Creating a Virtual Tour Design Guide for Museums with the Centre for Accessible Environments

An Outline of Inclusive Recommendations for Virtual Tour Creation

An Interactive Qualifying Project in partial fulfillment of the requirements of Worcester Polytechnic Institute submitted to:

Professor Rick Brown
Professor Scott Jiusto

Submitted by:

Cathryn Bedard
Jason DuBois
Scott Lehtinen
Brian Loveland

Project Center: London, United Kingdom
Term: D06
Sponsoring Agency: The Centre for Accessible Environments
Project Liaisons: Ms. Cassie Herschel-Shorland
Mr. Paul Highman

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Executive Summary

Museums in the United Kingdom are vital centers of historical, cultural and scientific learning that serve millions of visitors from the UK and around the world. Unfortunately, many of these museums are not fully accessible for all disabled people, due to physical, sensory, and intellectual barriers that can inhibit intended educational and inspirational experiences. In response to barriers at public facilities, the Disability Discrimination Act 1995 and 2005 were created to require public buildings to be accessible for disabled people. This includes overcoming access barriers that can hinder the quality of the experience for any visitors. New technologies, including virtual tours, offer alternative means for society to experience museums, and are often used as means to extend the museum experience to those who could not previously experience it due to access barriers. However, museums must be conscious of and avoid new barriers that can be created by these high-tech solutions. In addition, several smaller museums do not have the financial or personnel resources to implement changes to make the museum accessible for disabled people.

The Centre for Accessible Environments (CAE), a nonprofit organization in London, assists organizations in finding access solutions for their buildings. They work to improve access by providing access training and consultancy services, as well as publishing best practice guidance manuals. Their underlying goal is to provide recommendations for access improvements in buildings, and to promote inclusive design, which is the idea of considering access barriers through design, rather than adding them on.

Implementing any extensive access options in smaller museums normally requires the assistance of an outside consultant and extensive financial commitment. However, many small museums have limited budgets that do not allow for such access developments. Additionally, some do not have the option of implementing physical improvements due to the historical significance of the building. Virtual tours can provide an alternative access option, without significantly altering a museum. Furthermore, virtual tours provide a museum with additional options for making their information available in different and creative ways, such as interactive media to enhance the educational experience which is provided. However, if the needs of users are not considered, virtual tours can create new barriers that hinder access. This project has developed a guidebook that outlines a method for creating and designing inclusive virtual tours, allowing museums to be more self-sufficient and selective when using outside help, and thus decreasing the cost of creation.

The outcome of this project was the development of the *Museum Virtual Tour Design Guide* for museum staff. We focused the guidance for small museums with limited resources, to allow them to improve accessibility through the use of a virtual tour, while minimizing costs. The guidebook stresses several ideas to ensure the virtual tour is accessible, specifically web accessibility, computer presentation, and ergonomics, all of which extend CAE's mission to create inclusive access.

The process that is used in the guidebook for the creation of a virtual tour is presented in a clear methodical fashion. The guide walks museum staff through five overall planning considerations that can be seen in Figure 1. Each section is presented with recommendations to consider through each stage of creating a virtual tour. The guide format is based on CAE's house style with the goal of user friendly design. Presenting the information in short paragraphs, charts, and bulleted design ideas makes the process clear and simple for the reader. The

guidebook helps the reader through several decisions while making their tour, for example what to include in it and how to arrange it. Recommendations in the guide are based upon information from interviews with professionals in fields relating to museums, access, and virtual tour creation. These ideas were integrated throughout the guidebook to ensure inclusive features that allow all users to experience a virtual tour.

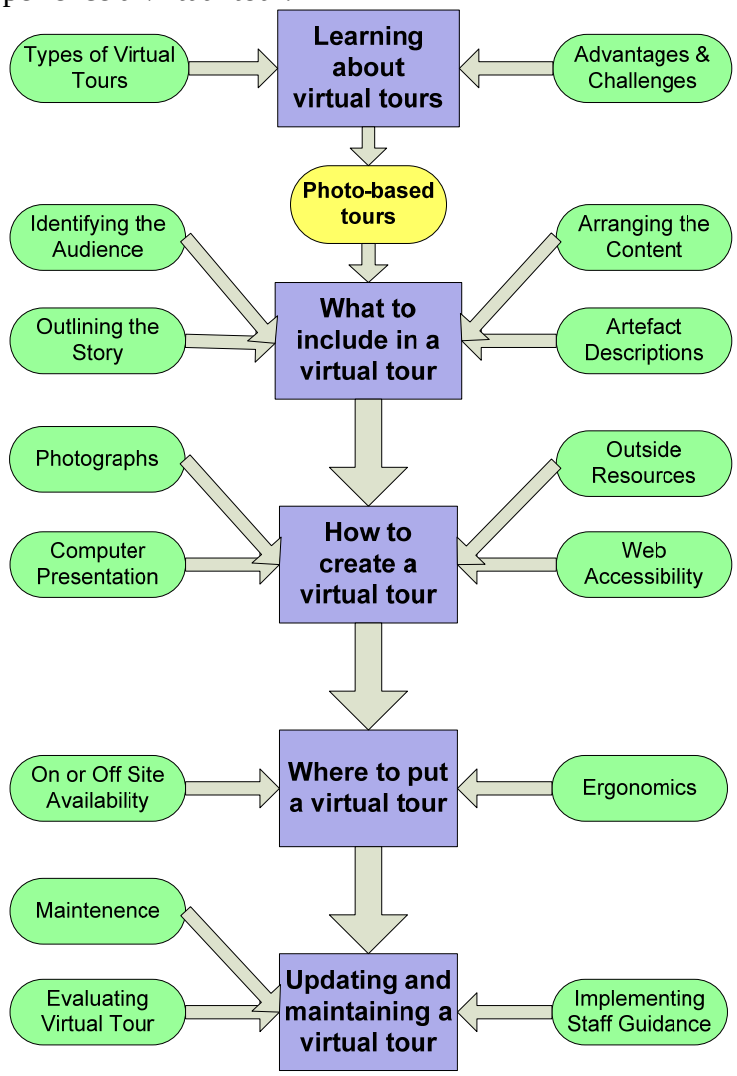

Figure 1 - Museum Virtual Tour Design Guide outline.

The first section of the guidebook, entitled 'Learning about virtual tours', introduces virtual tours, highlighting their potential to increase access and enhance educational opportunities. The reader is introduced to five different types of tour – text-based, photo-based, panoramic, video, and real-time virtual reality – as well as many important design options and considerations through examples and active links with exemplary virtual tours of other UK museums. The guidebook recommends that museums with limited resources develop photo-based virtual tours, due to the balance of simplicity, low cost, and educational effectiveness they offer. The assistance throughout the rest of the guidebook is based on photo-based tours, although much of the guidance is still applicable to the other types of tours. Figure 2 summarizes the benefits that museums receive from creating a virtual tour.

Category	Benefit of a Virtual Tour
Access	provide alternate access to listed or small museums by showing objects in rooms with limited access
	allow the user to explore with alternative formats including audio descriptions, enhanced visual aids, screen readers and British Sign Language (BSL)
	provide a closer, adjustable experience of objects that are roped off or sometimes overlooked by visitors
Education	provide a tool for use with school curriculum as an educational reinforcement and teaching supplement
	assist in the goals of life learning
	include additional information or references which are not available at the exhibit
	allow a personally paced learning experience which may be inhibited in the museum by other visitors moving through the exhibits
	provide a resource that can be personalised for the users' preferences or needs (language, font size and audio options)
	allow the user to focus on items of interest rather than going through a tour of the entire building
	allow an interactive experience to further understand certain artefacts either prior to, during or after visiting the exhibit
Artefact conservation	protect the original unique artefacts by reducing wear from handling or lighting
	allow access to artefacts in storage, due to limited space on-site

Figure 2 - Advantages of a Virtual Tour

The 'What to include in a virtual tour' section of the guidebook assists museums in identifying the proper content to be included in their virtual tour. Museum representatives are experts at identifying essential information and content in their museums. Therefore, this process discusses how to integrate the interpretive experiences of a museum visit into a virtual tour by using images and text descriptions in proper arrangement. This section is set up with several questions to assist museums with the process. For example:

- Who will use the virtual tour?
- Is the tour aimed at any specific age groups?
- What is different about the museum in comparison to most others?
- What is important or unique about the particular artifact?

These questions will assist a museum in identifying their audience and outlining the story they are trying to tell, which should help them determine the content to include in their virtual tour, producing the best possible experience for the user. The guidebook acknowledges that it is impossible to create a virtual experience with the same "wow-factor" as the real experience of a museum visit. However, a museum can use a virtual tour to provide an enhanced educational experience, through communicating additional information not provided elsewhere in the

museum. This is an alternative focus from attempting to replace the physical experience, and allows for the virtual tour to excel in an area where the physical museum visit may be lacking.

In the next section, 'How to create a virtual tour', the guidebook discusses the implementation stage of the tour, including organization and presentation of content. This involves ensuring that the tour meets specific standards for accessibility, and following recommendations on the presentation of content in ways which remove sensory and intellectual barriers. The importance of these ideas are emphasized in the guidebook, where it suggests designing according to the web accessibility standards and exploring user testing methods to ensure inclusive design of the virtual tour. Figure 3 shows recommendations on the presentation of content in virtual tours.

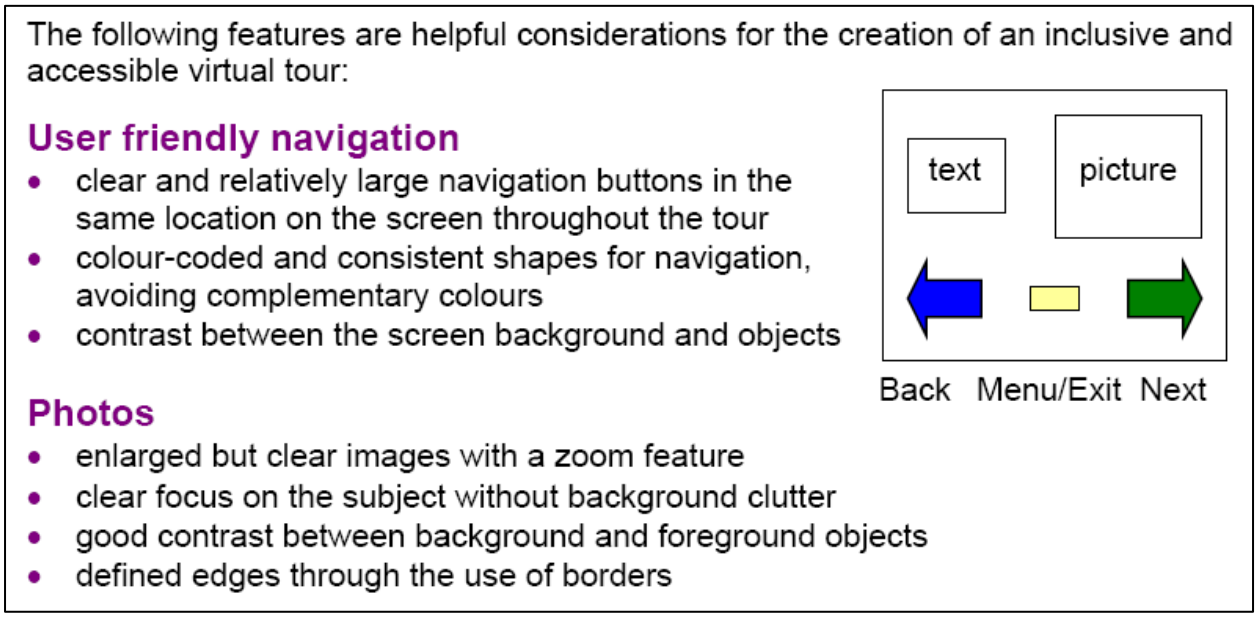

Figure 3 - Computer Presentation Recommendations

Technology requirements are also discussed to provide museums with knowledge on the necessary equipment to obtain photographs and software for web authorship. Extensive resources from other organizations are also provided, on topics such as audio descriptions and finding a web designer.

The guidebook concludes by discussing where to put a completed virtual tour as well as regularly maintaining and updating it. Considerations for the location of the virtual tour are also presented, specifically if the tour should be available on the internet or on location in the museum. For museums placing the tour on-site, guidelines for the ergonomic qualities of a workstation and additional references are provided so they can create a computer station that is accessible to all users. The last step is the recommendation for regular updating and maintenance of the virtual tour, including receiving feedback from users and acting upon it. Finally, the appendix includes extensive resources, including various disability organizations and resources that provide guidelines for or help improve access.

After completing the guidebook, it was tested and revised to ensure that the information presented was user friendly and clear in its recommendations. Revisions were completed based on feedback from the CAE staff. This resulted in refocusing and reorganization of the original drafts through pushing the guidebook to have specific steps, rather than simply presenting information. As part of the conclusions in the report, recommendations for CAE are provided

for upkeep and use of our guide, including integrating feedback. The guidebook will be located on CAE's website as a printable PDF with active links, allowing the guidebook user to explore further information and references which the guidebook provides. In addition, the September 2006 issue of CAE's journal, *Access by Design*, includes an article on the guidebook to make museums aware of its availability.

The *Museum Virtual Tour Design Guide* allows for new possibilities for museums to make their exhibits available to all users. However, if not properly developed virtual tours can impose new barriers causing more disadvantages then assistance to some individuals. This guidebook gives museums information on the surrounding issues related to a virtual tour, rather than simply the technical knowledge to create one. This allows museums to use a virtual tour to not only provide a new access option, but also an increased educational experience for all users, allowing them to fulfill their historical, cultural and scientific role in society.

Abstract

This project, completed with the Centre for Accessible Environments (CAE), involved the creation of a guidebook that assists museums in the United Kingdom in creating a virtual tour, to enhance their accessibility and the educational experiences they provide. Through on-site research and interviews with professionals of museum access and virtual tour design, we developed a low cost process for small museums with limited resources. This project assists CAE in their mission to enhance accessibility through the use of inclusive design.

Acknowledgements

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Table of Contents

Table of Figures

Table of Tables

Table of Authorship

	Primary Author(s)	Primary Editor(s)
Executive Summary	Cathryn, Brian	Cathryn, Brian, Scott
Abstract	Scott	All
Acknowledgements	Cathryn	All
Chapter 1: Introduction	Scott	Cathryn
Chapter 2: Background		
2.1 Centre for Accessible Environments	Scott	Cathryn, Brian
2.2 Disability Discrimination Act	Brian	Cathryn
2.3 Disabilities in the UK	Cathryn	Brian
2.4 Museum Education and Interpretive Experience	Cathryn	All
2.5 Learning Style Incorporation	Cathryn	All
2.6 Societal Value of Museums	Cathryn	All
2.7 Technological Implementation	Jason	All
2.8 Web Accessibility	Brian	All
2.9 Virtual System Setup	Jason, Cathryn	All
2.10 Other Works on Museum Access	Brian	All
2.11 Summary	Cathryn	All
Chapter 3: Methodology		
3.1 Identifying Museum Accessibility Issues in the United Kingdom	Cathryn	Brian
3.2 Interview Process	Cathryn, Brian	All
3.3 Virtual Tour Process	All	Cathryn, Brian
3.4 Implementing Interpretive Experiences	Cathryn	Brian, Scott
3.5 Design and Test Virtual Tour Guidebook	Brian	Cathryn
3.6 Summary	Cathryn	All
Chapter 4: Results and Analysis		
4.1 Interviews	Brian	All
4.2 Feedback	Brian	All
4.3 Revisions Based on Feedback	Brian	All
Chapter 5: Guidebook		
About this guide	Cathryn	Cathryn
Process outline	Scott, Cathryn	Cathryn, Brian
Overview of virtual tours	Jason, Scott	Cathryn, Brian
What to put in your virtual tour	Scott, Cathryn	Cathryn
How to make your virtual tour	Cathryn, Jason, Brian	Cathryn
Where to put your virtual tour	Scott, Jason	Cathryn, Brian
What to do with your finished virtual tour	Brian, Cathryn	Cathryn
Appendix: Additional resources	Brian, Scott	Brian, Scott
Chapter 6: Conclusion and Recommendations		
6.1 Recommendations for Museums	Jason	All
6.2 Recommendations for CAE	Scott	All
Appendix I: Americans with Disabilities Act	Scott	All
Appendix II: Interview Plans	Cathryn	All
Appendix III: Guidebook Feedback Questions	Brian	Cathryn, Scott
Appendix IV: Other Physical Access Implementations	Jason	All
Appendix V: Detailed Timeline	Brian	Brian

Chapter 1: Introduction

Discrimination laws have been implemented worldwide to promote equal opportunities for all people in society. In the United Kingdom, the Disability Discrimination Act (DDA) requires all public places to provide equal opportunities and experiences for the whole community. However, these guidelines are often left open to interpretation and thus a wide range of options for improvements exist. Possible developments include physical changes made to public places as well as the addition of supplemental features specific to certain disabilities. Improvements in technology have furthermore created greater expectations for access improvements. A virtual tour is a relatively new tool that can be used to meet certain access requirements. It can be set up on a computer in a way that allows the user to interactively view artifacts or information without actually being on-site. However, knowledgeable guidance is needed for proper and effective creation of an engaging and inclusive virtual tour.

