

Tools & Techniques

Portable Computers & Interactive Multimedia: a new paradigm for interpreting museum collections

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Abstract

This paper describes a GEMISIS doctoral research project nearing completion at the University of Salford, U.K. and offers some preliminary findings. The aim of the project was to design an interactive multimedia application for a portable computer in a museum setting, to assess the application as an aid to interpretation and to examine its impact on the visitor's understanding and enjoyment of the museum experience. It will discuss the introduction of portable computers into museum galleries, briefly describe the design and development process of the interactive multimedia application, review the methodology employed and provide a summary of preliminary findings.

Introduction

The research discussed in this paper has been funded by the GEMISIS 2000 project, a collaboration between the University of Salford, Cable and Wireless Communications, the City of Salford, the City of Manchester and the Manchester Training and Enterprise Council. The objectives of GEMISIS 2000 are to promote economic regeneration, to forge links between the public and private sectors, to improve the quality of life for the community and to provide test-bed sites for multimedia initiatives.

The central aim of this research project, now in its final stages, was to examine the potential applications of new technologies for heritage attractions and museums. Initial exploratory research in the U.K. had revealed that the use of interactive multimedia in museums was variable in terms of quality and sophistication. Although there is a range of different technologies currently being utilized across the U.K. in museums and heritage attractions, (Davies 1995, Francis et al 1992, Lewis 1993, MacDonald 1996) it is mainly in new museums that interactive multimedia has found prominence. Interactive multimedia exhibits are important in the design of new galleries as it is recognized how effectively they communicate to visitors and complement the more established interpretative formats (Aisford 1991, Alison and Gwaltney 1991, Valls 1994).

It is also true that museums are beginning to recognize the need to include new technologies. A recent survey found that almost 80% of attractions surveyed were planning to develop new interactive multimedia exhibits in the next two years, with projected budgets up to and in excess of £250,000 (Farnell 1997). These findings were supported by a report into 'The Current and Projected Use of New

Media in UK Museums' which found that one quarter of museums in the UK were planning new multimedia installations accounting for up to 50% of their budget (Visual Arena 1998, Terry 1998).

Recent technological developments such as the Internet and World Wide Web (WWW) are of increasing importance to heritage attractions and museums, (Bowen et al 1996, Campbell and Wells 1996, Clutten 1996, McKenzie 1997) because they provide museums with new channels of communication for both actual and potential visitors, and are an effective way of marketing both destination and the experience. It is evident that much more could be accomplished in terms of applied new technology especially in the interpretation of exhibits.

This paper will review the introduction of a portable computer into a museum gallery, detail the design and development process of a portable interactive multimedia application, review the methodology employed and provide a summary of preliminary findings. For the purposes of this research interactive multimedia is defined as the combination of text, graphics, sound, animation, video and interactivity into a single media (Bunzel and Morris 1994, Lopuck 1996, Prochak 1990).

Museums, Multimedia and Portable Computers

The introduction of interactive technologies in museums has coincided with the changing role of museums in society. As museums evolve from being custodians of artefacts to interpreters of the past and move away from glass cases towards interactive multi-sensory experiences, museums are no longer a place to visit but a place to participate

(Bearman 1989, Besser 1997, Dodd 1994, Hunter 1996). Interactive multimedia is a promising interpretative medium for heritage attractions and museums that can compliment existing interpretative techniques.

The number of museums with fixed interactive multimedia kiosk installations has increased rapidly in recent years, and it has reached a stage where an interactive multimedia exhibit is a must have for all new galleries. Interactive multimedia exhibits are excellent interpreters, they can communicate large amounts of often complex information in a user friendly and interesting way, whilst empowering visitors to access the information they require at their own pace (Alison and Gwaltney 1991, Dube 1997, Fahy 1995, Koester 1993). Interactive multimedia exhibits are not a replacement for traditional interpretation methods, but are complimentary, and can assist in placing exhibits and artefacts in their historical and cultural context; and appear to be universally popular with visitors (Alison and Gwaltney 1991, Koester 1993, Nakano 1995). Multimedia kiosks can provide visitors with an engaging, educational, interactive and media rich experience; the only drawback is their fixed position.

