster than other children within the group. They were aware of where other groups were moving and what they found. They seemed to compete with each other group even though all 3 groups had different sets of questions.

The first finding was that they were straightforwardly looking for an object inside the museum. It seemed that they just didn't know how to guess on the screen, which is good for the project. For example, at a question "Which city first started the mail-order catalog business?" they were looking desperately for the exact matching sentence even though they were in the middle of old Sears catalogs all over the section.

There were several challenges in the user testing. The biggest challenge was that some of the exhibitions were too difficult or too detailed for their age to understand. They had no idea of who Al Capone was or what the tax evasion meant. Questions they did great was to find the identical picture from the device. Another challenge was that some of the text descriptions were in the eye level of grownups and way too high for children to read. Even if they could find a text description in their eye level, the target users' reading capability was an issue, too. Surprisingly, a few of them couldn't spell their names correctly and couldn't read the text description. Most of the subjects didn't want to read the text description, however there were one or two subjects in each group that assumed the role.

Hardware was an issue too. They were all familiar with holding and carrying the PDAs in their little palms. Group B, however, got frustrated when they accidentally pressed a tiny jog dial button in the left side and had their screen get out of the full-screen mode. They had to reset the device and start over again with the researcher's help. The other groups with no side button on the PDA had no such problem.

About the interface, all the subjects had no problem using the finger buttons and green circle buttons. Group C never used the "Hint 1" and "Hint 2" in their first play. They eventually learned about the hints and used it in the second play though.

Interview

This group of subjects was from a suburb area of Chicago. They were visiting the museum for the first time. They came as one of the city's one-day camp activities and knew one another only for a day. Among 11 subjects, 5 were male and 6 were female. They all answered that they liked to go to museums and played video games at home, probably due to a certain competition among children.

8 subjects responded that this software was interesting. 3 subjects who answered negatively were those in the group B. What happened to this group was that the researcher had to reset the device and they lost the accumulated points every time their screen went out of the full-screen mode.

They answered that they liked using a personal device in the museum. They thought they learned about history through this game play. Upon the question “what do you think you learned about the history of Chicago?” subjects shouted a few “genre” names such as “Great Chicago Fire,” “Train,” and so forth, repeating or agreeing with their friends. About the level of difficulty of questions, they all said it was very easy to play even though their scores were not high enough.

What they liked about the software was the concept of using PDAs in the museum tour, the floor map hint, and playing the scavenger hunt with other peers together. What they didn’t like about it was some of the questions they couldn’t find the answer easily and the device reset.

Below is the feedback they provided of a few ways to improve the software:

- Hint 2, the map, should be provided along with the question so that they can have any idea which room to go to.
- Instead of 4 minus points for looking up each hint, the full 10 points should be given once they answered correctly.
- Instead of losing whole 10 points for pressing “Skip” button, they should be able to go back to the skipped questions later.

Children and PDAs have similarities. They both have slow processing power, small memory, and most of all they have short history of their life. The big difference is that

children are easily distracted while PDAs just do what is assigned to them. The interview inspired how to improve the project. First of all, they need more intuitive and visualized approach. Instead of asking a question in plain text, it should show maps and identical graphics before the question or at least along with it. Developers should keep in mind that the children have such a short history of their lives and thus can't relate one fact to another. Second, they need instant interactions with the objects. They are more enthusiastic about finding an object in the museum rather than adding a few points in their PDA. If they fail to find an answer within their eyesight, they get frustrated soon and distracted to other eye-catching exhibitions. Rather than letting them choose among 10 categories, it would be more effective to let them choose one of the 3 exhibition rooms or one of the 13 spots. Third, certain types of group play and group competition should be encouraged. They are greatly motivated while playing within a group and/or in competition with other groups.

CHAPTER 7

The Future of this project

There are many possible ways to expand this project in the future in terms of the physical environment, the location environment, and the communication environment.

This Scavenger Hunt game covers 3 physical rooms out of 18 exhibition rooms and galleries of the Chicago Historical Society. As explained in the previous chapter, there are only 3 permanent exhibition rooms and the other 15 exhibitions change every 3 to 6 month depending on exhibitions. Supposing that updatability and periodical maintenance are possible, the entire museum could be integrated in the future of the Scavenger Hunt game.