Many museums in the United Kingdom are included amongst the public buildings that need access improvements. As areas of high social interest and learning opportunity, it is especially important for museums to be accessible for all visitors. While most large museums already have virtual tours of their exhibits, many small museums have limited finances and staff which have prevented them from implementing this important educational feature. Small museums often also have small rooms and narrow passageways which hinder accessibility; these cannot be improved without destroying the historical significance of the building. Therefore, virtual tours can be a valuable resource and access tool for small museums. Virtual tours not only provide a learning supplement and access option for people with disabilities; they also increase the educational outreach of museum information. The creation process, however, can be complex and expensive. Therefore, a low cost alternative for a high quality and inclusive virtual tour would be very beneficial to small museums.

Many organizations have provided helpful information and recommendations for museums in order to improve access options through building design. The Centre for Accessible Environments (CAE) is a charitable organization registered in 1976 that has been working with museums by suggesting access options to meet the requirements of the DDA. CAE provides guidebooks and recommendations to buildings in the United Kingdom that emphasize the idea of inclusion by design. This suggests that buildings should be designed to be accessible and welcoming for all disabled people. Several other organizations have been assisting in the research and analysis of possible access solutions. The Scottish Museum's Council, for example, provides access audits through a list of questions to determine how well a specific museum is equipped to provide for different types of disabilities. The Museums, Libraries and Archives Council (MLA) also participates in work to create better accessibility in museums. The MLA has published guides to assist museums in creating better access for all. The guides discuss several topics on accessibility ranging from new technologies to low cost options. These ideas are similar considerations that are necessary for virtual tour creation.

While much research has been done on the topic of disability access, there is still a need for consistent and easy to access information for museums. Ionides (2005) demonstrates that, "universal inclusion and multi-sensory design for exhibitions and displays is not understood or taken into account by most exhibition designers. People with sensory disabilities are not included in the main design of facilities". Through a MLA study in 2005 on website accessibility in museums and libraries, it was found that 58% of the websites failed to meet basic

web accessibility requirements. These results suggest that there has been a lack of research and guidance provided for museums regarding web accessibility and that barriers still exist. Currently, in relation to virtual tours, museums hire a consultant to assess their facility and establish what content needs to be included. This is a very involved process that is expensive. Museums often are unaware of all the resources available that could help them identify certain features and content that could be included in a high quality virtual tour. Therefore, proper guidance is a perfect way to allow more museums to take advantage of this educational opportunity.

The goal of this project was to assist CAE in guiding museums through the creation process of an accessible virtual environment. The final deliverable of the project was a set of recommendations for museums to create an accessible virtual tour, the *Museum Virtual Tour Design Guide*. The guidebook was created for museums to help identify proper content and presentation. In order to develop the guidebook, our group gathered information from interviews with museum staff members, designers, and disability organizations. It was found that many museums are unaware of the various disabilities of their visitors as well as the advantages of a virtual tour. The guidebook allows museums to understand the need for an inclusive visit and how to implement access features into a virtual tour. The guidance is aimed at the staff of small museums with limited budgets so that they can take advantage of this technique for improving accessibility and educational experiences of the museum.

Chapter 2: Background

The process of developing public buildings to be accessible for disabled people is continuous. Improvements have been implemented in many different ways removing a wide range of physical, sensory, and intellectual barriers. However, most efforts have been focused on improving the workplace and public transportation. Discrimination policies such as those found in the Disability Discrimination Act in the United Kingdom have extended these guidelines to museums worldwide. The Centre for Accessible Environments (CAE) has taken on the task of assisting museums in their journey through recommendations for renovation of their programs, museum layout, and special features. Computer based programs have opened new possibilities for better communication and access to museum exhibits, which focuses our project on the concept of virtual tours. Museum barriers are often generalized and misunderstood as merely those that affect visitors with mobility impairments. However, different sensory and intellectual barriers require different accommodations for access and learning. This section discusses the guidelines of the Disability Discrimination Act along with CAE's mission statement. The present access issues of museums in the United Kingdom are analyzed as well as web accessibility and case studies. The background information is discussed as a supportive means to make museums more accessible for the disabled community through of the use of modern technology for virtual access.

2.1 Centre for Accessible Environments

The Centre for Accessible Environments (CAE) is a nonprofit organization founded in 1969 to assist in the creation of equal experiences for the public using their theory of inclusion by design. This theory contains the idea of buildings being designed in a way that does not include barriers that limit the experiences of disabled people. CAE works with organizations throughout the United Kingdom to revise buildings and bring them up to code with the Disability Discrimination Act (DDA). The organization became registered as a charity in 1976 and is funded by consulting on the design of new buildings that must be created with the idea of inclusion by design. CAE is also funded by training programs, membership fees and donations. The main goals of this organization are focused on creating accessibility improvements while considering all disabilities.

The Centre for Accessible Environments' recent projects include working with museums to make necessary access improvements. They have access consultants who help organizations in the United Kingdom that need to be improved to follow the DDA. The Centre has assisted the London Development Agency and the Historic Royal Palaces to help with access remodeling. They have also worked with the Royal Institute of British Architects in promoting inclusion by design. Several published handbooks include *Designing for Accessibility* and *Good Loo Design Guide*. CAE assists organizations by guiding them in the creation process of accessible environments for disabled people. The Centre also runs training programs to teach the public about the accessibility issues that the United Kingdom is trying to improve upon. Their goal is sharing their technique of improving access options with businesses and museums to allow for equal opportunities.

2.2 Disability Discrimination Act

Although the Centre for Accessible Environments has been around since 1969, the first law requiring disability access in public places was made relatively recently in 1995. Parliament in the United Kingdom passed the Disability Discrimination Act which required all public places to provide access for disabled people. The act had a gradual deployment period, requiring full compliance by 2004 (Acts 1995). However, many museums, particularly smaller ones, have not had the necessary resources to allow for updated improvement. Additionally, many museums could benefit from more knowledge about different disabilities and how prevalent they really are in the United Kingdom. In 2005, a new version of the Disability Discrimination Act was passed, which was primarily a revision of the 1995 act. With the passing of the DDA, the Centre for Accessible Environments' importance has been heightened as it helps organizations, including museums, to comply with the requirements.

2.2.1 Disability Discrimination Act History

The 1995 DDA defines a disability as "has a physical or mental impairment which has a substantial and long-term adverse effect on his ability to carry out normal day-to-day activities" (Acts 1995). The 2005 act changes the definition to include people with medical disabilities such as HIV and cancer (Williams 2005). This is important because museums must be aware of who they must accommodate, to an equal level of every other patron, by the law. In addition, the 2005 act requires all "public authorities" to implement the "Disability Equality Scheme", which requires a disability access plan, as well as annual reports of the steps that have been taken to comply with the DDA. There are several museums listed in the act who must comply with these regulations, including The Museum of London and The Science Museum (Acts 2005).
In 1999, the Disability Rights Commission Act was passed to create the Disability Rights Commission (DRC), for the purpose of advising the UK government on the status of the Disability Discrimination Act legislation. The Disability Rights Commission continues to publish reports on the status of the DDA, including *Monitoring the Disability Discrimination Act (DDA) 1995*, in February, 2004. In addition, they publish various specific reports, including *The Web: Access and Inclusion for Disabled People,* which covers webpage accessibility for disabled people. The DRC is also the organization with which a complaint can be filed regarding a violation of the DDA. Therefore, museums need to be aware of the expectations the DRC sets in all respects, including virtual access.

2.2.2 The Disability Discrimination Act and Museums

The majority of the Disability Discrimination Act does not affect museums, but is rather written as a guideline for employers. A large part of the act concerns Part II, "The Employment Field" and Part V, "Public Transport". Although the museums have to comply with Part II of the act in terms of their own employees, that is not within the scope of this project. The primary section that concerns museums and their accessibility for disabled people is Part III, "Discrimination in Other Areas". The museums clearly fall under the section of "access to and use of any place which members of the public are permitted to enter" (Acts 1995).

The DDA requires "service providers" (the category of which the museums fall under) to provide "reasonable adjustments" to allow accessibility by disabled people. The DDA proposes

several solutions for providing equal access for disabled people, when there is a physical feature (such as a stairway) that prevents this idea:

a) remove the feature;
b) alter it so that it no longer has that effect;
c) provide a reasonable means of avoiding the feature; or
d) provide a reasonable alternative method of making the service in question available to disabled persons. (Acts, 1995, 35)

Particularly in the museum setting, the first three options are often unreasonable in terms of cost and the affect on the museum experience. In addition, some museums in historic buildings are locations which are considered "listed", where physical modifications can not be made by law (Department for Culture 2006). Therefore, the preferred method for museums is to implement option (d), of providing the same service in an alternative way. An ideal choice, being a virtual tour, is not only a new alternative, but can allow more access without physically changing the museum itself. There is nothing strictly specified in terms of what alternative methods are acceptable. The decision of whether or not the alternative method is acceptable is at the discretion of a disabled person, who has the right to take the museum to court over the matter.

2.3 Disabilities in the UK

Physical, sensory, and intellectual disabilities are prevalent worldwide. This proposes the need for recognition and removal of potential barriers in museums for disabled people. Recently in the United Kingdom, 157 thousand people registered as blind. As of March 2004, about 55 thousand people registered as deaf, and another 159 thousand people appeared on the register for having hearing impairments. All statistics reported represent a rising trend in the number of people reported in the United Kingdom having disabilities. This information only further supports the heightened need for improved accessibility options.

The population in the UK is represented by a substantial number of elderly citizens, as 21% of the population reported in the last census in 2001 was over 60. When considering the nature of hearing, sight, and mobility disabilities, it is important to look at the elderly population for these factors tend to increase with age. Additionally, it should be mentioned that the mortality rate has been decreasing leading to an increase in the aged population. According to the National Statistics report in March 2003, "Since March 2000 the number of blind people on the register has risen in most age groups. The largest growth was in the number of people on the register aged 50-64, which increased by 9% to 14,500" (National Statistics 2003). Similarly, in March 2003, 63% of the people registered with hearing impairments were of ages 75 and over (Department of Health 2004). It is important to cater to the needs of the elderly and remove barriers that hinder their experiences in life. Furthermore, it is their right to be able to enjoy museum opportunities especially after many have worked for most of their lives and have paid taxes that lead to museum funding. This idea of paying taxes also provides legal justification for ensuring that the whole community can have access to learning opportunities. It is important therefore, to incorporate the needs of disabled people as well as elderly people into the design of accessible options for museums.

2.4 Museum Education and Interpretive Experience

The goal of museums is to present a collection of artifacts for research and life learning to allow an experience that scholarly works cannot offer in the same way. This type of experience cannot be described easily, as personal perceptions depend on visitor disposition, museum setup, and atmosphere among other factors. However, technological advances have allowed a wider range of options for museums to present their material and educational services to the public. Museum websites, digital image repositories, and computerized databases of artifacts have all provided ways to make information more accessible to the community. These advances allow better collaboration of resources and museum efforts to better support educational interests (Marty 1999). These innovative technologies expand the ways that information is presented and therefore touch upon different learning styles of visitors more then ever. Virtual tours have also been successful in allowing those with physical and mental disabilities to access exhibits from their own homes. This feature is also advantageous for able-bodied people, for it can provide a supplementary learning tool and even additional information on exhibits or references for further education. In fulfillment of the Disabilities Discrimination Act, these technologies can provide people with physical or mental handicaps with improved access to allow them to get more out of museum visits.

Interpretive experiences of museums are the most important aspect to consider in museum education. As the American Association of Museums (AAM) Committee on Education states, the definition of interpretation to include:

- Interpretation is a dynamic process of communication between the museum and the audience.
- Interpretation is the means by which the museum delivers its content.
- Interpretation media/activities include, but are not limited to: exhibits, tours, Web sites, classes, school programs, publications, and outreach (AAM 2005).

This idea of a "communication" of the exhibits as a way to deliver a certain message to visitors is essential for the identification of interpretive experiences that need to be included in our project. The question of "how" concerns the setup and features of an exhibit, web site, virtual tour, etc. However, this is more involved than it sounds, as many factors such as access options, website access guidelines, user friendliness, and target audience all have to be considered for a successful system. Interpretation involves the developmental process that comes from research as well as interviews with museum staff, particularly educational coordinators. The AAM also emphasizes the importance of improvements ensuring that "appropriate technologies are used to expand access to knowledge and self-directed learning" (AAM 2005). Suggestive standards direct focus on the determination of content delivery through technology. This further supports the idea of virtual tours, and more specifically, the correct methods to integrate interpretations into a website.

2.5 Learning Style Incorporation

It is essential for museum staff to consider different learning styles of their visitors when presenting information both in relation to the construction of virtual tours and the layout of museums themselves. Most people that are college aged and older are primarily visual learners (Felder 1988). They are more likely to be independent in a museum and view items they feel are

important. Therefore, the importance of proper artifact presentation as well as inclusive museum and website organization is emphasized. People that are more intuitive, or auditory learners, favor factual knowledge and therefore would most likely be interested in reading about presentations and listening to tour guides or audio descriptions of the various museum pieces. Labels as well as facts presented about exhibits need to be clear and written at an educational level that most people (including children) can understand.

Visual and auditory senses are extremely important when considering learning styles as well as disabilities. When a person has an impairment of one sense, they are forced to rely on other senses to gather information (Felder 1988). Therefore, it is important for museum staff to present all artifacts in a way that does not discriminate against any style of learning. Virtual tours also need to address and overcome any barriers that can hinder the experience of disabled people by including various access features. Incorporating different types of presentation also provides an option for those who do not have the ability to choose how they learn because of an auditory or visual impairment.

The sensory qualities of museums as well as virtual tours can account for their success or failure to capture the interest of visitors. The way a museum makes people feel when they enter is largely influenced by the designers and architecture surrounding them. These features are essential for incorporation in a virtual tour to make the experience as realistic as possible. Anything from the colors and smells, to the organization and types of artifacts, create a unique environment for learning. Descriptive statements and clear complementary images of exhibits on virtual tours is the next best experience to going to the museum itself. Virtual tours can provide a better educational experience in some cases considering the ease of accessing information from any computer.

Within museums, the staff has the most effect on each visitor's view and experience. This reinforces the idea that limited access can be helped with the assistance of museum staff. Working with exhibition designers and recommending ideas with respect to DDA regulatory issues, more stringent guidelines for access can be derived. It is necessary for the staff to consider proper presentation and be skilled in museum design. Also essential is knowledge of access features for disabled people, as well as the importance of making all options known to visitors. A directory of artifacts is also a helpful tool for visitors that just want to learn about specific works without viewing the whole museum. Presentation of what museums have to offer as well as the quality of the objects and factual information are the most important aspects of a visit (Felder 1988). It is necessary for the same idea to be applied to a virtual tour so that the quality of the experience is exceptional.

2.6 Societal Value of Museums

When looking into the success of museums, it is important to consider their influence and popularity. A total of 7.4 million people live in the 610 square miles of London alone, making it a densely populated city (National Statistics 2005). London is the largest city in the United Kingdom and is one of the richest sites for history and culture in the world. The United Kingdom has a population of about 60 million people and is predicted to attract about 30 million tourists with the conclusion of 2006 (BBC News 2005). Some museums such as the Museum of London contain half a million years of history, attracting millions of people worldwide. Within its borders, the UK is the home of over 2,500 museums that attract over 80 million visitors annually. This means that over 30% more people than the size of the population of the UK take advantage of the educational opportunities of its museums annually (Museum Association 2005).

These statistics prove the significant value of history and culture among people worldwide and therefore set high expectations of museum experiences. This idea provides more of a reason for museums to implement better accessibility options for those with disabilities.

2.7 Technological Implementation

Many access improvements in museums include technological supplements for physical, sensory, and intellectual impairments. Each different specialized tool helps to enhance the experiences of those with disabilities by removing barriers and allowing learning techniques that cater to their specific needs. Although physical improvements to museums themselves are not the primary focus of this project, it is important to consider the options already implemented to understand the concept of access development. Virtual tours on the other hand, are our top interest for providing an accessible solution to museums with limited resources. They allow for physically impaired people to learn from a museum without having to leave their own homes. Also, web accessibility features allow for increased access for people with sensory disabilities such as hearing and visual impairments. This section discusses the types of virtual tours that can be implemented as well as physical changes that can be made to museums for increased access.

2.7.1 Physical Improvements

There are various technologies that museums have begun to use to create a more inclusive experience for visitors, especially visually impaired people and people with hearing loss. Such ideas include touch tours that allow patrons to touch and hold certain artifacts in an exhibit. Other options implemented such as tactile graphics, allow a visually impaired person to feel a piece of art and therefore help to create an inclusive visit. Museums have also used British Sign Language (BSL) tours and hearing aids or headphones for hearing impaired people. Printouts of audio descriptions can also be helpful. All of these implementations are relatively inexpensive and sufficiently help those with disabilities. The only problem with all of these solutions however, is that one must be able to maneuver throughout the museum in order for them to be effective. Virtual tours can solve this problem, expanding museum access to more of the community.

2.7.2 Virtual Tours

A virtual tour is a digitized representation of an actual tour provided to users as an alternative educational supplement. They are used to further enhance the learning qualities of a particular subject, and are a great way of providing a similar experience for disabled people who may not be able to maneuver through a crowded exhibit. Therefore, it is important for a museum to include all the same information and enable someone to absorb the same knowledge from the virtual tour that they would receive from a museum visit. It is important to look at the advantages and disadvantages of different virtual tours and decide the most feasible and effective tour in specific situations.

