MEseum: CONSTRUCTING DIGITAL NARRATIVES FOR THE MUSEUM VISITOR

By

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Abstract

As the modern museum continues to evolve into a more digitized institution, the need to facilitate the interaction between the museum and an equally emergent digital generation of museum audience is imperative. Many museums have sought for ways to support this interaction and invariably enhance their visitors' experience through the application of various interactive and online technologies. This research aims at the design and development of a museum-visitor interactive system with a set of tools catering to the new generation of museumgoers. By introducing and using the concept of narrative as a key element for accessing, collecting and sharing museum experiences, the proposed system, *MEseum*, offers various tools to the museum-visitor that allows for the authoring, curating and sharing of museum experiences. The basic concepts underlying the research are; (a) A new approach to the museum experience as a customizable interactive narrative (b) A social media context within which that experience is implemented and (c) The use of various interactive technologies to facilitate the experience, including but not limited to social media and way finding tools. The research explores these concepts and applies it to each phase of the museum visit, from planning a visit, to arriving at the museum, and then, later access to memories made.

Dedication

To the Mike-Ifeta family, the vehicle by which I arrived.

To the ones who arrived before me- my siblings; Odiri, Ese, Og and Akpoesiri, four templates by which I am opportune to model my life after.

To Michael, my father, the one who is as constant as the northern star.

And to the memory of Roseline, my mother, who gave me life and conscientiously raised a man she never met. Your exit has only reinforced that which your presence quickened. This is truly yours.

Acknowledgments

As I look back upon these last two years of graduate school, one moment seems to rival all others. I remember, and with so much clarity the very first class I sat in and because it coincided with the first class of the term, we also had to introduce ourselves. I listened patiently to the others speak and before long, the gaze of the instructor had fallen on me. That was quite fast I thought as I sat in silent desperation but it was my turn to give a short sentence about myself; my name, where I was from and my academic background and I had to speak. Now, all I had heard until this moment were sentences that ended with such phrases as "…and I have a Psych background", "… and my first degree was in Industrial Design", "…and I have an undergraduate degree in Computer Science". Although I knew from the onset that the program was multi-disciplinary, I could not quite make out at that moment what part of 'multi' I fit in. It felt as though I was at the other end of the spectrum. I thought about my response for a fraction of a second even as new and inquisitive pairs of eyes joined that of the instructors'. I eventually responded and my self-introductory sentence ended with the words "…and I am a Theatre Artist".

I remember this moment every time I get the blank expression that often follows the revelation of my academic journey but the reason I tell this story now is to somehow validate the trajectory that has taken place between then and now, and which could only have been possible through the Human Computer Interaction program at Carleton University, and at the hands of its instructors. Residual skills from past disciplines have only been heightened by this sojourn and I have become a more intellectually refined man because of it. So, I will like to specially thank

some of the people who have in one way or another been instrumental to this academic endeavor and its success thereof. I would like to first of all acknowledge and express my gratitude to Erenia H. Oliver, an administrative assistant at the School of Information Technology who suffered a barrage of emails from me in the months leading up to my admission and acted as an effective conduit between the program and myself. Your sustained empathy and kindness throughout my study is appreciated and will not be forgotten. I also like to thank the current chair of HCI program, Professor Anthony Whitehead, whom I believe felt some of the brunt of my 'incessant' correspondence with Erenia in those months. I am indeed thankful for the role you have played in my journey, both as chair of the program and an instructor. Special thanks go Professor Robert Biddle, also an instructor in the program. The book you so willingly introduced me to early on in the program; 'Computers as Theatres' by Brenda Laurel affirmed my place and answered most of the questions I had coming out of that first class. It took a while but I eventually found my fit.

Special thanks goes to Anthony Scavarelli of The Luminarists, Justin Loranger Ahluwalia and Jesse Gerrior, the amazing and talent filled team I worked with on this project. Thank you for your time and technical input. I would also like to thank members of staff at the Canadian Aviation and Space Museum, especially its Director General, Stephen Quick and its Manager, Museum Projects, Renée Racicot for their warmth and support, and for providing everything and more that was required to conduct a successful graduate research.