Another possibility to extend the project is to add a location-based approach. Radio Frequency Identification (RFID) is a method of identifying unique items using radio waves. Typically, a RFID reader communicates with a tag, which holds digital information in a microchip. But there are also chipless forms of RFID tags that use material to reflect back a portion of the radio waves beamed at them. Equipped with a RFID reader and a middleware between the reader and a PDA, the Scavenger Hunt game can be more interesting and personalized as users can swipe the reader in each artifact for the right answer. Since RFID tags are as cheap as less than one dollar, and becoming easier to implement, the tags could be used on all the displays in the museum.

Communication-wise, group activities could be featured too, had the museum a wireless environment. Having Macromedia Communication server and a WiFi set up inside the museum, children could post their comments and communicate real-time with each other inside the museum. It would enable group or individual competitions within a school trip.

Considering these technologies are all available and becoming easier to implement, these features will soon show up in museums and galleries in a near future. They will help children to develop interests, learn about history, and engage in history learning. They will also enhance the overall museum experience for everyone who visits the museums.

REFERENCES

- Broadbent, J. and Marti, P. (1997). Location Aware Mobile Interactive Guides: Usability Issues. Museum Interactive Multimedia: Cultural Heritage Systems Design and Interfaces. Pittsburgh: Archives & Informatics. 88-98.
- Cleaver, J. (1988). Doing children's museum. Williamson publishing.
- Duan, M. (2004). "An Introduction to Art, the Wireless Way," [Online]. Available: <http://www.cooltown.com/cooltown/mpulse/1002-lasarsegall.asp>. (August 3, 2004).
- European Media Laboratory GmbH. (2003). "Deep Map," [Online]. Available: <http://www.eml-development.de/english/Research/Memory/1>.
- Experience Music Project. (2004). "About EMP," [Online]. Available: http://www.emplive.com/visit/about_emp/overview.asp.
- Exploratorium. (2001). "Electronic guidebook forum," [Online]. Available: http://www.exploratorium.edu/guidebook/forum_report.pdf.
- Field Museum. (2004). "Behind the Scenes: The Field Museum's Mammal Collections," [Online]. Available: <http://www.fnmh.org/expeditions/stanley/about.html>
- Gartenhaus, A. (1933). Minds in motion: using museums to expand creative thinking. Caddo gap press.
- Gay, G., Spinazze A. and Stefanone, M. (2002, November). Handscape: Exploring Potential Use Scenarios for Mobile Computing in Museums. Cultivate Interactive: 8.
- Gee, J. (2003). What video games have to teach us about learning and literacy. Palgrave Macmillan.
- Invisible Ideas (2003). "About Invisible Ideas," [Online]. Available: http://www.invisibleideas.org/invis_i_d.html
- Krautler H. (ed.) (1977). New strategies for communication in museums. WUV-Universitätsverlag.
- London Canal Museum. (2004). "Mobile Internet," [Online]. Available: <http://www.canalmuseum.org.uk/wapsite.htm>.

Open Heritage/Information Society. (2002, June). Museums and Multimedia: Multimedia Technology in Museums and Museum Content in Multimedia Publishing. Report. IST-2000-25136.

Pises, A. (2002). Flash design for mobile devices. NY: Hungry Minds.

Rayward, W.B. and Twidale, M.B. (1999). From Docent to Cyberdocent: Education and Guidance in the Virtual Museum. Archives and Museums Informatics: 13.

San Francisco Museum of Modern Art. (2001). "Points of Departure," [Online]. Available:
<http://www.sfmoma.org/press/pressroom.asp?arch=y&id=117&do=events>.

Sherman, A. et al. (2002). An assessment of the effect of handheld application on the enhancement of The Field Museum visitor experience. Spectra: 29.

Talking Street. (2003). "Lower East Side: Birthplace of Dreams," [Online]. Available:
<http://www.talkingstreet.com/les.php>.

The MATAHARI project. (2000). "Mobile Access To Artifacts and Heritage At Remote Installations," [Online]. Available:
<http://www.isy.liu.se/~klas/matahari/presentation.html>.

Watrall, E. and Herber, N. (2004). Flash MX 2004 Savvy. Sybex.

Woodruff, A., and Aoki P., et al. (2001, April). The Guidebook, the friend, and the room: visitor experience in a historic house. CHI 2001 Extended Abstracts. Seattle. 273-274.

Zern, Kimberly. (2003). Evaluation report – handheld computers and learning in the informal museum setting. Museum of Science. Boston.

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 02504 5067