The museum guidebook was the original portable interpretation medium, enhanced further by audio guides, initially linear cassette tape based units, now random access CD-ROM and digital units. These audio guides can free visitors from having to read text panels, allowing them to concentrate on the exhibits. However even the latest audio guides are limited to providing one channel of information with limited interaction for the museum visitor (Cooper 1997, Martin et al 1997, Serrell 1998, Whittington 1997).

This research project identified the potential of combining elements from each of these media into a single interpretative application. The portability of the guidebook and audio guide, could be effectively combined with the level of interaction and media richness of CD-ROMs and interactive multimedia kiosks. The result of this fusing of technologies is the portable computer with an interactive multimedia application.

Portable computers and Personal Digital Assistants (PDA's), also referred to as palmtops or electronic organisers are in the early stages of being introduced into museums (Beishon 1997, Broadbent 1997, Dodds 1995, Not et al 1997, Vodde 1997). These units are being used primarily for visitor navigation and orientation however they may have more sophisticated interpretation applications in

the future. For example at the Smithsonian a conventional audio tour has been digitised on to a PDA, in this case an Apple MessagePad. By keying in a number on the touch screen, visitors can access commentary and limited text descriptions of some exhibits (Vodde 1997). By using infrared transmitters the unit can become location aware and provide information as visitors approach the next exhibit. (Not et al 1997) A touch screen portable computer is under development that will assist visitors in locating a gallery in a museum and specific exhibitions or objects within the gallery with audio instructions via headphones (Broadbent 1997). Examples such as these, although useful, are still limited in the interaction between exhibit and interpretation and in enhancing visitor learning.

GEMISIS Research Project

The aim of this research project was to design an interactive multimedia application for a portable computer in a museum setting, to assess the application as an aid to interpretation and to examine its impact on the visitor's understanding and enjoyment of the museum experience. A number of potential hardware platforms were identified and demonstration units obtained. After careful evaluation it was decided that the Fujitsu Point 510 Portable Computer was most suitable, as it featured the Windows 95 operating system, large 10.4" hi-resolution touch screen, reasonably powerful Intel 486DX4/100MHz processor and was relatively affordable at £2000 per unit. Our only misgiving was its weight as it was rather heavy, however it was felt appropriate to continue with this hardware none-the-less. Portable computers are clearly an area of rapid development and no doubt at the completion of this three year research project lighter, smaller and more powerful computers will be available.

The Museum of Science & Industry in Manchester, U.K. was selected to test-bed the project because of a number of factors; it was a local and highly prestigious museum; as a science museum they were interested in the potential of new technology for interpretation; and they were enthusiastic about the project and keen to be involved. Their new Fibres, Fabrics and Fashion Gallery was used as a base for the research. The Fibres, Fabrics and Fashion Gallery is a textile gallery of major importance to the museum. Recently redesigned it contains a number of redundant nineteenth century textile machines, and a range of interpretative areas detailing the harvesting, trading, and exporting of cotton, and other textile processes such as printing and dyeing. There are also a number of hands-on fixed interactive exhibits designed to

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show the properties of a range of different fabrics. Manchester was a leading center of importance in the textile trade of the nineteenth century and at the heart of the Industrial revolution. The museum is located in the Castlefield district, which was the hub of rail and water transport links and central to the textile industry.