The simplest variation of a virtual tour is a text-based version. In this particular tour, a user is provided with descriptions of artifacts. The author must portray an exhibit to someone without any visual image and therefore must be talented at conveying an accurate sense of space while being quite descriptive (Carveth 2005). A text-based virtual tour also has the advantage of being printed and handed out to patrons; it then can be converted to Braille and be read aloud by

a text to speech program enabling everyone to partake in this particular virtual tour. The simplicity of a text-based virtual tour leads directly to the relatively low cost of its production.

The next step up in complexity of virtual tours is a photo-based version. As its title implies, the virtual experience is portrayed through a series of still-photographs while providing a description similar to that found in the text-based version. This version of a virtual tour has the advantage of showing the user what the exhibit actually looks like without having to worry about any misconceptions caused by a text description. This tour can also be printed out for distribution and accompanying text can be converted into braille. Images can be transformed to tactile graphics. Depending on the software used, a photographic virtual tour can have the option of being interactive. This means that the user can click on the screen to perform different tasks, such as zooming in on a certain exhibit. It can also be interactive in the sense that the user can click on a particular artifact triggering an audio or text description. The only hardware needed to create such a tour is a digital camera, which depending on the quality, can be obtained fairly inexpensively.

A panoramic virtual tour consists of a series of photographs that are taken and "stitched" together to create a 360^{o} view of an exhibit. This is done by taking pictures of a room with a pre-set percentage of overlap. The overlap is used to create a seamless image (Brannon 2002). Through the use of this technology, an interactive computer image is produced that further enhances the feeling of actually viewing an exhibit by enabling more freedom in a virtual experience. This particular tour cannot be printed and handed out. Though a panoramic virtual tour is better at creating a virtual experience, it may not be the best option for museums trying to create an inclusive visit for all. When looking at panoramic tours one must keep in mind the high cost for hardware and software that is needed to create a successful tour.

A fourth type of virtual tour is a video based tour. In this case, a video is made in first person view, walking the user through a typical tour that the museum provides to its patrons. Audio is provided in the form of a tour guide. For hearing impaired patrons, a text version of the audio can be implemented. The video includes all exhibits of the virtual tour, or have smaller video segments about certain exhibits that enable the user to decide what they want to learn. A video-based virtual tour can be quite expensive and time consuming to produce, but at the same time it can incorporate things such as music and special effects that other tours can not do effectively.

The most elaborate and complicated tour is real-time virtual reality. This is where three-dimensional objects and rooms are created to give the user the feeling that they are actually in the museum amongst the exhibits. The real-time aspect allows users to navigate their way through the world that is created on the screen as if they were really walking around. This particular type of tour can be extremely expensive as it requires extensive knowledge to create and the use of a professional photographer. The maintenance and updating does not require the whole tour to be done over again, so the up front cost is high but updating is relatively inexpensive. Also, due to the technology needed to run these virtual tours, it is difficult to offer this type of tour online.

2.7.3 The Current Virtual Tour Creation Process

Usually, if a museum was to inquire about a virtual tour, common practice would involve the assistance of a consultant. Their job would be to analyze the exhibits as well as the layout of a museum to try and determine the unique and important interpretive aspects for virtual inclusion. They would then make a list of options for the museum including the quality of the

tour its cost, as well as examples of content presentation. The type of tour, whether text-based, photographic, panoramic or video based, would involve different software and equipment requirements, thus altering the cost. It would then be the consultant's goal to determine the best type of virtual tour for a particular museum while keeping the cost within the museum's budget. Any virtual tour created would most likely need updates and revisions from any museum changes, such as new exhibits. This process involves a financial commitment of museums to keep their virtual tour accurate and successful. Furthermore, advances in web technology would be another reason for updating a virtual tour. The initial cost, as well as maintenance, proposes the need for a less expensive solution.

2.8 Web Accessibility

One critical part of the creation of a virtual tour is to ensure that it is accessible for disabled people, who may wish to use it for alternative access. It is important to understand that not all people view the web in the same way. Many people who have visual impairments use text readers, which read the text directly off the page. There is one basic idea behind web accessibility – to never use direct visual changes (such as manually changing the font size) as the only way to get an idea across. This doesn't mean avoiding all visual effects, but rather properly implementing them in a way which a text to speech reader, or text only browser can interpret them. In addition, any time an image or other multimedia (including Adobe Flash, Apple QuickTime, etc) is used, an alternative text description should be provided in order to allow users who can not view the image to understand it. The W3C (World Wide Web Consortium) WAI (Web Accessibility Initiative) is the de-facto standard for web accessibility guidelines. The first edition of the WAI provides specifics on fourteen guidelines that should be followed in order to create an accessible website. Several of the specific guidelines the W3C WAI (Web Accessibility Initiative) include:

- Provide content that, when presented to the user, conveys essentially the same function or purpose as auditory or visual content. (#1)
- Ensure that text and graphics are understandable when viewed without color. (#2)
- Mark up documents with the proper structural elements. Control presentation with style sheets rather than with presentation elements and attributes. (#3)
- Ensure that pages are accessible even when newer technologies are not supported or are turned off. (#6) (W3C, 1999)

The other ten guidelines focus on correctly using tables, dealing with foreign language, minimizing and controlling moving text, user interface methods, and the ability to take several input devices. One specific technology that helps a website achieve accessibility is the use of CSS (Cascading Style Sheet), which is a separate file from the standard HTML (Hyper Text Markup Language) file, containing all of the formatting. Therefore, the HTML file itself includes only the information to be displayed on the page, and the tags indicating the type of information it is (header, etc). This allows a text to speech reader to accurately represent the information for a blind person, as well as a person using a traditional web browser to view it with all of the visual effects.

There has also been specific research on the current status of website accessibility for disabled people in the UK. In 2004, the Disability Rights Commission published a report entitled *The Web: Access and Inclusion for Disabled People*, and found that 81% of websites

failed to meet even the most basic of requirements for web accessibility (DRC 2004). In 2005, the MLA published a follow-up study, specifically focusing on museum, library, and archives websites, in partnership with the City University of London. Although they found more positive results than the DRC study, they still found that 58% of the websites they observed failed to meet basic disability requirements (MLA, 2005). If a museum is planning on using its website as its alternative access means, then it must meet these requirements. In addition, if the DDA is read strictly, a museum website must not provide a lower standard of access for disabled people than it does for those without disabilities. Both studies (DRC and MLA) provide recommendations for the necessary improvements of websites to make them accessible for disabled people. Providing an action plan for making a virtual tour will aid museums that did not pass web accessibility requirements, proving to be an extremely important step in improving museum access.

The MLA web accessibility study tested websites using automated testing, involving the WAI guidelines proposed by W3C, as well as user testing by disabled people themselves. The biggest (and most common) problems they found were with websites designers not fundamentally thinking about alternative access, using inferior descriptions for links, and not providing alternative text on images (relying on only the image itself and not providing a text description). The conclusion of the report includes recommendations for museums to make web accessibility a high priority, creating a "web access plan" and using human testing of the sites, rather than relying on automated tools.

Other works, including the MLA Disability Profile, and the SMC checklists, also mention the importance of website accessibility. Especially as many of their disabled clients will refer to the web as an alternative means of accessibility, providing a website that is accessible becomes increasingly important. As museums continue to rely on the internet as a means of information transfer to their clients, they must continue to think about accessibility through design, rather than "making it fit" after the fact. Therefore, as the incorporation of a virtual tour is the closest option to providing the same interpretive experience compared to actually being in the museum, important steps are needed to help museums identify access needs from the beginning.

2.9 Virtual System Setup

There are many guidelines that are necessary to follow in order to fulfill the needs of all users in creating a virtual tour. As discussed in one of the Royal National Institute of the Blind's (RNIB) information guides, "recognizing the diversity of your audience is the key to reaching them" (RNIB). The ergonomics of the setup of a computer system are essential to consider for the comfort of a disabled user, especially for those with physical or visual impairments. If a tour is viewed from home, a disabled person would most likely have the necessary and ergonomically friendly features to allow for better computer navigation. However, if museums wish to allow virtual tour access on-site, it is necessary for them to understand the importance of certain guidelines that should be followed. This would allow for not only the best physical access to the tour, but the best communicated presentation of information. Hence, there are many options available that should be kept in mind in choosing the way in which information is physically presented in relation to size, color, and clarity of statements, graphics, and interactive tools. This section will discuss the importance of consistency of virtual system setup that is essential to consider in creating a successful virtual tour for a population with diverse needs.

2.9.1 Ergonomics of an Interactive Workstation

In order to provide alternative access for disabled patrons and create an even better environment for all, the ergonomics of the computer station need to be considered. According to the Smithsonian Guidelines for Accessible Exhibition Design, the floor space required by a wheelchair is 760 mm (30 in.) wide by 1220 mm (48 in.) long (Majewski). There should be no more than 485 mm (19 in.) of clear space under the table of the computer to ensure that the space is usable. It is also important to ensure that the workstation has the required knee space and proper table height in order for users to be comfortable. Providing both wheelchair accessible and public workstations next to each other and at relatively similar heights creates a more inclusive environment for all. A space of 1525 mm (60 in.) turning diameter is then required for a wheelchair user to make a full 180^{o} turn out of the work station or a 915 mm (36 in.) T-shaped area as shown in Figure 4 (Majewski).

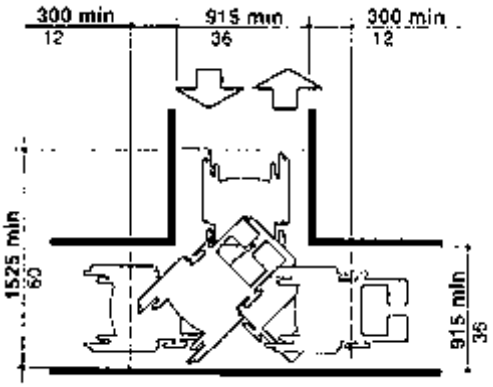


Figure 4 - T-Shaped Space
(Majewski 1996)

The interactive work station must be able to be operated by the limited use of one hand. This ensures accessibility for people with limited muscle and hand control. The interactive experience should not require any tight grasping, pinching or twisting of the wrist and no more than 5 lbs. of force to operate. It should also include non-slip surfaces and be at least 75 mm (3 in.) in its smallest dimension (Majewski 1996). Table extensions or wrist rests might be needed by some users in order to ensure they can operate the controls effectively. Interactive work stations including touch screens should be at an angle between 55-77^{o} from the back of the monitor to the horizontal surface (Tate 2004). Touch screens require a person to be able to lift their own hand and not have to move any sort of control, but can be expensive compared to a simple mouse, and are not user friendly for blind people.

The interactive controls of a work station must be within reach of people who use wheelchairs as well as people who are standing. If the controls are meant to be used from a forward approach in a wheelchair they can be no higher than 1220 mm (48 in.) and no lower than 380 mm (15 in.) above the floor. If a parallel approach is to be used they must be between 1370 mm (54 in.) and 230 mm (9 in.) above the floor. For people that can not extend their arms to full length and can not use an interactive from the side approach, a front-reach range maximum height of 1220 mm (48 in.) above the floor is preferred (Majewski 1996).

2.9.2 Information Presentation

There are many guidelines that are necessary to follow for the best presentation of information on a computer screen. User-friendly navigation allows a large audience to be able to proceed through a virtual interactive process with ease. It is important, for example to place commonly used buttons such as "enter" or "next" in the same location on the screen throughout the tour. Color coding common directional choices are also helpful for people with visual impairments. The first priority of information organization should be to produce as much factual knowledge as possible while maintaining an uncluttered presentation. All pictures, headlines, text, captions, and graphics should be separated so that not one aspect is focused on more than another. The RNIB recommends that graphics have high contrast so that their contents can be distinguished by partially sighted people. There should also be one or two subjects of focus, so that the pictures are not only simple to see, but the descriptions will be more easily remembered.

There are many qualities that should be included in the presentation of ideas and information that are necessary for inclusion in a guide for the process of making a virtual tour. It is obvious that the text used should be very clear and common to the relevant audience. Therefore, plain English is the best option for use. However, as shown in the 2001 Census, a significant percentage of the people in the United Kingdom speak Welsh. Therefore, a useful option for a virtual tour would be to allow the user to choose their preferred language before proceeding through the tour. Additional language features could include a BSL feature for tour guidance as well as Braille supplements.

The formation of ideas should be clear and to the point for ease of learning. It is essential to use short sentences with simple words to communicate an idea. Short paragraphs are also advantageous in capturing a reader's attention and absorption of the material. Descriptions of artifacts should also include using Clear Print recommendations provided by RNIB's See It Right packs that contain size recommendations as well as suggestions for using serif fonts. It is also important to ensure that the typeface used for numbers is very clear, as it is often hard for visually impaired people to distinguish different numbers. The color scheme used is very critical for both general user appeal as well as background and text distinction. High contrast of dark against light is the best option for presentation of descriptions. It is also better to keep consistent colors and avoid red and green in combination, as they are common indistinguishable colors to people with even minor visual impairments. Other features important to include are using organized text in columns that have sufficient weight as well as titles for all photographs, themes, and options.

Audio features would not only enhance a virtual tour experience, but would also allow people with visual impairments to get a better understanding of what is in the virtual tour. In other cases, blind people should be able to completely rely on these audio descriptions to follow what was going on. The RNIB recommends using a narrator that has a low frequency voice that is therefore generally pleasing to the ear. Detailed narrations of the sensory qualities of the museum itself such as the smell, lighting, and size can help set the mood to obtain a similar experience to actually being there. In depth descriptions of paintings, artifacts, and scenery also help those with visual impairments to follow along in the tour. This feature could also be used in classrooms if the tour was on the internet, as teachers could show segments to younger students as an interactive movie type learning process.

2.10 Other Works on Museum Access

Although many museums still require assistance in creating a more accessible environment, there is some work that has been done previously to aid them towards this goal. A large amount of information is available from the Museums, Libraries, and Archives Council (MLA) on accessibility, primarily through their published reports available from their website. In addition, the Scottish Museums Council also provides information for museums to increase their accessibility for the disabled. Researching previous improvements allows a better focused project by considering successful options already implemented in other museums. In this way, the incorporation of other works can allow virtual museum improvement to be taken to a more extensive fulfillment.

2.10.1 MLA Disability Profile

Of the several publications that the MLA provides to its members, one of the most useful and relevant to our project is a set of twelve guides called the *Disability Portfolio*, published between 2003 and 2004. The Disability Portfolio guides museums (as well as libraries and archives) through meeting the needs of disabled people, both as patrons and staff of museums. The first few guides, such as *Disability in Context*, *Meeting Disabled People*, and *The Disability Discrimination Act*, provide background information about disabilities, specifically in the United Kingdom. Especially interesting is the fact that only 5% of disabled people use wheelchairs, and many of those 5% only use them part time (MLA 2003a). This shows how difficult it is to identify someone as a disabled person simply by physical appearance. The second guide, *Meeting Disabled People* gives step-by-step guidelines for the correct language to use when interacting with a disabled person, and the words to correctly characterize their disabilities. This is directly related to our work by providing excellent background in proper use of language for our deliverable to avoid offending anyone, as well as making them feel as included as possible.

Multiple guides in the Disability Profile continuously reinforce the necessity of incorporating British Sign Language (BSL) into accessibility plans, as there are 50,000 to 70,000 users in the United Kingdom (MLA 2003a). A large part of the non-disabled community does not understand that BSL is a completely separate language, not simply a hand representation of English words. The language has its own grammar and syntax, and a large amount of its users consider it to be their primary language. Therefore, it is important for museums to understand that deaf people using BSL may often not understand complex English sentences, even if they are written out. It is therefore important to keep the complexity of English writing to a minimum when communicating with someone who uses BSL as their primary language, or better yet, have a means to communicate in BSL. This can be included in virtual museum access, as it is essential to consider for inclusive access.

The *Using Technology* and *Inclusive Information* guides are particularly relevant to both the virtual tour and physical museum improvement parts of this project, as they give specific suggestions on disability access. The *Inclusive Information* guide primarily focuses on providing the same information that is already provided for non-disabled patrons to those with disabilities. Some of the suggestions are as simple as choosing font properties that partially sighted people can distinguish, environments that are laid out in a way that does not distract from the main point, and keeping large print, audio, and braille copies of items. This also includes using a simple language level that can be easily understood, which affects a large variety of disabilities. For example, people with learning difficulties, and those who use BSL as their primary language

would be better accounted for using simplicity in the presentation of factual knowledge. The "Disability Discrimination Act" section also proposes a list of "auxiliary aids and services" to be available to the disabled, including everything from "Videos in British Sign Language" to "Multi-sensory events". The *Using Technology* guide lists several technologies that make access easier for the deaf and blind, including use of induction loop systems, where a partially deaf person can hear an amplified version of the same thing everyone else in the room is hearing, without affecting other visitors in the museum.