Finally and by no means the least, I would like to sincerely thank my supervisor, Dr. Ali Arya for his guidance, understanding and most importantly his friendship during the course of

this research. Friendship became invaluable when academic mentorship could not quite speak the language needed for the days when morale was low and the future grim. Words will fail to convey my level of gratitude and I dare say I would not have taken flight the way I have under the tutelage of anyone else. I admire your leadership and hope that the bond that has been established during the course of collaborating on this project will be strengthened even further, over time. Thank you sir.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 An Emergent Generation of Museumgoers

The function of the museum in today's society is far removed from what it used to be. The development of museums has been intensely personal and haphazard in plan. The emphasis has been upon collection of the beautiful and the curious (Alexander & Alexander, 2008). One museum authority has suggested that collection is the sole reason for museums and that exhibition, education, culture and the social good are only rationalizations and window dressing used to justify the basic collecting passion (Alexander & Alexander, 2008). This is indicative of a value system that placed very little importance on social interaction and public education. It was not until the 20th century that museum research expanded beyond collections to include museum practices and the museum's visitors themselves (Alexander & Alexander, 2008). Alexander & Alexander (2008), explains that:

> Exhibition, education, or interpretation-the conveyance of culture-and a commitment to community or social welfare has grown to be important aims for the museum in the last century.
>
> As public education expanded worldwide, museums joined schools as agencies for conveying cultural traditions. With the 20th century came even more emphasis on attracting visitors, which has led to more emphasis on public service over the basic maintenance of collections. Stephen Weil has suggested that museums have moved beyond collections and collecting so dominant in the 19th and early 20th centuries, to

become institutions rooted in interpretation in its broadest sense, actively seeking to provoke thought and the exchange of ideas between the museum and its visitors.

The modern museum now plays a major educational and social role in today's society. This shift in paradigm has seen the visitor's status evolve from mere spectator into an active participant. This has been facilitated in part by the rise and dominance of digital technology. The resultant effect of both evolutions is a dire need to foster a new model of communication, to build a more intimate experience, a new type of relationship between the institution and the individual, between the museum and the visitor.

Advances in interactive technologies are significantly affecting the experience of museum visits; however there is the need for further research to explore how these technologies can be fully optimized to create a better visitor experience. This study looks specifically at the application of interactive digital media in furthering the museum-visitor experience.

1.2 Background

As digital technologies pervade the modern museum and progressively transforms it into a digitized institution, the need to cater to an equally emergent digital generation of museum audience has become essential. More critically, emergent digital technologies have challenged basic museum assumptions, altering the meaning of "audience," "venue," "collections," even "mission." Visitors have become online users, engaging with museum via the Web, where they explore digital collections (Thomas, 2007, P.3). Most museums have sought after and adapted interactive technologies as ways to sustain and or improve the level of interaction and heighten the experience with this emergent generation of digital museum audience.

> The modern museum offers visitors many ways of interacting with exhibits, from hands-on interactive systems that help visitors learn basic principles in children's museums, to touch screen computer displays that encourage visitors to delve more deeply into the background and context of important works in art museums (Marty, 2007, P. 131).

However, the application of interactive technology in furthering the level of interaction and enhancing the museum-visitor experience has, and like all new technology, been faced with its own unique sets of concerns and challenges. Questions have been raised as to the credibility in the claim that personalized, interactive technologies actually improve the process of visiting the museum (Evans & Sterry, 1999). Concerns have arisen about the interfaces of interactive systems and their capability in adapting information resources dynamically to meet the contextual needs of various users (Paterno & Mancini, 2000). There has also been concerns about the social implications behind interactive, personalized technologies in museums (Woodruff et al., 2002) and lastly, as interactive systems in museums become more popular and more personal, concerns about information usage, user profiling, and privacy policies have become more common (Hsi & Fait, 2005). These concerns opens up avenues for further research into an efficient way through which the use of interactive technologies in museum can best serve to enhance the museum-visitors' learning and experience.