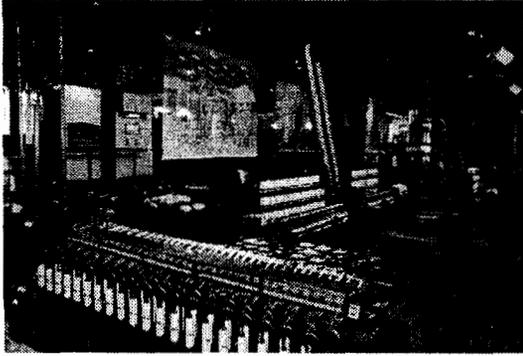


Figure 1: Fibres, Fabrics and Fashion Gallery, Copyright Museum of Science and Industry in Manchester

This gallery was chosen for a number of reasons; although it was a new gallery little had been added to the interpretation of the large textile machines, which are located in the center of the gallery. During school holidays and weekends, the textile machines can be seen working at designated times. Therefore, for most of the time during weekdays, they are inactive and interpretation is limited to a simple text panel with few words and a black and white photograph. The viewing platform is a raised area with the textile machines in the central lower level.

Research Method

The research followed the established methodology of Front-End Analysis, Formative Evaluation and Summative Evaluation. Front-End Analysis takes place before an exhibit is developed to identify the current strengths, weaknesses and visitors requirements. Formative Evaluation takes place as the exhibit is being developed, and is used to assess visitors opinions and refine the exhibit whilst under development. Summative Evaluation is used to measure the impact of the exhibit once completed on visitor's experience (Economou, 1997, Hooper-Greenhill 1996, Miles 1994).

Stage One: Front-End Analysis

Before the design and development of the interactive multimedia application could commence, front-

end analysis was undertaken to identify the strengths and weaknesses of the gallery and potential areas in which the portable computer could compliment the existing interpretation. Findings were used from a previous major visitor survey commissioned by the museum as an aid to the design process (Fisher 1995), together with opinions and ideas based on discussions with the gallery curator, museum demonstrators, the in-house interactive's designer and personal observations from the researcher and the co-author of this paper. Analysis revealed that visitors preferred to see textile machines working as it was difficult to visualise this process, there was little in the way of interpretation on site and no context for the textile machines, for example the textile mill itself, workers, processes or finished products. Therefore it appeared that visitors left the gallery with little additional knowledge. The absence of any additional interpretative material provided a highly appropriate site for the research project and an ideal situation to test a portable computer.

Stage Two: Interactive Design & Development

A multimedia application was designed and developed for the portable computer which would not only illustrate each of the textile machines working via a touch screen, but also placed them in context. This included the textile mill where they operated, the workers who operated them and the stages associated with the processing of cotton from a raw material into a finished fabric. The computer application used archival images of a textile mill of the period, structuring the application to mirror a working mill with different room sets. The same textile machines that are exhibited in the museum gallery were used in the application.

The use of a positioning system to make the computer aware of its location and thus able to provide information based on the visitor's location was considered. However this was not feasible due to technical and budget restraints and an alternative means of visitors navigating the gallery and the application was devised. Existing text panels in the gallery were used as location points and matched the corresponding room names in the interactive multimedia application on the portable computer, thus the structure of the application matched the layout of the textile machines in the gallery and the textile mill.

A map of the gallery was included in the application to provide an additional aid to navigation. Visitors could touch the on screen map where they were standing, thus locating themselves within the

gallery and accessing the corresponding section of the application. This was essential if a visitor was unable to locate the text panel in front of them describing that particular room. The application was designed so that as the visitor started using the computer they would have to complete the instructions before they could access the main application. Instructions were available at any time via a help system. An introductory section describing how the cotton was transported from the field to the mill was also included. The structure of the application was documented using a flowchart.

It was vital that the computer application was designed to be easy to use and visually appealing to the museum visitor. It was therefore decided to implement a discovery-based interface; each major section of the application was represented by an illustration of a room in the textile mill with their appropriate machines, people and objects. Each element on the screen acted as a hot-spot, which when touched linked to supplementary information on the chosen topic.