The *Access on a Shoestring* guide shows some simple low-cost measures museums can take to increase their accessibility. It makes a key point that a lot of small changes, often simply in the behavior of the staff, can make the environment more accessible for a disabled person. In addition, by planning ahead and incorporating accessibility into other changes museums are already making, a large amount of money can be saved, rather than retrofitting what has already been done. It again brings up the point that designing for access for disabled people doesn't necessarily mean physical wheelchair access, as a relatively small percentage of disabled people actually use wheelchairs. The guide also points out that individuals and small organizations are always creating their own solutions, so museums should not limit themselves to what has already been implemented.

Although on a far broader scale, as they cover libraries and archives in addition to museums, these guides are similar to the goal of this project, in providing step-by-step processes to museums for improving access for disabled people. However, because they are limited by having to broadly cover three different types of organizations, they do not go far enough to provide museums with specific recommendations on how to create access for their patrons, nor do they give a prioritization of what is most important for museums to implement. In addition, although the *Access on a Shoestring* guide does provide some cost-saving suggestions, the profile itself lacks any direction towards the resource-limited small museums.

2.10.2 SMC Museum Access Tools

The DDA applies to all museums within the United Kingdom, and not just within England. The Scottish Museums Council's (SMC) national audit in 2002 showed that almost 77% of the museums in Scotland had not conducted an access audit within 5 years (SMC 2002). In addition, only 45% even had an access plan in place, showing the breadth of the accessibility problem in the UK. To assist museums in complying with the DDA, the SMC provides accessibility audits to its members, as well as several lists of questions to ask to determine the museum's status for the various categories of disability. This includes people with mobility, hearing, and visual impairments. This action process is similar to the action plan that should be used when helping a museum identify important interpretive experiences.

The SMC's work echoes a lot of the points that the MLA work stated, as a list of simple steps to make to allow for accessibility by the blind and the deaf. Particularly in terms of visually impaired visitors, the SMC work checklist gives a list of simple steps that can be taken to ensure accessibility, which cost very little in additional funds. These ideas include keeping a second copy of all printed material, providing copies with larger point font, keeping layouts simple, and keeping copies of their works in braille. In addition, they stress the importance of trained staff who knows how to identify and how to interact with blind and deaf people. Very few of their recommendations require physical change to the facilities, but rather making a lot of small changes. Their ideas involve considering disabled people in every part of the museum

design, to enhance the experience of the 95% of disabled persons who are not in wheelchairs. It is important for this idea to be applied in relation to virtual tours to ensure inclusive design.

2.11 Summary

There are several disabilities and learning styles that must be considered during museum setup to create experiences that are beneficial to the whole community in the United Kingdom. Although the statement of "a reasonable alternative method of making the service in question available" from the Disability Discrimination Act is very open-ended, museums still need direction in terms of practical solutions that qualify as reasonable alternatives. With thorough understanding of the educational qualities and interpretive experiences of museums, we can start to formulate the important features necessary for inclusion into a virtual tour. From that point, an action plan with steps helping museums to transform important interpretive experiences of visit into a virtual tour would be beneficial. There are options already available to museums to improve their accessibility, however, we need to consider the limited resources of many of the museums and create a set of recommendations for them. Also important to include are proper computer presentation methods and ergonomic specifications for a useful workstation. With the help of the Centre for Accessible Environments and our IQP project, museums will be able to implement an inclusive virtual tour as an access option and educational tool. Helpful examples and resources will also allow them to comply with the Disability Discrimination Act and provide a better experience for all of their patrons.

Chapter 3: Methodology

The main goal of this project was to help the Centre for Accessible Environments (CAE) provide additional accessibility options for museums throughout the United Kingdom through the development of a guidebook to assist in the process of creating a virtual tour. As a critical part of this guidance, we provided simple steps and recommendations to museums with limited resources for inclusive virtual design. We developed and included a method to assist museums in integrating their important interpretive experiences into a virtual tour. The final deliverable includes steps for the construction of a virtual tour while including recommendations on web accessibility and an ergonomic setup to ensure that the resulting virtual tour is accessible. Also included in the guide are a set of possible alternative access options for museums to use as considerations for improving access within their museum building. The guidebook serves as a tool to allow museums to have the ability to make their own informed decisions in the creation of their virtual tour, allowing to be more selective with outside help, if needed. In addition, this guidebook expands the range of guidance provided by CAE, fulfilling their mission of inclusive design for improved access. The specific objectives that were met to satisfy these goals included the following:

1. Determine access issues in museums in the United Kingdom through interviews and research.

2. Interview professionals involved in the virtual tour creation process.

3. Determine proper content and interpretive experience implementation to be included in a guidebook.

4. Create a guidebook with steps for designing an inclusive virtual tour.

5. Test the guidebook for feedback and revisions.

To successfully complete this project it was necessary to outline specific steps to ensure the completion of the above project goals. A graphic summarizing our project goals and methodology is shown in Figure 5, on the following page.

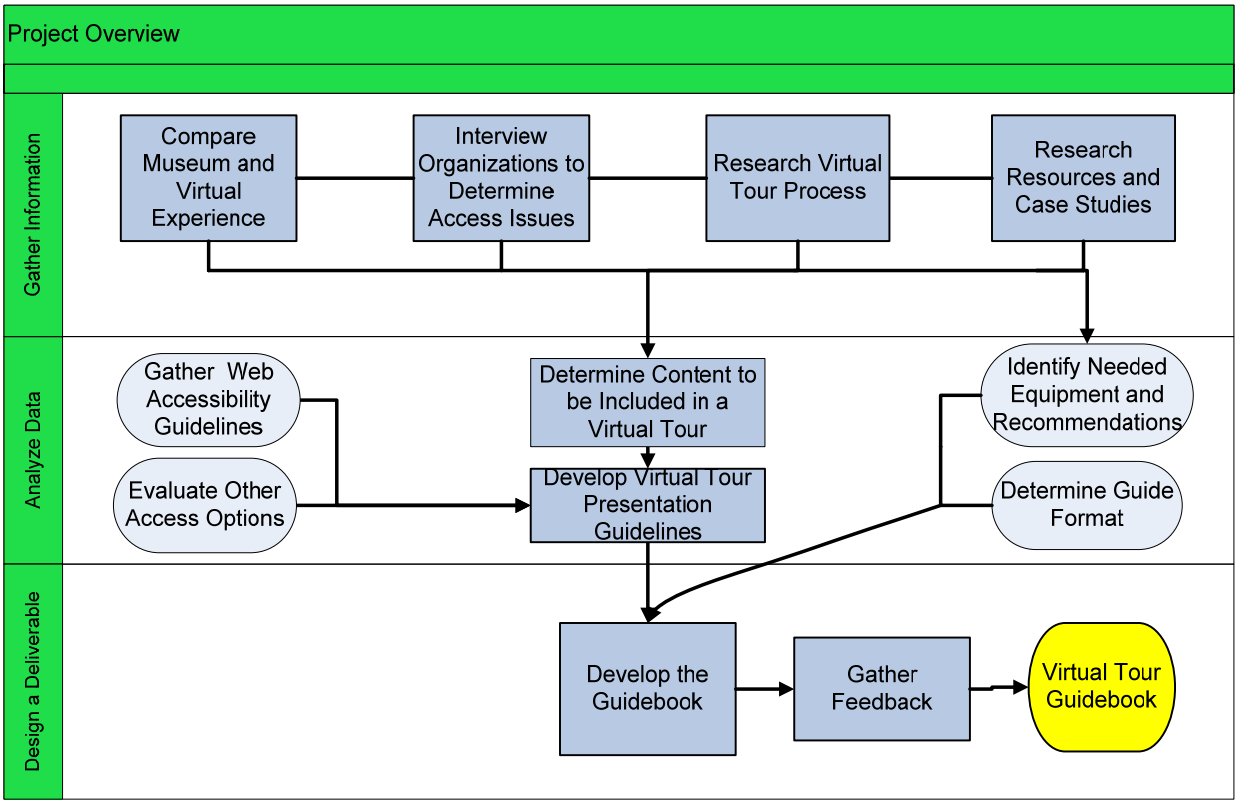


Figure 5 - Project Overview

We followed a strict timeline while completing our project in order to ensure that we would achieve our goals. Our on-site commitment to this project was from March 13, 2006 until April 28, 2006, which gave our team approximately seven weeks to start and complete this final part of our project. Our final project timeline that was followed is shown below in Figure 6. A more detailed copy, including specific tasks, is included in Appendix V: Detailed Timeline.

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
On-site Interviews							
Design Guide							
Test Guide							
Revise Processes							
Finalize Guidebook							
Write Report							

Figure 6 - Project Timeline

3.1 Identifying Museum Accessibility Issues in the United Kingdom

In order to best determine access issues in museums, our team went through various research and preparation steps. We analyzed case studies, as discussed in the background, to gain knowledge of the most prevalent access issues as well as solutions that have already been implemented. On-site we reviewed several of the guidebooks written by our sponsor, the Centre for Accessible Environments. Specific helpful editions included the *Access Audit Handbook*, *Good Loo Design*, and *Access to ATMs*. From these publications, we incorporated ergonomics of a computer workstation as well as different access approaches into the guide, to ensure the completed virtual tour is presented in an accessible manner. These resources also allowed our group to understand the general guide setup and CAE's house format to use in our developmental process. The guides also helped to show the range of ideas and considerations to include in the guide we developed in order to make it accessible.

Through weekly meetings with our liaisons, we gained useful information about access that was incorporated into the guidebook. They provided us with various resources on web accessibility and current access issues. We also attended the Jodi Awards held at the British Museum honoring museum websites that have excelled at providing access for disabled people. This gave us a first hand idea of the impact of improving options for disabled people, especially by using technology and the web medium. In order to obtain information and recommendations for construction of a high quality and effective guidebook, our team decided to complete interviews with many professionals working on access in museums.

3.2 Interview Process

To extend our research beyond work that had already been done, it was necessary for us to perform several interviews with museums and professionals in the UK. CAE provided a list of contacts to which our group sent emails, requesting an interview for insight on our project. Museum staff, the RNIB, the MLA, and virtual tour and exhibition designers provided the most relevant advice and comments on present museum access issues. Through these discussions, we gathered insight on specific access improvements and particular accessibility barriers which should be removed for the purpose of developing the most desirable project focus. The final goal of the research was to gather information on museum accessibility and the virtual tour creation process to apply to the virtual tour creation guide. Prepared focus questions were used in the interviews to outline the topics for discussion. Valuable information was also gathered through email responses to our list of questions. In order to create the process that is outlined in our guidebook, we used the research we gained from the interviews and other background research for development. This section will further discuss our data collection process.

3.2.1 Preliminary Museum Visits

While on-site, we visited various museums to learn more about how they incorporated their exhibits into virtual tours. The Science Museum of London has a virtual tour that includes the majority of their artifacts. We compared the experience of being in the museum itself to that of the virtual tour, to determine how interpretive experiences were integrated, and what ideas were included. In addition to looking at the Science Museum, we visited the Victoria and Albert Museum, Anne Hathaway's Cottage, and Shakespeare's Birthplace. Both the Science Museum and the Victoria and Albert Museum created their virtual tours primarily as learning tools that

could also be accessed on the internet. Anne Hathaway's Cottage and Shakespeare's Birthplace have virtual tours that were created specifically for access and could only be used on-site. Visiting these museums made us aware of two ideas that needed to be addressed and solved for successful guidebook recommendations:

- Placement of the virtual tour – either on-site, on the internet, or both
- How to mimic the real experience of being in a museum

These ideas were therefore incorporated into our interview plans from that point onward, to gather feedback from professionals involved with museums and accessibility. The next step for gathering information was to interview people involved with museums and accessibility.

3.2.2 Interview Process

The most appropriate way to collect personal expertise from professionals in the area of museum accessibility and virtual tour design was to interview them informally through a conversational process. We followed the basic ideas of an in-depth qualitative interview, guiding the interviewee to discuss important topics pertaining to our guidebook. Our interview questions can be found in Appendix II: Interview Plans, an example is shown in Figure 7.

An Outline for Determining Disability Access Issues with Input from Museum, Heritage, and Disability Organisations

Interview Participant Name:
Organisation:

Background

1. What is your role in relation to museums?

Access Issues

2. What are the most prevalent access issues museums have, which you are aware of that need to be solved or improved?
3. Are there any specific issues difficult to address simply through a guidebook? (such as intellectual access)
4. Other than the Disability Portfolio, what have you done in the past to help museums solve access problems?
5. Are there any specific museums you work with or do you primarily complete guides that can be used by all museums?

Access Implementations

6. What is some feedback you have received from your recommendations to museums? Specifically, were there parts of work that you completed which they liked or disliked?
7. What is your opinion on virtual tours in relation to them being an additional option for access to the museum for disabled people?
8. Are there specific implementations of virtual tours that you think do an excellent job at providing access?
9. Do you have any recommendations or questions regarding the virtual tour creation process?

Figure 7 - Sample Interview Questions

During each interview all group members took notes and afterwards discussed and summarized ideas and important points. The information we obtained from the interviews was helpful in designing the guidebook.

3.2.3 Data Analysis

The information collected from the interviews was necessary for the creation of our guidebook, as it provided us with first hand information specific to museums in the United Kingdom. However, we could not simply take everything straight from the interviews and use it in the guidebook. The most important issues had to be determined based on all results and used as main points of focus to create the most helpful guide possible. The information had to be transformed into our virtual tour process as supportive references. This qualitative analysis of major access needs, virtual tour advantages, and the design process were all performed in order to identify and outline the guidebook in a way that clearly addressed each issue.

3.3 Virtual Tour Process

There are several important steps for determining the content and design of a virtual tour. The first step is to understand exactly what a virtual tour is as well as the many options and special features that can be included. As discussed in Section 2.7.2 , there are four types of virtual tours – text, photo, panoramic, and video. Based on the financial restraints of small museums and simplicity of creation, the most appropriate virtual tour was determined to be photo-based. Therefore, the guidebook was created with photo-based tours as a focus, but also includes information about other types for additional interest.

This section will discuss the steps our team followed in creating content recommendations for the *Museum Virtual Tour Design Guide*. We had to research the typical virtual tour procedure in order to understand and develop our creation process that allows museums to complete most of the process themselves. This allowed for specific steps and guidelines to be created to identify all of the important features to include in a virtual tour. Web accessibility regulations and user friendliness were of the highest priority in formulating inclusive recommendations in the guidebook to ensure accessibility of the virtual tour.

3.3.1 Virtual Tour Content Presentation

Based on the Centre for Accessible Environment's objectives for our project, it is necessary for visitors to have memorable experiences at museums for the purpose of learning. Therefore, in a virtual tour, once important interpretations have been identified, the information should be presented in a way that encompasses the maximum educational experience. When considering the most important interpretations, it is essential to realize what is attractive to specific mindsets, as well as different learning styles. These ideas are essential to incorporate into the development of a virtual tour in order to achieve as close of an experience as possible to the physical museum experience.

For the best ideas on how to incorporate features for different learning styles and abilities, it was essential to consider what had already been done within museums. For a physical museum visit, the museum staff has the option of presenting the works in completely different ways depending on the visitor. For example, children may perceive a far different tour

than elderly people. In addition, disabled people might participate in different tours, such as touch tours for visually impaired people or a British Sign Language presentation for hearing impaired visitors. However, for the virtual tour process in the guidebook, without creating several distinctly different virtual tours, consideration of all users had to be taken into account in the way the content was presented. A virtual tour can be made to create better accessibility by removing barriers, with only one version required to satisfy all types of visitors. Through the use of the process outlined in our guidebook, a museum is assisted in the creation of a virtual tour that is suitable for their entire audience by adhering to the accessibility guidelines and inclusive information presentation ideas.

3.3.2 Our Virtual Tour Creation Process

A large part of the cost of a virtual tour is due to consulting fees by a virtual tour designer. The goal of our guidebook is to lower the cost of virtual tour creation by giving museums a process to complete much of the development of the tour with their own resources, rather than paying a consultant to do it for them. This essentially allows a museum to be more selective when choosing outside help if they do not have a sufficient understanding of web design. However, they are perfectly capable of determining the content and layout of the virtual tour. In addition to saving money by completing part of the process themselves, they are more likely to be satisfied with the outcome, as they will have far more control over the project than if an outside consultant had created the whole tour. These ideas are the objectives of the *Museum Virtual Tour Design Guide*. The guidebook was designed to walk a museum through the step-by-step process of creating their own virtual tour, but also leaves it open to consulting a virtual tour designer after the content has been decided upon. This way it will lower the cost of the creation process and gives a museum more control over the final product, compared to the traditional virtual tour process. The guidebook was designed in this way to assist museums in getting more for their limited resources.

3.3.3 Designing Deliverable for CAE

There are three different options that our group considered to present our data to CAE when the project was completed. Possible options considered before identifying a guidebook as the best way to convey our final deliverable included:

- Web Page
- Condensed IQP (Report)
- Guidebook

The guidebook option was selected because it is more user friendly by serving as a physical workbook for the identification process. The guide is a five step process of considerations on how to identify content and integrate important educational experiences into a virtual tour in the most efficient manner. Having a tangible guide allows the user to write down comments as they move through the steps. Through our research and interviews with museums, we have focused specific sections of the guidebook on topics that were mentioned multiple times throughout our interviews. The guide is a step forward expanding access options by providing a source of consistent information that can be used by any museum. The idea of making it tangible provides CAE with something to distribute to any museums that need this service. CAE will be placing our guidebook on their website as a PDF so someone can follow the links provided in the

guidebook or simply print it out to follow the steps. This guide has a clear setup; it opens options to museums lacking resources, time, or insight in virtual tour construction.