Efforts made at enriching the modern museum experience have most often than not wound up in the creation or deployment of yet another technological innovation either in the form of interactive installations spread across strategic locations in the museum or virtual simulations expected to increase the level of interaction and engagement between the visitor and

a specific artifact. While these advancements have had their places and served their purposes, the issue of enriching the museum visitor experience transcends the context in which such technologies are employed.

1.3 Problem Statement

The theme driving much of modern museum interactivity is that of constant integration, where access to all types of resources (behind the scenes, in the galleries, online, etc) becomes uniform, seamless, and transparent (Marty, 2007, P. 132). By integrating online resources with in-house experiences, museums are able to offer visitors the ability to create personalized museum visits, tailored to each person's individual needs (Marty, 2007, P. 131). Most of the recent research in this area has focused on aspects of personalization and pervasive computing experiences in museums (Arts & Schoonhoven, 2005; His & Fait, 2005; Jaen, Bosch, Esteve, & Mocholi, 2005; Manning & Sims, 2004: Parry & Arbach, 2005; Silveira et al., 2005). The attempt to enhance the museum-visitor experience has resulted in the elevation of self over community, of the personal over the communal. The unintended consequence of this model is that it threatens the depth of communal learning and decreases the level of interactivity (between the museum and the visitor and among museum visitors themselves), which it initially set out to enhance. Marty (2007, P. 132) states that;

> As interactives in museums become even more personal, there is the risk that the individual users will explore only issues of interest to them. In breaking down the traditional barriers of information access in museums (removing many concerns of time and space, as well as certain physical limitations of artifacts), visitors have the

opportunity to build new walls, concentrating only on their own particular needs and interests. For this reason, some have argued that interactive technologies in museums can be inherently asocial.

Although many (Galani & Chambers, 2002; Hsi, 2003; Woodruff et al., 2002) have taken steps to limit this seeming disconnect between intentions and executions, there is still limited research into how social media could be employed to establish a new model for interactive technologies in museum.

Further more, Walker (2006) argues that measuring what people learn from a museum visit is difficult, partly because everyone learns something different based on their prior knowledge and interests, and partly because museum learning tends to happen over long periods of time. Hence, people usually come away from such visits overwhelmed with all that they have experienced and with very little to reflect on. Such experiences, though grand and breathtaking at the time end up as *'fleeting and forgettable'* shortly afterwards. It is only months or years later that some other object, event or story will bring back the memory of the object encountered in the museum (Falk and Dierking 2000). What may help visitors call and reflect on a visit is to make explicit the trail they have followed as a narrative path, allowing them to later revisit, reflect upon, reorder, and share it (Walker, 2006). The extension of the museum-visitors' experience through the creation of personal narratives that can be retold and shared within a community of similar interests then becomes very critical if the visitors' experience is to be preserved and enhanced.

The power of narrative is no secret in the museum world where various forms of storytelling have long been employed to engage visitors (Bedford, 2001). However storytelling have been continuously used rather exclusively by the museum in exhibition strategies. A way that may help visitors capture these grand but fleeting experiences and subsequently enrich and extend the museum experience is the construction of personal digital narratives and making explicit the paths of such digital narratives, allowing visitors to later revisit, reflect upon, reorder, and share it. Digital narrative or storytelling refers to a form of digital media production, using a story-like sequence of multimedia content that allows everyday people share aspects of their life's story. Technological advancements can help in the construction of these digital narratives of the museum visit that extends far beyond the single event of arriving at the physical space of the museum. The museum visit encompasses everything; from the intentional or unintentional preparation made before (pre-visit experience) arriving at the physical space, the actual tour of the physical space and its artifacts and everything that occurs after leaving the museum building (post-visit experience). Finally, while indoor mapping and navigation technologies are becoming more available, lack of guidance through complex exhibitions or linear prescribed paths are the two common experiences. Ability to plan a desired visit based on personal interests and reliable suggestions, and then follow that plan, can significantly improve and encourage museum visits.

The problem addressed by this research is the design of an interactive framework that allows the museum visitor plan a personalized visit, effectively record experiences made, and access/share these experiences within a social context.

1.4 Research Questions And Objectives

The research explores the museum-visitor experience as a customizable interactive narrative and its implementation within a social media context.