The main navigation into each room was represented with buttons at the bottom of the screen, one for each of the rooms in the mill. These corresponded with the interpretative text panels in the Fibres, Fashion and Fabric Gallery. There were two additional buttons, one for the help system and one for the gallery map. To compliment the theme of the textile gallery the multimedia application used a fabric texture as a background. The buttons at the bottom of the screen which were used to access the different mill rooms within the application looked like 'real' buttons, which had been stitched onto the background. The visual design of the application screens was documented using storyboards.

Once the design had been finalised in the form of a flowchart and storyboards, media acquisition and creation took place before the authoring of the interactive multimedia application. One of the major problems faced in the creation of this application was that some images required were unavailable due to copyright restrictions. Therefore, a large amount of the media content had to be created from scratch. The final application was authored using Macromedia Director, with images manipulated using Adobe Photoshop and video edited using Adobe Premier.

Stage Three: Formative Evaluation

With any multimedia software development it is crucial that a prototype is tested by the target audience, to gauge their reaction and incorporate

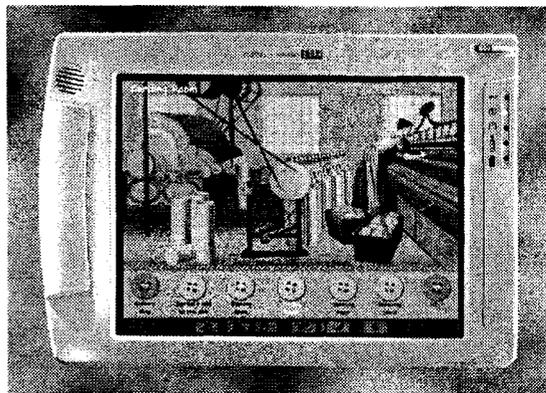


Figure 2: Screen from the Interactive Multimedia Application

feedback into the final application (Economou 1997, Raphling 1994). The interactive multimedia application developed for this research project was tested by multimedia developers based at the University of Salford, who were shown the prototype at an early stage, in order to gain feedback from other experienced multimedia designers. During its development, the prototype was also extensively tested with different user groups including general museum visitors and museum staff. Feedback was obtained via informal discussion and observation. A usability test where by visitors in the gallery were asked to use the portable computer for a short time and then asked specific questions was used to clarify user friendliness of the interactive multimedia application and at the same time to establish opinion on the portable computer. Again, observation and informal conversation provided feedback. Such testing continued throughout the development stages of the prototype with refinements and adjustments made as appropriate.

In addition the gallery curator, demonstrators and interactive designer also tested the application during the design stages and after completion of final revisions to check that the program material and context was correct. Not only did this confirm the quality of information but also enabled the in-house curatorial team to gain a clearer understanding of the portable computer's potential as an interpretative tool.

Stage Four: Summative Evaluation

Triangulation of research methods with a range of data collection techniques is often advantageous as each approach can compliment the other and reveal insights that a single method alone would be unable to do (Allan and Skinner 1991, Veal 1992,

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Yin 1993). Thus a multi-method approach, combining pre-visit and post-visit questionnaires, structured unobtrusive observation and interaction log recording were used to gather both quantitative and qualitative data.

Questionnaire Survey

In order to assess the impact of the portable computer on the visitor's experience and learning, it was necessary to pre-test the visitor's knowledge and experiences prior to their visit so that changes (if any) could be measured. Visitors were questioned both before and after they visited the study area with a series of open-ended questions. It was perceived that visitors learning could be measured and their opinions on the gallery could be recorded. Visitors were shown a photograph of a textile machine both before and after their visit and asked to identify it and the process it performed. Additionally they were asked to recall processes which took place in the textile mill. Both groups were also asked their opinions of the gallery, including most and least liked elements. Visitors from the computer control group were asked additional questions on their opinion of the computer and the impact, if any, it had had upon their visit and their knowledge of textile machines and processes.