The other deliverable options were decided as insufficient for different reasons. A major drawback of a web page is that it might be more difficult for CAE to distribute the information. It is not feasible for the museum staff to be at a computer while going through the whole interpretive experience and virtual tour content identification processes. It would be easier therefore, to be able to carry a guidebook around with them for better and more descriptive responses to the action plan. The time constraints would also have made it difficult for us to create an easy to use web page. The main problem with a condensed IQP report is that it would be difficult to gather a quick understanding. Museums would not be able to effectively use the information in a condensed report, compared to other implementation options. This also would not present itself a simple process that museums would want to follow.

3.3.4 Guidebook Implementation

When all the interview information was obtained, we formulated our work into a set of formal recommendations and processes. Our focus was to make consistent suggestions we considered feasible for a small museum. The guidebook will be made available on CAE's website as a PDF with active links. Since the process remains continuous after our departure, we developed feedback recommendations for CAE. The guidebook was split into five sections, all relating to virtual tour content, design, and maintenance. The final table of contents is shown in Section 4.3 and the final guidebook in Chapter 5:.

3.4 Implementing Interpretive Experiences

Determining a method for incorporating the important experiences of museums into a virtual tour is critical for in the success of any virtual tour. Originally, we planned on helping museums identify their interpretive experiences, but from the advice of our liaison, our time was better spent taking this idea further and showing museums how to use the interpretations to create a virtual tour. Most museums, as our liaison discussed, have a sufficient knowledge of their interpretive experiences and therefore primarily need guidance on what to do with them in relation to virtual tours. Therefore, in order to determine the implementation steps, our team had to determine the formulation and design of the content that should be included in a tour. Although it may seem like the obvious answer is to include all exhibits of a museum in a virtual tour, some exhibits require more emphasis than others to communicate a specific idea or unique feature, or are more important to focus on if a museum can not include all of their exhibits due to resource limits.

The other major factor that had to be kept in mind throughout the content design process was the fact that the guidebook had to be geared towards providing access for disabled people. Therefore, we did not only have to figure out recommendations on how to compile virtual tour content, but also how to present it inclusively and still maintain similar interpretive experiences as an actual museum visit. This idea included creativity in the arrangement of exhibits for the tour as well as how to make it appeal to the target audience. The museum staff is the most knowledgeable of the interpretive experiences that they provide and therefore this implementation process was needed to help them in their thought development.

3.5 Design and Test Virtual Tour Guidebook

The design of the guidebook was a continuous process throughout our time on-site. It was created in conjunction with performing interviews throughout the seven week period. Constant revisions were made as our team gathered more information and feedback from our liaisons and advisors. The end product was more methodological and user appealing than the first couple drafts due to the use of simplified wording and graphics. It also includes additional access considerations for museums as well as contacts and resources for examples and assistance. This section discusses the additional inclusive ideas and the testing process of our guidebook that allowed our team to create the final deliverable.

3.5.1 Further Access Assistance

The application of web technology allows CAE to provide accessible resources to museums in a different and more modern form. This idea implies that the rest of the museum itself is relatively well accessible for disabled people to the extent specific museum funding allows. In addition to the objectives set by our sponsor, we have decided to provide additional resources for museums that cannot even meet the expense or other requirements of a virtual tour with our new creation process, but still want to create an inclusive experience. This includes a list of other options that can be incorporated into the museum. Ideas applied to our recommendations were taken from disability implementations in museums described as useful based upon the museum staff interviews and observed visitor reactions. Other suggestions include improvements found in case studies, in particular, those used to aid people with visual and auditory impairments. The list of recommendations includes a range of ideas, and points museums in the direction of other resources available to them which they may not know about. These alternative access options are not only solutions for museums with little financial support, but also pose as a supplementary idea for museums that can afford improvements but do not know where to look for ideas.

3.5.2 Refining and Testing the Guidebook

Once the first draft of the guidebook was fully developed, we began an intensive revision process. The first step was to get basic feedback from the advisors and the sponsor, to ensure there were no blatant errors and that the general direction of the guidebook was correct. We then took their feedback and heavily revised the guidebook to get it to a point where it could be released to the public for testing.

We contacted several small museums in the London area, and asked them for their feedback on the guidebook. We provided the museums with a list of focused feedback questions, which are shown in Appendix III: Guidebook Feedback Questions. These questions were aimed to allow those giving feedback to give open constructive criticism while ensuring the feedback focused on the areas we were looking for. We wanted to get feedback on the content of the guidebook itself, and to find out if the guidebook would have helped them (if they already have a virtual tour), or if it would encourage them to create a virtual tour (if they do not have a virtual tour). In addition to testing with museums, we provided a copy of our guidebook to some of the professionals in the field of museum access, which we had interviewed prior to developing the guidebook. Our goal in this testing process was to ensure that the guidebook contained sufficient information and resources to allow a museum to follow along.

We received extensive feedback and comments from both our liaisons specifically, and all of the staff at CAE through all of our guidebook drafts. Although the feedback came from sources very close to the project, this was the most useful of all of the feedback as they thoroughly read through its contents. Those at the sponsor were also able to give their expertise through comments on the entire scope of the guidebook, from formatting to content to style, which was especially helpful.

The feedback from museums and other professionals in the area was very limited due to their lack of time. The guidebook was sent to them for review three weeks before the end of our project, many responded saying they would need more time to review our work. However, using the limited feedback from them and all the feedback from our sponsor, we were able to refine our guidebook to a state where it was in its final publishable form, in a relatively accelerated timeframe. As described in Section 6.2 , the final version of the guidebook is placed on the sponsor's website.

3.6 Summary

Our final deliverable for the project, *Museum Virtual Tour Design Guide*, walks museums through the process of developing a virtual tour. Conducting multiple interviews allowed us to develop a set of steps for the creation of a virtual tour. We then tested our initial design with staff from local museums, for the purpose of revision. Our method allows the museum itself, rather than a consultant, to complete a majority of the process, allowing them to reduce costs. Through the entire guide, there is a focus on inclusive design, to continue the mission of the Centre for Accessible Environments.

Chapter 4: Results and Analysis

The results of our project fall into two primary outcomes: information gathered from interviews and our guidebook. The interviews gave us core ideas from professionals in the field of museum access in the United Kingdom, especially focusing on ideas surrounding virtual tours and current access issues in the UK. The guidebook is the culmination of what was learned from the interviews and the extensive background research we completed, combined with the feedback we received from the testing stage.

4.1 Interviews

In order to gather additional information on accessibility, virtual tours, and guidebooks, we interviewed several professionals the respective fields. This section describes some overall ideas that were gained from the interviews, as many of the specifics are included in the guidebook itself. Table 1 shows the names, titles, organizations, and the interviewee's speciality for each of the interviews that were completed.

Interviewee	Title	Organization	Speciality
Elizabeth Denton	Education and Access Officer	Royal Armouries, HM Tower of London	Museum Access and Education
James Dibble	Director	Land Design Studios	Exhibition Design
Ann Donnelly	Museums Curator	The Shakespeare Birthplace Trust	Museum Curator
Mike Gogan	CEO	The Virtual Experience Company	Virtual Tour Design
Catherine Hillis	Arts and Heritage Officer	Royal National Institute for the Blind	Disability Organization
Jemima Relli	Director of Digital Programmes	Tate	Web Design
Marcus Weisen	Health and Disability Advisor	Museums, Libraries and Archive Council	Museum Organization

Table 1 - Interviewees

In addition to those listed, we also received valuable information from our liaisons at CAE, Ms. Cassie Herschel-Shorland, Senior Access Consultant, and Mr. Paul Highman, the Principle Information Officer. Although formal interviews were not conducted with them, as was with those listed above, we received a great deal of information from them through daily interaction. In addition, the rest of the staff at CAE was very helpful in providing feedback throughout the project.

One of the key ideas developed due to the interviews was a question as to the placement of virtual tours, if they should be physically on-site or on the internet. There seemed to be issues with museums not wanting to give up space to place the virtual tour on-site. They are worried about it being a distraction to museum patrons, slowing down the traffic through the museum, or possibly taking away from the physical museum experience. From the discussion with James Dibble of Land Design Studios, it was also discovered that some museums worry about placing a virtual tour on their website. Museums fear that it could create too great of an alternative to a physical visit, decreasing the number of visitors. However, discussions with others yielded the

opinion that a virtual tour is more likely to attract more visitors, as they can get a preview of what will be seen at the museum, and tempt them to see it in person.

Another key idea gained from the interviews was the need for detailed guidance for museums in relation to specific uses of technology, as much of the guidance already available gives general information. Detailed guidance would allow museums to be more comfortable in approaching the implementations of specific technologies, as properly presented information can simplify this material. There are several guidebooks that cover some topics in virtual tour design, such as the MLA *Disability Portfolio* and the RNIB *See It Right* guides, however they do not cover enough specifics to walk museums through the process of creating a virtual tour. Marcus Weisen, the Health and Disability Officer at MLA, who was involved in the creation of the *Disability Portfolio*, expressed his desire to compile additional guides on specific technologies that can be used to enhance access. However he explained that the time and funding necessary to complete such a project was not available. There are also several guides available from disability organizations, covering other accessibility specifics, such as CAE's *Access to ATM's* guide, and the CAE *Specifiers' Handbooks*, however there is nothing that exists which walks a museum through the steps of creating a virtual tour. This is where the guidebook we developed fits in, walking museums through the process and giving them the necessary information to create a virtual tour.

Another key point is to ensure the technology does not overshadow the experience, ensuring that the experience is of the museum and not of the technology. Mike Gogan, a virtual tour designer, encouraged us to make sure that an inaccessible building is not replaced by an inaccessible computer. The goal should be to recreate the experience as closely as possible, but understanding that it is impossible to completely replace the physical experience of being in front of the object. It was also suggested to us that a virtual tour should be placed amongst the exhibits so that the power of the "real" is maintained as much as possible. Using a virtual tour, the educational experience for all visitors can be enhanced by providing additional information that is not easily available during a physical visit. It is also useful for pre and post-visit information, which could entice a user to visit the museum as they become more interested in the exhibit.

4.2 Feedback

An important part of the guidebook development process was receiving feedback on developed drafts from museums and other professionals, including our sponsor, CAE. The feedback process that was developed is described in detail in Section 3.5.2 of the methodology. Despite the extensive revisions which were made through the use of the feedback processes, we did not receive as much feedback as we would have liked. Many of the changes were via feedback received from those very close to the project, particularly the advisors and liaisons. Completing a project of this scope in a seven week period only allowed for three weeks to be left for testing, which simply was not enough time to receive feedback from those other than the sponsor during the feedback stage. However, we did receive much input from people outside CAE during our interviewing stages earlier, and their ideas were incorporated into the guidebook. Many museums that we contacted looking for feedback said they would need a few months before they had the time to look it over. The reason we did not receive the feedback we wished for is likely the same reason this guidebook was developed – that the target audience is very strapped for resources and simply did not have time to spare to look at our guidebook when so much else is going on at the museum itself. The guidebook itself includes contact information

for CAE, so that they can receive feedback on it. This is discussed in further detail in Section 6.2

4.3 Revisions Based on Feedback

The biggest change made between the original and final editions of the guidebook was the development of a more step-by-step process that truly allows a museum to walk themselves through the virtual tour creation process. Previous drafts simply provided the reader with detailed information on the process. The original Table of Contents for the guidebook is shown in Figure 8 and the final version shown in Figure 9. The titles of the chapters show the change that was made, from a simple listing of information, to a step by step process. The "About this guide" section was added to present the reader with the overall goal of the guidebook and to pique their interest, hopefully leading them to read and use the guidebook in the process of developing a virtual tour. In addition, several formatting revisions were made to make the guidebook far more user friendly, such as special text boxes for outside links and recommendations. Examples of photo-based virtual tours are provided so that the reader can see what a successful tour looks like, and use them to model theirs around. Also, there are examples of considerations to keep in mind when presenting a virtual tour to ensure it is accessible by all. The guidebook was formatted using CAE's own guidelines and was designed to closely resemble their publications.

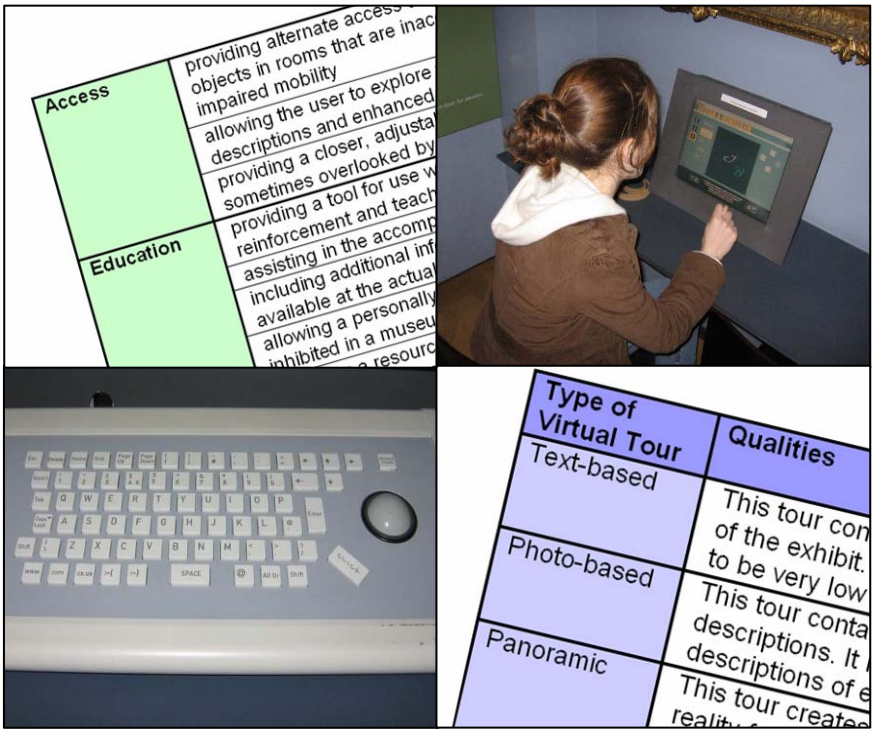
Figure 8 - Original Table of Contents

Figure 9 - Revised Table of Contents

Chapter 5: Guidebook

The guidebook that was developed is included on the following pages. This is the final version that was developed using the methods described in Chapter 3, and incorporating revisions based on our testing process feedback. The *Museum Virtual Tour Design Guide* will be available to museums through CAE's website, www.cae.org.uk, in Adobe Portable Document Format, which allows for it to be read both interactively on a computer, and as a printable version. Based upon the final results, CAE asked our group to write and article for the September 2006 issue of CAE's journal, *Access by Design*, to make museums aware of the guidebook.

Museum Virtual Tour Design Guide



About this guide

Museum Virtual Tour Design Guide covers the design and content identification steps needed to successfully make an accessible virtual tour. This guidebook focuses on photo-based tours as a feasible option for museums with limited financial resources.

This guidebook provides practical assistance to help museum staff understand the advantages of virtual tours, how to develop a virtual tour, how to include access options and how to maintain a virtual tour. Feedback can be sent to info@cae.org.uk.

Guidebook creation

This guidebook was created in April 2006 by students from Worcester Polytechnic Institute in Worcester, MA, USA with support from the Centre for Accessible Environments. The authors, Cathryn Bedard, Jason DuBois, Scott Lehtinen and Brian Loveland, created this guidebook to fulfill the Interactive Qualifying Project requirement of their Bachelor of Science degrees.

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Introduction

Virtual tours

A virtual tour is an educational tool that can benefit all users. It can provide detailed and up close images of museum artefacts and text descriptions on a computer, sometimes with even more information than in the museum itself. Virtual tours also serve as an access option for disabled people who cannot otherwise experience exhibits due to physical, sensory or intellectual barriers. Among other options, a tour can include audio features as well as user preferred display and navigation options, all of which help to remove barriers.

Objectives

This guide is designed to provide museums that have limited resources with a set of steps to create their own virtual tour. The primary goal is to present museum staff with the appropriate steps to identify content and presentation setup. This can reduce the need for external consultants and thus the cost of production, while increasing virtual tour feasibility for museums with a limited budget. This document was created with the consideration of inclusive design for all users. The basic steps this guidebook covers include:

- What to put in your virtual tour
- How to make your virtual tour
- Where to put your virtual tour
- What to do with your finished virtual tour

The information included in this guide is based on background research and interviews with representatives of disability organisations and those in the field of virtual tour creation. The guide includes different options for enhancing accessibility as well as design recommendations to remove barriers which can inhibit a user's experience of the museum. The steps can also be used to develop a more elaborate virtual tour.

Disability Discrimination Act 1995 and 2005

The Disability Discrimination Act (DDA) 1995 and 2005 requires all public facilities to provide an equal experience for all visitors. The DDA protects the rights of disabled people by making it unlawful to discriminate against them.

Museums must reasonably attempt to remove any access barriers that inhibit visitors from experiencing an exhibit. However, if this is not possible due to the site being listed as a historic building for example, museums are still required to make an equal experience available. A virtual tour can be used to improve museum accessibility where physical changes to the museum itself are not feasible. Therefore, it is important to ensure that it is designed with inclusive features. While a virtual tour can assist with improving museum accessibility, a full access audit and access plan are recommended to identify barriers and plan to remove them.

Table of Contents

Process outline

The flowchart below shows the main steps that are included in this guidebook. Each block represents a chapter with important points to consider. The recommended process for creating a virtual tour has been designed to be easy to follow. While this guidebook works through the necessary steps one by one, it is important to read through the entire guidebook and consider all of the stages before beginning the process.

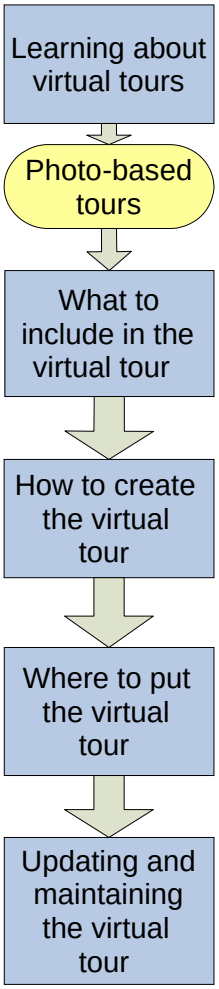
The first step in the process is to understand the scope of virtual tours. There are many different types of virtual tours and this section explores the different options available. This guidebook focuses on the creation and implementation of a photo-based tour, as the most economically feasible option for many museums.

The second step in the process is to decide what content to include in the virtual tour. Each museum can tell its own story and interpretive experiences through the exhibits included in the virtual tour.

Once the content is decided upon, everything must be pieced together. This section covers some of the computer details necessary in creating the virtual tour, including computer presentation and web accessibility.

When the virtual tour has been created, it is important to consider placing it somewhere that everyone can access. This section covers options for where to place the tour in the museum, the ergonomics of an accessible setup and recommendations for placing a tour online.

The last step in the process is to ensure that the tour is updated regularly. This section covers some of the details of maintaining the virtual tour and the importance of an informed staff with regards to the virtual tour.



Through following the steps explained above and contained in this guidebook, museums will have assistance in creating an accessible virtual tour of their facility that can also provide a better learning experience for all museum visitors.

This guide is intended to help reduce the cost for museums in creating a virtual tour. It is difficult to quantify the exact cost savings, as it depends on many factors. If the museum has staff which can complete the entire virtual tour, then there will be no need to pay for an outside web designer. The rates of web designers and number of hours required are unique to the designer. It is important to follow the guidance while choosing a web designer, and developing a budget for the project prior to starting it.

Overview of virtual tours

A virtual tour is a digital representation of a location or artefacts shown on a computer. In relation to museums, a tour is an educational tool that provides images and information that can enhance learning experiences. Virtual tours can also be an access option for disabled people who cannot otherwise experience an exhibit, due to physical, sensory or other barriers.

There are different types of virtual tours that can be used to represent exhibits. The first step in creating a virtual tour is to understand what it is and the specific features that it contains. This section discusses the different types and advantages of virtual tours while focusing on photo-based tours as the most feasible option for museums with limited financial resources.

Types of virtual tours

Type of virtual tour	Qualities
Text-based	This tour conveys an accurate sense of space through description of the exhibit. This is a simple tour, with no visual aids, allowing it to be inexpensive to create.
Photo-based	This tour contains pictures of each artefact with in-depth text descriptions. It is a simple tour to produce, involving only pictures and descriptions of exhibits.
Panoramic	This tour creates a 360 degree image of an exhibit for a greater feeling of reality for the user. These tours are often high cost due to the need for high quality pictures to ensure the photographs match correctly when patched together.

Example of panoramic virtual tour

The Old Operating Theatre virtual tour (created by Stuart Franey):
www.thegarret.org.uk/tour.htm

Type of virtual tour	Qualities
Video-based	This tour consists of a video depicting a typical museum visit, which can use both audio and text descriptions to further enhance the experience. This type of tour can be expensive to produce and difficult to update. In order to add new information, new video content needs to be produced, which can be an expensive process.
Real-time virtual reality	This tour is a mixture between the video and panoramic tour. It creates a virtual reality experience of a museum, where the user can explore the museum without restrictions on the path they take. It allows the user to experience a 360 degree arrangement of three-dimensional objects that are often immobile in the museum. It is generated in real-time, similar to a video game. Updating costs are somewhat less than that of a video-based tour, as the entire tour does not need to be recreated. Since these tours are detailed, they are often expensive to create.

Example of real-time virtual reality

Shakespeare's Birthplace – produced by The Virtual Experience Company: available on-site

Advantages of a virtual tour

There are several features of a virtual tour that enhance the learning potential and accessibility of museum content. Virtual tours can also be valuable for museums in respect to artefact conservation. Specific benefits include:

Access	providing alternate access to listed or small museums by showing objects in rooms with limited access
	allowing the user to explore with alternative formats including audio descriptions, enhanced visual aids, screen readers and British Sign Language (BSL)
	providing a closer, adjustable experience of objects that are roped off or sometimes overlooked by visitors
Education	providing a tool for use with school curriculum as an educational reinforcement and teaching supplement
	assisting in the goals of life learning
	including additional information or references which are not available at the exhibit
	allowing a personally paced learning experience which may be inhibited in the museum by other visitors moving through the exhibits
	providing a resource that can be personalised for the users' preferences or needs (language, font size and audio options)
	allowing the user to focus on items of interest rather than going through a tour of the entire building
	allowing an interactive experience to further understand certain artefacts either prior to, during or after visiting the exhibit
Artefact conservation	protecting the original unique artefacts by reducing wear from handling or lighting
	allowing access to artefacts in storage, due to limited space on-site

Photo-based tours

A photo-based virtual tour is portrayed through a series of still photographs with descriptive text about the subject. For a better understanding, follow the example links below to learn about photo-based virtual tours.

The Science Museum of London has a high quality virtual tour. The user can pick which exhibits they wish to explore rather than being forced to follow a predetermined tour. Text descriptions of the story that the museum is trying to tell are accompanied by a still-frame picture that is described in a caption underneath. Also included are some interactive elements that show how a simple photo-based virtual tour can be expanded and built upon.

The Science Museum of London website:
www.sciencemuseum.org.uk

The Victoria and Albert Museum also provides a good example of a virtual tour. The user has the choice of deciding which exhibits they wish to explore. In this example, a map is provided of the exhibit so that the user may get a sense of space and how the objects are laid out. Some exhibits have virtual tours that are more elaborate, using panoramic tours along with three-dimensional modelling, consider taking some time to explore the different exhibits. This site shows the various styles of tours and how each one can be used to create a successful virtual tour.

The Victoria and Albert Museum virtual tour website: www.vam.ac.uk/exhibitions/touring_exhibs/index.html

The British Museum has a virtual tour that is another good example. As a learning tool it is effective in providing a general tour along with a children's tour, adding to the museum experience. It can be used as a post-visit experience where visitors can learn more about particular exhibits that they found to be interesting. This site is also equipped with a section with audio descriptions for blind and partially sighted people. This part of the tour not only gives the historical significance of the artefact but also a detailed description of the object.

The British Museum virtual tour website: www.thebritishmuseum.ac.uk/compass/

Tate Modern shows the presentation of art through a virtual tour. The user is provided with still-frame photographs accompanied by text descriptions. This particular tour offers options specifically created for blind and partially sighted people as well as people with learning difficulties. High contrast pictures of artwork are provided with detailed descriptions. These descriptions are an example of not relying on the picture to describe the art. The site also provides the user with the option of printing a raised copy of the art with a swell paper copier. For deaf visitors and BSL users, Tate provides a BSL glossary.

The Tate i-Map virtual tour website: www.tate.org.uk/imap/

Advantages of a photo-based tour

A photo-based tour is not only cost effective in relation to the other types of virtual tours, but has many advantages which allow it to be a good option for the most effective presentation of material with a limited budget.

Specific benefits include:

Access	providing audio descriptions
	providing descriptive text and clear images
	enabling options for BSL
	providing an addition access option if put on the internet, assuming it follows the web accessibility guidelines
Education	enriching the educational experience at the museum as an additional learning tool
	allowing the user to explore the exhibit rather than just reading a description
Maintenance	allowing incorporation of new exhibits without recreating the entire virtual tour
	easy to update and inclusive for user needs

If the museum does not already have a digitised collection, then pictures need to be taken for the virtual tour. A professional can be hired for the process, if it can fit within the museum's budget. Otherwise, the digitalisation can be done inexpensively through the use of a digital camera by a member of the museum staff or a volunteer.

How a virtual tour can enhance your museum

A virtual tour is an effective educational and access tool for museums. However, it is important to point out that it also can compliment the educational opportunity of a museum that is already physically accessible. This section points out the benefits in each situation.

Physically accessible

If a museum is already physically accessible for disabled people, a virtual tour could be used as supplemental information. Audio and visual features could also be included for inclusive access. The tour could include quizzes and other interactive features for educational purposes.

Limited access

For museums with limited access, a virtual tour can be an excellent tool for providing access to all parts of the building. Photo-based tours can allow visitors to see all the exhibits or objects in a museum. This is helpful for providing a closer view for items that are roped off from visitors.

In both situations, the option of changing text size and colour, audio and BSL features are beneficial to all users. A virtual tour can be personally paced by the user and can be guided or self navigated to include all learning styles or visitor preferences.

What to put in your virtual tour

When designing a virtual tour it is essential to identify the content to be presented. It is important to include the interpretive experiences of the museum visit in the virtual tour to make it effective. This section provides guidance on how to translate these experiences into the virtual tour through content identification.

Identifying the audience

The first step in the process of creating the virtual tour is to identify the target audience. This helps specify the proper content and presentation features to be included. The following are some important questions to consider:

- Who will use the virtual tour?
- Is the tour aimed at any specific age groups?
- Is the purpose of the tour to improve the experience for current visitors, to interest new visitors or both?

The answers to these questions may help the museum develop ideas to guide them in the creation of their virtual tour. Focusing on a target audience may help to promote a maximum learning experience. Gearing the content towards the interests of your target audience is important for a successful virtual tour.

Outlining the story

Each museum has exhibits and artefacts that tell stories. The most important question in virtual tour development is: ***What is the story that should be told?*** It is necessary to determine the journey which you would like your visitors to experience through the use of the virtual tour. In order to help identify the storyline, it is recommended that the museum consider the following questions:

- What do you expect people to take away from visiting the museum?
- What is different about the museum in comparison to most others?
- What is the main focus of the museum?

It is important to keep the target audience in mind while answering these questions. Once a storyline is developed, the order and presentation of the exhibits that need to be included should begin to fall into place.

Example

A tour of someone's house may be set up to tell the story of their life. This tour may start with childhood artefacts, and move through other stages of their life as a timeline.

Artefact descriptions

It is beneficial to have the information included with each exhibit in the tour be detailed and descriptive; possibly even providing more information than is available at the exhibit in the museum. It is recommended to answer the following questions in order to provide a thorough description of the exhibit:

- What is unique about the particular artefact?
- What pictorial or descriptive qualities should be emphasised to communicate this uniqueness?

By including the answers to these questions in the virtual tour, the audience should be able to understand what makes the exhibit so memorable. Descriptions in a virtual tour have the ability to provide additional information or resources for users who develop a desire to learn more about the exhibit. This can also be useful for visually impaired people who benefit from description.

Tour guidance

In order to provide the information in an easy to follow manner, it is recommended that a tour follow a strategic setup while embracing the storyline. There are two basic ways to go about creating guidance in a virtual tour.

Guided tour – With a guided tour, visitors can experience all of the exhibits in their intended order. This is a good option for users who want to learn about everything the tour has to offer.

Independent tour – This option can allow the user to experience a specific room or object without going through an ordered process. The user can skip to different parts of the tour that they prefer to learn about.

It is recommended that the virtual tour provide both options. The following screen shot is the first page of the Shakespeare's Birthplace virtual tour, designed by The Virtual Experience Company.

Shakespeare's Birthplace virtual tour

Arranging your virtual tour

The arrangement of the exhibits in the virtual tour is an important part of the process. It is recommended that the tour be created to explore the museum in a logical manner. Below are two options that can help in developing the arrangement of the exhibits.

Take photographs of exhibits that will be used in the virtual tour and lay them out on a table. Museum staff members can discuss what order they should go in and position them accordingly. This could start a discussion on the content of the virtual tour and help to stimulate creativity.

or

It is possible to lay out the tour in Microsoft PowerPoint as a slide show, where the slides can easily be interchanged. To test the quality of the tour layout, it is recommended to start with the staff and then include visitors of the museum.

As can be seen by these two examples, the process of arranging the virtual tour does not have to be high-tech. An important part of this process is to receive input from the museum staff, so that all ideas are considered.

How to make your virtual tour

Along with the content that goes into the virtual tour, equally important is the way it is presented and its accessibility. A virtual tour that can not be accessed or understood creates more barriers rather than removing them. This section discusses guidance on the inclusive design of a virtual tour. Designing with the web accessibility standards and exploring user testing methods are the most important steps in ensuring inclusive design.

Including users in the design process

To produce an accessible virtual tour, it is important to consider involving potential disabled users in the creation process. They may provide useful information about their preferences and point out specific physical, sensory, and intellectual barriers. This can be done through discussions and feedback during development stages, or through exploring alternative methods such as the Usability Exchange. It is recommended to have ongoing consultation with disabled users to ensure that they have influence on the layout of material, text descriptions and navigation features of the virtual tour. Organisations such as the Royal National Institute of the Blind (RNIB) can be used to help the museum find particular user groups in the development of their tour. In addition, your local Council for Voluntary Service (CVS) may be able to provide you with a community group. You can find your local CVS through the National Association of Councils for Voluntary Service.

The Usability Exchange for disabled user testing of websites:
www.usabilityexchange.com

The National Association of Councils for Voluntary Service:
www.nacvs.org.uk

Computer presentation

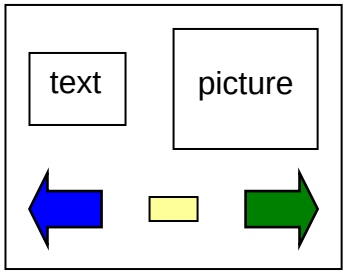
User-friendly presentation of the virtual tour is essential to its success. The guidelines in this section are based on RNIB's *See it Right* pack (2002) as well as other guides and research.

For more information on the RNIB's *See it Right* pack:
www.rnib.org.uk/xpedio/groups/public/documents/PublicWebsite/public_seeitright.hcsp

The following features are helpful considerations for the creation of an inclusive and accessible virtual tour:

User friendly navigation

- clear and relatively large navigation buttons in the same location on the screen throughout the tour
- colour-coded and consistent shapes for navigation, avoiding complementary colours
- contrast between the screen background and objects



Back Menu/Exit Next

Photos

- enlarged but clear images with a zoom feature
- clear focus on the subject without background clutter
- good contrast between background and foreground objects
- defined edges through the use of borders

Text

- sans serif fonts with a minimum of 14 point
- avoidance of italics, underlining, and words in all block letters
- sufficient weight of font in text and titles
- simple but descriptive sentences
- options for the user to enlarge text
- avoidance of scrolling text

This is sans serif font with sufficient weight and contrast.	This is an unclear font with insufficient weight and poor contrast.

Information presentation

- short sentences with simple words
- short paragraphs that capture a reader's attention
- sentences presented horizontally
- avoidance of too much information, causing clutter

Colour

- high contrast (light/dark colours) for user appeal and background and foreground distinction
- consistent colours that do not distract from the tour
- avoidance of complementary colours together: red and green, blue and orange and purple and yellow

Additional features

- audio descriptions for blind and partially sighted people
- detailed narrations of what the museum itself is like (surroundings, lighting, smells, and so on)
- in depth descriptions of paintings, artefacts and sensory qualities
- the option of BSL for deaf visitors and BSL users

Audio descriptions

Audio descriptions are a helpful feature for blind and partially sighted users, as they can provide interpretation from tone of voice as compared to screen reading software. Although audio descriptions are not required to meet basic web accessibly requirements, it is recommended that they be included if the budget allows for it. Creating audio descriptions is more involved than having a narrator reading text that would normally be on the screen. The narrator needs to not only discuss a detailed description of the artefacts, but also the significance of the exhibit. It is important to keep in mind that some users may not be able to see the image clearly. Therefore, it is helpful to find a knowledgeable writer who can convey an accurate sense of space with detailed descriptions. This could be someone working in the museum that has experience with descriptive writing and could assist with the development of audio descriptions.

For detailed explanations of the different aspects of creating an audio description consult the RNIB's *See It Right* pack and *Talking Images Guide* or Vocaleyes, a charity which provides audio description services.

More information on Vocaleyes can be found at their website: www.vocaleyes.co.uk

Here are some quick recommendations to consider when implementing audio descriptions:

- using a writer with knowledge of description techniques
- reading descriptions with a clear, pleasant and varied voice
- using tone that reflects the mood of the work
- implementing professional recording of the audio description

Outside help or do it yourself?

Once the content for the virtual tour has been identified, the next step is to assemble it into a final product. First, it is helpful to decide the method for the technical implementation of the tour – with an outside consultant or with an internal web designer. This guide by no means provides the technical knowledge required for web design. In the *Technology requirements* section, there is a brief description of some software tools for web design; however they still require significant background knowledge in terms of the web itself.