Observation

Visitors were observed unobtrusively as they explored the gallery, because it was important not only to test how using a portable computer effected their learning and experience, but also how it effected their behavior whilst in the gallery. Typically observations can record the frequency and/or order of behaviors, however for this study, it was felt that it was the duration of individual behaviors, which was most important. The researcher therefore used a second portable computer with an application designed to assist the observation. An preliminary observation was undertaken in the gallery to identify the behaviors exhibited by visitors, these behaviors were recorded and used as the basis to construct the observation application.

The application was designed so that the observer would see a visitor exhibit a particular behavior and would then touch the appropriate button on the screen, then when a different behavior is exhibited the observer would touch that button on the screen. The observation program was designed so that it would record each behavior to the nearest second and would save the file in a format, which could be imported, directly into a spreadsheet for analysis. By reducing the time the observer had to look away from the subject and re-

moving the need to calculate and record the duration of individual behaviors, the accuracy of the data gathered was significantly improved.

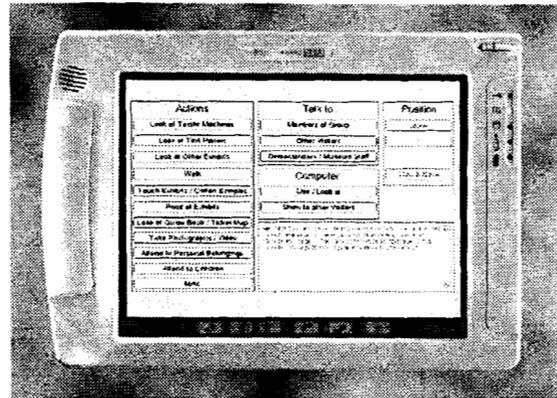


Figure 3: The Observation Application

Interaction Logs

A problem, which arises when trying to evaluate an interactive multimedia application, is analyzing how the visitor is interacting with the application. This is difficult to achieve without standing next to them for the duration of the observation, which was impractical and would clearly affect the visitor's behavior. Therefore an interaction log facility was incorporated into the application, this recorded every section the user accessed and how long they were on each screen to the nearest second. It was hoped this data would be useful for identifying which sections of the application were most popular with visitors and aid understanding of how they used the application. As with the observation application data was saved in a format that could be directly imported into a spreadsheet for analysis.

Research Sample

Two groups were used in the study, a control group of 50 adults who experienced the gallery naturally and a second group of 50 adults who experienced the gallery using the portable computer using the interactive multimedia application. All were selected randomly and asked a series of questions on entry and exit, and observed during their visit in the designated area of the gallery. Due to the fragility and expense of the portable computer, it was decided to exclude visitors below the age of 16 years. All organized tour groups and lone parents with young children were also excluded.

The study took place within the raised area of the gallery, which overlooks the display of textile ma-

chines situated on a lower level in the central area. The first visitor to enter the raised area was approached and asked if they would be prepared to participate in the research. If they agreed, they were asked a series of questions, and left to explore the gallery in their own time. At this point, visitors from the computer group were given the portable computer. Visitors were observed during this time and asked another set of questions before they left the gallery. Once the post-visit questionnaire has been completed the next visitor to enter the study area was selected and approached.

With any evaluation project it is important to conduct a pilot study to test the research methodology. To this end a pilot study was undertaken with both visitors from a control group and those using the computer. The pilot study revealed that slight refinements were required for some questions to aid visitor understanding and that revision should also be made to the observation application to improve usability by the researcher. The pilot study was used in addition to develop codified answer categories which simplified the data entry phase significantly and was also useful in practising procedures and timing of the survey.

Summary of Preliminary Findings

This section will summarize the preliminary findings of the research and includes data from each of the research instruments.

1. Recognition of textile machine and process

Before entering the observation area 74% of visitors from the control group and 52% of visitors from the computer group could correctly identify the textile machine and the process it performed from the photograph shown to them. After their visit 82% of visitors from the control group (8% increase) and 70% of visitors from the computer group (18% increase) could correctly identify the textile machine and the process it performed.