Recommendation

Unless the budget absolutely prohibits it, or sufficient web design knowledge is available, the best option for a museum is to find a web designer. The designer would have to be willing to start with the content that a museum identified through the use of this guide, and assemble it into web form to be used in a virtual tour. A good place to start is with the same web designer a museum used for their current website, if they have one. Otherwise, the British Standards Institution (BSI) PAS 78:2006 *Guide to good practice in commissioning accessible websites* provides some recommendations on choosing a web designer, particularly for keeping accessibility in mind.

Technology requirements

In order for the museum to complete the website themselves, basic web authoring and photo manipulation tools are required. Although the choice is up to the museum itself, there is a wide range of tools available in terms of both capability and price. The industry standard tools are Adobe Dreamweaver (formally Macromedia Dreamweaver) for web authoring and Adobe Photoshop for photo manipulation. A reduced price version of Adobe Photoshop, called Adobe Photoshop Elements, is also available and should be sufficient for the image manipulation that is necessary for basic web development. Adobe GoLive and Microsoft FrontPage are also popular web authoring tools.

If the museum desires to take the photographs themselves, a digital camera is recommended, although using a film camera and scanning is also an option. In general, digital cameras are specified in terms of their image resolution, in mega pixels, and for web photos a camera generating at least four mega pixel images should produce photos of acceptable quality. If the museum wishes to use the camera for printed materials, the investment in a higher quality camera is recommended.

Important steps

Once the content to include in the virtual tour has been identified and the method for creating the tour has been chosen, the next step is to begin the process of virtual tour implementation. There are two primary parts to this:

- assembling the content (taking the photographs)
- implementing the tour (authoring the webpage)

Photographs – If the museum has completed or is in the process of completing a digitisation project, this would be an excellent source of high quality pictures that are already available. Otherwise, the museum must obtain the photographs of the exhibits to be included in the tour. This could be done by working with a professional or completing the work themselves.

Working with a professional photographer is an option for museums that desire higher quality photographs, which could be used in later projects. However, to save on resources, it is perfectly acceptable for the museum to take their own photographs. To obtain the highest quality pictures and creating the most professional outcome, some reading into basic photography is recommended. The manual that comes with a camera is an excellent source for this information, as it discusses specific settings, for obtaining high quality photographs. It is also important to ensure that all pictures are taken at the highest possible resolution to obtain the highest quality photographs, which can be scaled down at a later time.

Physical layout – In order to incorporate photographs into the website, the museum needs to consult a web designer or use a web design tool to create the HTML code appropriate for web presentation of the photographs. As discussed previously, it is recommended that the museum only attempt the website creation themselves if they have sufficient background. Important considerations include both the *Web accessibility* guidelines, below, as well as the *Computer presentation* on page 13.

Web accessibility

Following web accessibility standards ensures that the virtual tour content presented is available to everyone, regardless of how they experience the site. It is important to consider the guidance provided by the standards of the Web Accessibility Initiative (WAI), set by the World Wide Web Consortium (W3C). Complying with the web accessibility standards allows all internet users to experience the virtual tour, including people who use screen readers and other technologies. Complying with the WAI is something that is primarily done by whoever creates the site, being the web designer or the museum itself, although it is important to consider throughout the process.

A full copy of the W3C WAI standards can be found at: www.w3.org/WAI/, as well as additional resources to assist in complying with the standards

Tips provided by the WAI for consideration by web designers:

1. images and animations – use the alt attribute to describe the function of each visual
2. image maps – use the client-side map and text for hotspots
3. multimedia – provide captioning and transcripts of audio, and descriptions of video
4. hypertext links – use text that makes sense when read out of context, for example, avoid 'click here'
5. page organisation – use headings, lists, and consistent structure, use CSS for layout and style where possible
6. graphs and charts – summarise or use the longdesc attribute
7. scripts, applets and plug-ins – provide alternative content in case active features are inaccessible or unsupported
8. frames – use the noframes element and meaningful titles
9. tables – make line-by-line reading sensible, summarise
10. check your work – validate, use tools, checklist and guidelines at www.w3.org/TR/WCAG

Additional information on web accessibility is also available from the BSI, under PAS 78:2006 *Guide to good practice in commissioning accessible websites.* The standard provides guidance that goes beyond the WAI standards by acknowledging the fact that they can limit the creativity of the website by not allowing content requiring plug-ins, such as Adobe Acrobat or Adobe Macromedia Flash. Instead of disallowing them as the WAI does in some cases, it provides alternative means to provide access while using these formats, which is a compromise between creativity and accessibility. In addition, the standard provides guidance on choosing a web developer, user testing of the website and maintaining accessibility.

A copy of BSI PAS 78:2006 can be purchased from BSI at: www.bsi-global.com/ICT/PAS78/index.xalter

Where to put your virtual tour

The next step in the creation process is to determine the best way for users to access the virtual tour. There are three options for the availability of a virtual tour: on-site, online or both. The recommendation of this guidebook is to make it available both on-site and online, but each option is explained in detail throughout this set of recommendations. This section also discusses the ergonomics of a computer work station, assuming placement of the virtual tour on-site.

On-site access

An important consideration for the museum is whether or not they want to make the virtual tour available on-site (at an accessible kiosk). For museums with limited access to the building, the recommendation of this guidebook is to always make the virtual tour available on-site, so that it is available as an alternative access medium for disabled visitors.

If the decision has been made to make the virtual tour available on-site, the placement of the virtual tour at the museum is also important to consider. Placing the tour in an accessible exhibit area of the museum allows all users taking the tour to experience the significance of being at the museum as well as the educational value of the tour. However, it is not always physically possible to make the tour accessible in an exhibit area of the museum. In these situations, it is recommended that the tour be implemented on-site in an accessible location.

Shakespeare's Birthplace on-site virtual tour

Internet access considerations

Another important consideration is whether or not to make the virtual tour available on the internet. By placing the tour on the internet, the general public can preview what is available in the museum. This preview may create a greater interest in the subject, stimulating the general public's desire to visit the museum. In this way, a virtual tour can be considered a complementary experience. If the museum has its own website, a link can be provided to the virtual tour. If the museum does not have a website, it may be an excellent opportunity to create one integrated with the virtual tour.

Ergonomic setup

If the museum has made the decision to make their virtual tour available on-site, it is important to consider how it will be presented. In order to create an accessible and user friendly environment for all visitors, it is important to regard the ergonomic qualities of the workstation. The following are standards to consider when creating a work station that is accessible:

Computer station surface: • activity surface preferred at 760mm from floor level • more than one height option or an adjustable system
Space below surface of computer station: • depth of 500mm minimum from front to back, with chamfered front edge • 700mm height (750mm will clear armrests on a wheelchair) • width of 800mm minimum
Controls: • manual controls 750-1000mm from floor level • base of interactive or touch screen units at a maximum height of 760mm from floor level
Other important information: • large cells for touch screens preferred at 40 x 40mm • screens should be adjustable, or kept at an angle of between 55-77 degrees from the back of the monitor to the horizontal surface • interface operable with one hand • removable seat

For more detailed ergonomics of creating a work station consult: BS 8300:2001 *Design of buildings and their approaches to meet the needs of disabled people – Code of practice*, available from BSI at www.bsi-global.com/Building/Disability/index.xalter

Also helpful in creating a work station are recommendations in *Access to ATMs* by the Centre for Accessible Environments

User controls for on-site access

If placing the virtual tour on-site, it is also important to consider a user interface method that is easy to use. There are many different kinds of interactive controls available. While some new technologies may seem like the best option at first, it is important to ensure they do not create frustration by introducing new barriers. There are a variety of computer mice, keyboards, and interactive screens to choose from. It is important to keep in mind that this is what connects the user to the virtual tour, and if the controls are difficult to manage, it may hinder the virtual tour experience. The RNIB has information on controls that have few visual barriers and can help with the decision on suitable options to fit the museum's and user's needs. User testing is vital to the success of the interactive control of the virtual tour and should be done before any one setup is decided upon. Once a suitable choice has been made, the instructions on how to use the controls need to placed in an obvious location next to the virtual tour and written in a clear manner.

What to do with your finished virtual tour

The final step in the virtual tour creation process is to regularly improve and update its content. This is where a photo-based tour is convenient because it is often easier to update than other types of tours.

Since a virtual tour is created for the visitors of the museum, it is important to have a feedback system that allows people to give their opinions to help the museum improve its virtual tour. It is important to ensure that the staff members of the museum are knowledgeable about the virtual tour and are able to pass this information onto visitors to enhance the visitors' overall experience. This section discusses how to maintain a successful virtual tour.

Maintenance

What is special about photo-based virtual tour 2maintenance?
A virtual tour is unlike other forms of communication, such as print or pre-recorded audio and video. New information can be added and modified, unlike printed materials which must be completely replaced. This is one of the advantages of a virtual tour, but if ignored, can also be a significant disadvantage. With the additional flexibility of upkeep come additional user expectations of an up to date tour.

Considering maintainability from the beginning
It is important to consider creating a virtual tour with expandability in mind. Although this may mean a greater upfront cost, it could mean substantial savings later on if the museum wants to expand its virtual tour. In addition, the museum may want to decide how they plan to update the virtual tour when physical changes to the museum are made, for example, when additional items are added to an exhibit. It is important for changes in the physical museum to be updated in the virtual tour, to avoid confusion by the user and to ensure that the best experience is provided.

Who will maintain the virtual tour?
One challenge of web content, which includes the HTML based virtual tours discussed in this guidebook, is the fact that the latest copy of the virtual tour is presented to each user each time it is requested. Unlike printed material, which is printed all at once and is guaranteed to stay the same, web content can change. Changes to the environment make it possible for a virtual tour to end up in a 'broken' state, where the content does not display as expected. If staff members who work at the museum complete the web content creation of the virtual tour, then this is not as much of an issue, as they will be able to fix it. However, if the virtual tour is completed by a consultant, it is important to discuss their maintenance plan for updates and what they will do if something goes wrong. This could include paying them a yearly fee for a set number of hours, or simply paying them by the hour when work needs to be completed, depending on the consultant.

Evaluating virtual tour service

Feedback is one of the most important and effective ways of finding out what can be improved in any service. For a virtual tour, there are several ways which information can be gathered from users:

- providing a written questionnaire about the virtual tour
- providing a comments section for feedback in the virtual tour
- gathering feedback from visitors through discussion
- ongoing consultation with disabled users

All the feedback may be monitored weekly to make sure that the virtual tour is meeting the needs of the visitors. It is important to remember that the virtual tour was created for the users and that their feedback is essential in maintaining a successful tour.

Implementing staff guidance

One of the most important features of having a successful and inclusive virtual tour is to make visitors aware of it. The first step in this process is to provide guidance and training to museum staff about the value of the virtual tour and the importance of informing all visitors of its content and educational significance. The virtual tour is only valuable to users when they are aware it is available. Therefore, it is essential to ensure that the museum staff members inform all visitors of the virtual tour features and availability.

Appendix: Additional resources

The British Dyslexia Association (BDA): www.bdadyslexia.org.uk
The BDA promotes the welfare of dyslexic people. They aim to influence government and other institutions to promote a dyslexia friendly society. They strive to represent the needs of dyslexic people in higher education and work. Along with research, they provide training and consultancy services regarding policy and strategy.

British Standards Institution (BSI): www.bsi-global.com
BSI is the body which sets the national standards for the United Kingdom. The most relevant to virtual tour creation are BS 8300:2001 *Design of buildings and their approaches to meet the needs of disabled people – Code of practice* and PAS 78:2006 *Guide to good practice in commissioning accessible websites*. The standards are available for purchase from their website as well as via telephone at 020 8996 9001.

Centre for Accessible Environments (CAE): www.cae.org.uk
CAE is a charitable organisation which assists in the use of inclusion by design. CAE has assisted museums and other organisations in creating access solutions to their facilities. They have published many guides which may be helpful in the consideration of removing barriers:

- *Access to ATMs: UK design guidelines*
- *Access Audit Handbook*
- *Designing for Accessibility*

Disability Rights Commission (DRC): www.drc-gb.org
The DRC's goal is to create 'a society where all disabled people can participate fully as equal citizens.' The DRC's mission is to change the public's attitude and awareness of disabled people.

Museums, Libraries and Archives Council (MLA): www.mla.gov.uk
The MLA is a government funded organisation which assists museums, libraries and archives in unlocking all of the information which they provide. The MLA has published several guides on accessibility, the most influential being the *Disability Portfolio*. The *Disability Portfolio* is available free on their website, in both Microsoft Word and Adobe PDF formats, by choosing 'Information' followed by 'Publications'.

Royal Association for Deaf people (RAD): www.royaldeaf.org.uk
The RAD promotes the welfare and interests of deaf people whose first or preferred language is BSL. They strive to create inclusive environments for the entire deaf community. The RAD has training courses to help raise awareness by teaching BSL and lip-reading.

Royal National Institute of the Blind (RNIB): www.rnib.org.uk
The RNIB is a national UK charity which assists blind and partially sighted people. RNIB often works with museums and can provide useful information, such as ideas for removing barriers or information and providing information other museums which have tried certain ideas. The RNIB has published several guides on removing visual barriers. The two useful guides for creating virtual tours are:

- *See It Right*
- *Talking Images Guide*

Royal National Institute for Deaf People (RNID): www.rnid.org.uk
The RNID represents the nine million deaf people and people with hearing impairments in the UK. The RNID supports and conducts a lot of hearing research. They are an excellent resource for any inquiries regarding accessibility for deaf people or people with hearing impairments. They complete training programs, including one designed towards the study of BSL.

Usability Exchange: www.usabilityexchange.com
The Usability Exchange can be contacted to find out if your website is accessible. They employ disabled people to test the accessibility of websites. Through remote viewing software it is possible to observe the testing as it takes place.

The Virtual Experience Company: www.virtualexperience.co.uk
The Virtual Experience Company assists in the creation of virtual tours for museums. They focus on real-time virtual reality tours, where a user can experience the museum in virtual reality. The tours also allow users to explore selected objects in greater detail, including options such as bringing up additional text information, high resolution photographs and detailed three-dimensional models.

Vocaleyes: www.vocaleyes.co.uk
Vocaleyes is a national charity which works to enhance the experiences of blind and partially sighted people at the theatre and museums. They provide audio descriptions, with focus on theatre performances but they also complete work for museums, galleries and heritage sites. They are an excellent resource for professional audio descriptions, from development to recording stage.

Other access options

Although this guide provides several recommendations for solutions to create a virtual tour, sometimes it is not the correct access solution. When physical changes are reasonable, it would be more advantageous to remove the barriers, as the physical visit is often far more powerful than a virtual representation. This is a recommendation to consider, before committing resources to a virtual tour. All reasonable options should be explored by consulting several of the references included above and by performing an access audit. Specifically, the *Access on a Shoestring* and *Accessible Environments* guides found in the MLA's *Disability Portfolio* provide excellent information on affordable options that should be explored in addition to, or instead of a virtual tour.

Chapter 6: Conclusions and Recommendations

This section is devoted to our recommendations for museums and the Centre for Accessible Environments (CAE) regarding the *Museum Virtual Tour Design Guide*. The final guidebook will be available to museums throughout the United Kingdom on the web after a month of the release of this project to assist them in creating a virtual tour. This section covers future recommendations for CAE, including how to distribute the guide and updates to the guide that would be beneficial.

6.1 Recommendations for Museums

Based on our interviews and background research on museums, access issues, and virtual tours, we made several recommendations for museums in our guidebook. The majority of these recommendations are provided in the guidebook itself, and this section simply summarizes them. These recommendations deal with learning about virtual tours, what to include in the virtual tour, how to create the virtual tour, where to put the virtual tour, and updating and maintaining the virtual tour. These considerations are for museums with limited resources but can also be applied to larger museums with a larger budget to create a more elaborate virtual tour.

The first chapter of our guidebook simply introduces the user to virtual tours and provides information on different kinds of tours. This is where we recommend the photo-based virtual tour as the ideal tour for a museum with a small budget. It is simpler to make than panoramic, video, or real time virtual reality tours and has the capability to be accessible to all through the use of audio descriptions, descriptive text, clear images, and BSL options. If a museum has no on-site access issues then we recommend using a virtual tour as an educational tool, incorporating the accessibility options mentioned above. If a museum has limited access, a virtual tour can be used not only as an educational tool, but also as an access tool that removes barriers so that all users can experience all of the exhibits and artifacts.

The next sets of recommendations are about what to include in a virtual tour. We realize that museums understand the interpretive experiences they provide, so in this section we provided considerations on how to transfer these experiences to a photo-based virtual tour. We recommend starting off by identifying the potential audience of the virtual tour and outlining the story through strategic arrangement of images. The next step is to come up with descriptions of the artifacts. The guide provides some questions that we recommend answering to help in developing the descriptions. Virtual tours can follow a pre-determined path or allow the user to guide themselves throughout their virtual experience. Providing both options to the user is our recommendation so that they have the freedom to see what exhibits interest them or take the guided tour so that they get to see the exhibits the museum feels are the most important. After the content is decided, the arrangement of the artifacts needs to be determined. We provide two different options to decide the creative arrangement of content. The first way is to take photographs of the exhibits and lay them out on a table so they can be moved around. The other way is to put everything into a Microsoft PowerPoint presentation that allows you to move slides and decide upon the order. The important part of this process is to receive input from members of the museum staff so that different ideas are considered and the staff is confident in the order that is decided upon.

The third set of recommendations is about how to create the virtual tour. An important aspect of creating an accessible virtual tour is including the users in the development process.

This is something that was pointed out to us throughout our interviews. We also provide a couple of links to help museums find user groups that will assist them in testing their virtual tour. The next section discusses guidelines for computer presentation including considerations for user-friendly navigation, photos, text, information presentation, color, audio descriptions, and additional features. For the actual virtual tour creation, we recommend that a museum hire a web designer to put all the content and features that were identified together. However, for museums with a limited budget, we recommend using a museum staff member that has sufficient knowledge in web design.

Once the virtual tour is created, the museum needs to decide where to place it. When creating a virtual tour to extend access, it is important not to replace an inaccessible exhibit with an inaccessible virtual tour. The guidebook discusses ergonomics of building a computer work station when placing the computer in the museum. We recommend following the best standard practices set forth by BS 8300:2001 *Design of buildings and their approaches to meet the needs of disabled people – Code of practice*. Museums can place their virtual tour within the museum itself or put it online for the general public. Our recommendation is that museums do both, as this will create further access to the museum, extend their reach in terms of knowledge, and pass their information on to more people. We realize that there is no way to duplicate the power of the "real" and that a virtual tour will never provide the same experience as an actual visit. Therefore, if it is possible, we recommend that a museum place the virtual tour amongst their exhibits so that the artifacts are surrounding the user as they take the tour.

The final set of recommendations deal with what to do with the virtual tour after it has been created and implemented, including updating and maintaining its contents. An advantage of using a photo-based virtual tour is that it can continually be updated and made better over time. We recommend making notes of where further improvements can be made and once the museum has the time and money, they will be able to go back and create an even better experience for all users. Since virtual tours are created for the museum visitors, it is important to consider their feedback when accessing the virtual tour. It is our recommendation that a museum set up some way of receiving feedback from users either by providing a questionnaire, through discussion, or any other way they deem appropriate. It is also important to make sure that the museum staff are educated and trained about the use of the virtual tour so that they can ensure users are getting the full experience.

Taking our recommendations one step farther, we wanted to make it clear to museums using our guidebook that a virtual tour should not stop the museum from altering any physical barriers that will assist in creating accessibility. It is of the utmost importance to make the museum as accessible as possible. To do this, museums should have an access audit done to their facility. This will help museums be aware of solutions they can implement to extend access, beyond what our recommendations on a virtual tour can provide.

6.2 Recommendations for the Centre for Accessible Environments

The *Museum Virtual Tour Design Guide* was created for the Centre for Accessible Environments (CAE) to assist museums in the creation of an inclusive virtual tour. It is important for the tour to be maintained and updated simultaneously with additions to the museum itself. We recommend that CAE receives feedback from users for ideas on how to consistently improve the quality of the guidebook. Although we received feedback ourselves on the guidebook, the seven week time restraint did not allow for as much feedback as we wanted due to the busy schedules of museum and disability organization representatives. In order to find out how useful the guide is, it is our recommendation that CAE gets feedback from museums

that use the guidebook. Using feedback to improve the guidebook allows better guidelines to be presented to other museums. We have provided an email address in the guidebook for museums to respond with their feedback. Through the work of our project and the continued efforts of CAE, museums will be able to create virtual tours while using fewer resources than was previously required. This leads to the ultimate goal of museum accessibility and educational experiences being enhanced through the application of new ideas and technological innovations.

Through much discussion and consideration it was decided to make the guidebook accessible as a PDF link on CAE's website. This allows users to download the guidebook and view the links provided for further understanding. Its printable presentation also allows the user to print it out and make their own comments as they proceed through the virtual tour creation process. If the guidebook is as popular and helpful as we all hope it will be, CAE may want to do more to distribute it. For example, CAE may want to publish the *Museum Virtual Tour Design Guide* to accompany their many other guides on inclusive design. Another possibility would be to create an HTML version of the guidebook available through the CAE website. This would be offered as an alternative to the PDF version which created, and would allow for an enhanced user experience when used via the web.

Through working with the Centre for Accessible Environments and researching the issues of museum access and interpretation, our group has found a new respect and understanding of the importance of inclusion by design. Through the implementation of virtual tours it is possible to address the problem of accessibility in new ways. However, it is necessary to be careful that the technology does not overshadow the original experience or create new barriers through the use of a computer. Therefore, the use of inclusive ideas for design features is essential to overcome physical, sensory, and intellectual barriers. The *Museum Virtual Tour Design Guide* follows the ideas of inclusive design to expand the guidance of CAE by providing more access options for museums throughout the United Kingdom.

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Appendix I: Americans with Disabilities Act

In 1990, the US passed the Americans with Disabilities Act (ADA). This act was passed to create equal rights and opportunities for disabled Americans. The US government is providing assistance in conforming to the ADA regulations. Federal tax incentives are given in order to help meet the extra costs of updating buildings for accessibility. The focus for small businesses seems to be placed on removing "physical barriers that are readily achievable, which means easily accomplished without much difficulty or expense" (ADA Guide for Small Businesses 1999). Small public businesses are expected to remove these barriers as long as the expense does not cripple the business due to the large expense. However, as they grow and increase their resources, it is expected that they spend more money to remove these barrier to increase the accessibility. The Department of Justice branch of the US government has assisted with the struggle to increase accessibility by creating a mediation program.

In comparison to the CAE, the US has an ADA Mediation Program. The ADA Mediation Program was established in 1994 by the Department of Justice. The mediation program is an informal method to resolve conflicts of accessibility. If there is a complaint about a building, then a Department of Justice mediator would be brought in at no cost to either party to try to mediate the dispute and come up with a good compromise. Under successful mediation, both parties would agree to the mediator's recommendations in a binding agreement. It is important that the mediation is impartial "they do this by assuring the fairness of the mediation process, facilitating communication, and maintaining the balance of power between the parties" (Department of Justice ADA Mediation Program 1994).

According to the regulations of the ADA Standards for Accessible Design all public building must fulfill certain requirements of accessibility. Under the subsection "Accessible Buildings: Historic Preservation" it explains that each public building, even historically preserved buildings, must have at least one accessible entrance. However, this could be disastrous to certain historic buildings. By adding accessible entrances, such as ramps, the overall feel and historic significance could be taken away from the museum or famous landmark.

Appendix II: Interview Plans

An Outline for Determining Disability Access Issues with Input from Museum, Heritage, and Disability Organisations

Interview Participant Name:
Organisation:

Background

1. What is your role in relation to museums?

Access Issues

2. What are the most prevalent access issues museums have, which you are aware of that need to be solved or improved?

3. Are there any specific issues difficult to address simply through a guidebook? (such as intellectual access)

4. Other than the Disability Portfolio, what have you done in the past to help museums solve access problems?

5. Are there any specific museums you work with or do you primarily complete guides that can be used by all museums?

Access Implementations

6. What is some feedback you have received from your recommendations to museums? Specifically, were there parts of work that you completed which they liked or disliked?

7. What is your opinion on virtual tours in relation to them being an additional option for access to the museum for disabled people?

8. Are there specific implementations of virtual tours that you think do an excellent job at providing access?

9. Do you have any recommendations or questions regarding the virtual tour creation process?

An Outline for Determining Disability Access Issues with Input from Exhibition Designers

Interview Participant Name: James Dibble
Organisation: Land Design Studios

Background

1. What is your role in relation to museums you work with?

Access Issues

2. What are some current access problems that need to be solved?

3. What has inhibited museums from improving these access issues?

4. Have you seen any examples where virtual tours have helped to solve such issues?

Access Implementations

5. Who usually initiates the access concern, you or the museums?

6. What are the specific steps you use in the creation of an exhibition with access as a priority?

7. What personal recommendations do you have that should be kept in mind in creating a virtual tour for disabled people that can produce a better experience than a physical visit?

8. Do you feel that there any disadvantages from implementing a virtual tour?

9. How would you rate your knowledge of current access solutions, including physical changes within the museum as well as virtual tours?

An Outline for Determining Access Issues with Input from Virtual Tour Designers

Interview Participant Name: Mike Gogan
Organisation: The Virtual Experience Company

Background

1. What is your role in relation to museums you work with?

Access Issues

2. What are some access features that you implement into virtual tours?

3. How have virtual tours helped to solve museum access issues?

Access Implementations

4. What are the specific steps you use in the creation of a virtual tour?

5. What personal recommendations do you have that should be kept in mind when creating a virtual tour for disabled people that can produce a better experience than a physical visit?

6. How do you identify the content to focus on in a virtual tour?

7. What are some of the questions you are frequently asked by museums who are perspective clients? What are some of their biggest worries about a virtual tour?

8. What is your feeling on the placement of a virtual tour - should it be available for everyone on a museum's website, or should a visit be required to the museum in order to experience it? Is this often very museum dependant? Who usually makes the recommendation or decision on it, you or the client?

9. What do museums usually have problems with when creating a virtual tour?

10. If we were trying to build an inexpensive but effective photo based tour, how would we go about this process in respect to software?

11. If a museum had all the necessary information and content for their virtual tour (from using our guidebook) is it possible for you to take the process from there? What kind of savings would this provide to museums?

12. Are there any other people in this field that you recommend we contact for more information?

Appendix III: Guidebook Feedback Questions

Museum Virtual Tour Design Guide Feedback

Thank you for giving us feedback on the guidebook we created. We are open to all comments and criticisms, as it will help us improve it to make it more usable for museums. Please understand, however, that this is still an early draft of the guidebook, and there are several revisions that still need to be made, but please point them out to us. This is a list of some questions we hope will provoke thoughts about the guidebook, but please don't limit your comments to ones based on these questions, nor feel that it is a requirement to answer all the questions.

Thanks,
CAE Museum Virtual Tour Design Guide Group
Cathryn Bedard
Jason DuBois
Scott Lehtinen
Brian Loveland
cae-d06@wpi.edu

1. If you don't have a virtual tour: What had prevented you from creating one in the past? Does this guidebook relieve any of those issues? Would you be more likely to create a virtual tour now?

2. If you do have a virtual tour: How does the process this guidebook proposes differ from the way you created your virtual tour? Would this guidebook have helped you in that process?

3. Do you feel there are any areas of the guidebook that are lacking in content? (Sections that you wish more information was provided, or references to additional information) Are there areas of the guidebook where too much information is provided? (Where you felt that the information presented was unnecessary)

4. Please comment on you feelings on the writing style of the guidebook – Is it too casual (not professional enough)? Is it too strict, and doesn't walk you through the process enough?

5. What is your feeling on the overall formatting of the guidebook? Is there anything that is too distracting or areas where you think the attention is focused on the wrong objects?

Appendix IV: Other Physical Access Technological Implementations

As technology advances it becomes important for disabled people of the world not to be left behind. People with disorders such as visual, hearing, learning/cognitive, physical/motor and seizure can all use specialized tools to improve their way of life and museums are a particular sector of society where technology can be utilized to help provide the same experience to everyone regardless of their condition. This section will focus on the visually and hearing impaired in particular and what has been implemented in museums for them thus far.

Technology for Visual Impairments

The DDA requires museums to provide considerations for the disabled. However, it does not go into detail on how to accomplish this. That leaves museums responsible for analyzing their own exhibits and executing the necessary means to provide an inclusive visit for all. The blind or visually impaired have been left behind with regards to museums in the decades past. The visual stimulus of an exhibit is typically what comes to mind when one thinks of a museum and thus a mere audio description of an exhibit will not suffice in most cases. Instead, other senses need to be used when attempting to convey the meaning of a particular segment of a museum, the most prevalent one being touch. The stereotypical "no-touch" policy is being disregarded and visually impaired patrons are being encouraged to touch certain objects, particularly those on a touch tour. This is where museums set aside certain pieces of art and history for people to touch so that they may gain a better understanding of the meaning that they convey (Brennan 2003). These objects are often replicas of the original or in some cases the originals and gloves are used to maintain the artifacts for generations to come.

Tactile graphics are also becoming common in museums, which are basically a raised pattern of a picture intended to help the visually impaired gain a sense of space and style incorporated into that particular picture (Lang 2001). These graphics are great supplements to text and help to convey pictures, diagrams or maps. Art work has always been difficult to portray through audio descriptions and even touching a particular painting/drawing will not help in most situations, but with tactile graphics the visually impaired can get a real sense of what a certain piece of art actually looks like (National Centre for Tactile Diagrams).

More technologically advanced solutions are also finding their way into current day museums. User-Activated Environmental Audio Beacons (Ping!) is one such solution being tested. Ping! is a cell phone based software where someone will call a number provided at the museum and follow the step-by-step instructions on the phone (Landau 2005). The software has the user pick out a certain "Ping" or sound that they can easily recognize and will use to navigate themselves around the museum. Once the user has chosen their "Ping", that sound will no longer be available to others. This allows for multiple visually impaired patrons to use the system at the same time. By pressing a button on the phone an audio beacon will instantly be sounded and can be used to navigate the person to a particular area. Once at their desired location the patron can then listen to an audio description on the phone before repeating the process in order to move on. This particular technology allows the visually impaired to guide themselves through an exhibit space without the help or need of someone else. This system was tested at the New York Hall of Science during regular business hours. A total of twelve participants were used and it was found to be a success, as they rated the system as being excellent. The "pings" did not seem to bother other patrons of the museum and for the most part they did not even notice them (Landau 2005).

Through this study hopefully the Ping! system can be implemented at other museums and eventually become a staple of all museums worldwide.

Haptic devices are another technological advance that can be used in museum settings to help the visually impaired. These devices allow users to feel virtual objects in which the surface properties are modeled and feel like a solid, three-dimensional object with different textures, hardness or softness (Brewster 2006). One such haptic device called the PHANToM consists of a motor-controlled, jointed arm that allows six degrees of freedom with those being x, y, z, pitch, roll and yaw. It allows the modeling of free-floating three-dimension objects by "portraying a resistive force at the user's fingertip, or the tip of a tool or stylus that is grasped by the operator" (Brewster 2006). There are limitations to haptic devices with the most prevalent one being the fact that all contact is through a single point; like that of a finger, and there are no whole hand devices. Subtle surface textures are also extremely difficult to match and sometimes impossible. Through this technology a much wider range of objects could be "touched" and at the same time maintain the integrity of the actual exhibits.

Technology for Hearing Impairments

People with hearing impairments are another group that museums need to focus on to create an inclusive visit for. Museums must implement supplements to any speech based tours. This can be done through special sign language tours or by providing a print out of what is being discussed. Though these options work it also has the negative affect of taking the person's focus off of the actual exhibit and onto another person or paper. Headphones or other hearing aids are one way of solving that problem, an Induction Loop system is one such device. An Induction Loop system allows for a direct connection to the sound source enabling any hearing aid using a T switch to tune into the audio frequency and block out background noise (The Royal).

When looking at the tools discussed thus far, one will realize that they require everyone to be able to walk throughout the museum without any hindrance. Virtual tours are a way for any person to experience a museum without having to be there. Through the use of 3D graphics people are submerged into this alternate reality where they can explore the various exhibits a museum has to offer. Virtual tours can be done at the museums themselves or can be accessed via the internet anywhere in the world. This allows for the inclusion of the mobility impaired. It also can be used as a great supplement in that the tours can be taken by anyone and thus extending the museums reach into the community.

Through the use of such practices as touch tours, tactile graphics, virtual tours, sign language tours and such devices as Ping!, haptic and Induction Loop museums are moving closer to providing an equal experience for all. The limitations and barriers put forth by their disability are being overcome and eventually one day a museum visit can be inclusive and enjoyed by all.

Appendix V: Detailed Timeline

ID	Task Name	Duration
1	**Review Publications**	**4 days**
2	Look Over Publications	1 day
3	Identify Alternative Options Publications	3 days
4	Identify Guidebook Format Publications	3 days
5	Web Accessability Research	4 days
6	**Contact Museums and Organizations**	**12 days**
7	Develop Interview Request	2 days
8	Initial Contact Requesting Interview	1 day
9	Wait for Responses	4 days
10	Interviews Scheduled	0 days
11	Develop interview questions	2 days
12	Interview Questions to Cassie & Paul fo	2 days
13	Conduct Interviews	7 days
14	Interviews Completed	0 days
15	**Guidebook Development**	**14 days**
16	Clearly Define Sections	1 day
17	Interpretive Experiences Process	4 days
18	Content Presentation Process	7 days
19	Virtual Tour Background	4 days
20	Web Accessibility	3 days
21	Alternative Options	4 days
22	Guidebook Draft Developed for Testing	0 days
23	**Test Guidebook**	**20 days**
24	Identify Testing Methods	1 day
25	Choose Museums to Test Guidebook	5 days
26	Contact Museums for Second Round	1 day
27	Develop Testing Interview Questions	2 days
28	Conduct Testing	4 days
29	Testing Completed	0 days
30	**Finalize Guidebook**	**6 days**
31	Integrate Input from Testing	4 days
32	Review with Paul and Cassie	2 days
33	Finalized, Completed Guidebook	0 days
34	**Report Sections**	**30 days**
57	**Other IQP Assignments**	**28 days**