2. Visitor recall of processes within the textile mill

The average number of processes which could be recalled by visitors from the control group before their visit was 2 rising to 3 after their visit. However for the computer group the average number of processes recalled increased from 2 to 4 after their visit. A significant change was also found in those visitors who were unable to recall a single process. In the control group 15 visitors were unable to name a process pre-visit, this fell to 10 after

their visit (10% reduction). However for the computer group, 14 visitors were unable to name a single process pre-visit, this fell to just 1 following their visit (26% reduction). The textile processes most frequently recalled by both the control and computer groups were Spinning, Weaving and Carding.

3. Visitors Opinions of the Fibres, Fabrics and Fashion Gallery

The favorite element of the gallery for both groups was the textile machines, and the least popular aspect was that the textile machines were not working.

4. Visitors Opinions of the Portable Computer

When questioned over 90% of visitors from the computer group expressed the opinion that they had enjoyed using the portable computer and that it had been easy to use. The touch screen was identified by 56% of visitors as significantly contributing to ease of use. Other elements mentioned positively regarding ease of use were the flexible and straight forward structure of the application, clear buttons, help system and the location map.

The Videos/Animations were the most liked feature of the multimedia application, being identified by 44% of visitors. Also mentioned positively was the access to information, ease of use, visual screen design and audio narration.

The least liked aspect of the portable computer was that it was too heavy, as identified by 46% of visitors. Few visitors commented that they thought the computer distracted from the exhibits. However 84% of visitors expressed the opinion that they had explored the textile machines in more detail using the computer, and 92% that they had learnt more using the computer than they would have done otherwise.

5. Observed Behavior

Members of the control group spent an average of 12min 45sec in the gallery, however visitors who used the computer spent on average 3min longer in the gallery. Members of the control group spent the majority of their time away from the raised area looking at other exhibits, whereas the computer group spent the largest proportion of their time within the raised area, using the portable computer. Both groups spent approximately the same time looking at the textile machines.

6. Interaction Logs

Analysis of the Interaction logs revealed that on average visitors spent approximately two minutes reading the instructions, with 6 visitors later consulting the help section, each for just under 1 min. It was also found that 14 visitors accessed the gallery map, each for approximately one minute to assist them in identifying their position with the gallery. Over 80% of visitors accessed the videos/animations of the textile machines, with visitors accessing on average 35% of the entire interactive multimedia application.

Conclusion

The preliminary results of the GEMISIS research project described in this paper indicate that portable computers are popular with visitors, enhance their learning and increase the time spent in the gallery. The project's aim was to design an application and test the viability of a portable computer to enhance interpretation and aid learning in museums. It was not intended to provide a definitive answer or indeed provide the ultimate test model for a sophisticated interpretation application. The research has provided a fascinating insight into a little understood application of new technology and provided new knowledge in the visitor's use of computers in a museum environment. As Screven indicates 'the general impression that learning is taking place at or around computers (and other interactive/manipulative devices) may simply be reflecting their ability to attract and sustain attention not learning' (Screven 1990). Care must be taken when drawing conclusions.

Typically, the findings of this research project have opened up further avenues of exploration, and should become a prime research agenda. If the potential of using portable computers for interpretation is confirmed by additional research then museums will need to carefully consider practical issues, the cost of the computer and software development, the robustness of the computer and the potential risk of damage or theft. These factors may slow the introduction of portable computers, but as equipment becomes more powerful and more affordable this situation may change.

Early indications are that portable computers are a promising and effective interpretative medium for the future of museums. They will provide a professionalism of approach that is both user friendly and at the leading edge of technology and interpretation. As a consequence, interpretation will take on a whole new meaning as static exhibits

are animated and visitors facilitate their own pace of discovery based learning.

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