Thus, this research seeks to answer the following general questions:

- Will the implementation of customizable experiences improve the visitor experience?
- Are user-controlled narratives proper ways of storing and sharing visitor experience, and also making those experiences more attractive and its content more accessible?
- Will the inclusion of a social media structure in the design and development of an interactive museum system enhance the museum-visitor experience?
- What other features can be considered for such interactive system?

From a design point of view, the research objectives are the following features in the interactive system:

- Planning a visit based on user interests, exhibits, and input from other visitors
- Following the planned visit through some method of tracking while artifacts related to various steps can be collected and added to the narrative
- Connecting to other members before, during and after the visit

1.5. Significance of Study

Jeff Gates (2012), lead producer of New Media Initiatives at the Smithsonian American Art Museum declares that;

> Social media is changing the workings of our museums. Our hierarchical structure has historically disseminated information from our experts to our visitors. The envisioned

> twenty-first century model however is more level. Instead of a one-way presentation, online visitors are often interested in having a conversation with our curators and content providers. And many of us are joining our traditional experts in representing our institutions in these conversations. In response, new media specialists have been looking for ways to engage our public by designing and using applications that encourages dialogue…"

Research into the application of technology that will support this shift in paradigm is essential in maximizing the potential that digital technologies offer the museum. The field of social media in museums is in its infancy (Russo et al., 2007), hence the need to explore how its application can influence interactivity between the museum and the visitors. Social media such as blogs, wikis and digital stories facilitate knowledge exchange through social networking. Such media create a new forum within which dispersed audiences-including youth, rural and regional communities can engage with museums to actively debate notions of identity and voice these reflections online (Russo et al., 2007).

Interactivity is very important for museums; museums visitors frequently report being more engaged with the museum exhibit when they have opportunities for interaction (Falk & Dierking, 2000). Marty (2007, P. 131) states that;

> These interactions can take a variety of forms, such as conversing with docents or other visitors about the exhibits, manipulating the museum's artifacts in someway (touching or turning, for instance, paging through a flip book or gallery guide while touring the

museum, or learning from multimedia kiosks and other information stations available in the galleries.

1.6 Contributions

The main contributions of the current study are:

1. Introducing and using the concept of narrative as a key element for collecting, accessing and sharing the museum experience
2. Proposing a social media context for the museum experience
3. Designing a novel method and interface to help with a personalized museum visit through three phases
   i) Planning
   ii) Tracking
   iii) Connecting
4. Implementing a prototype system called *MEseum* based on the above features, through collaboration with the Canada Aviation and Space Museum.
5. Performing a user study focused on features of an interactive museum system

The basic ideas proposed by this research have been discussed in a joint paper (Navarro et al. 2013) with another research team working on 3D simulation of museum content.

1.7 Research Team

The *MEseum* project is in every sense a collaborative effort. Below is a list of the individuals who worked on the project in the course of the research, contributing their time, expertise and resources.

Name	Capacity
Efetobore Mike-Ifeta	Primary researcher and *MEseum* designer
Ali Arya	Supervisor and research collaborator
Anthony Carlo Scavarelli	Programmer 1
Justin Loranger Ahluwalia	Programmer 2
Jesse Gerroir	Programmer 3

1.8 Thesis Outline

The remainder of this thesis is divided into four chapters; chapter two follows the history of interactivity in the museum and reviews relevant literature and contributions made to enhance the museum-visitor experience. It also looks specifically at major achievements made in employing social media in furthering interactive experiences in the museum. Chapter three details the research approach used in the current study, highlighting the basic concepts and research methods. Chapter four describes the system design and implementation for *MEseum*- a museum-visitor interactive system. Chapter five reveals results from the user study. Some concluding remarks including directions for further research are presented in Chapter 6.

Chapter 2: Related work

2.1 Prior Contributions and Review of Relevant Literature

This chapter is divided into five sections. The first section reviews literature on the digital museum. The second and third is a review of the literature on interactive technologies and social media in the modern museum respectively. The fourth takes a look at digital storytelling in museums, researches that have been built around the use of technology in authoring and sharing digital narratives and also shows specifically the gap in knowledge from previous researches that the current study intends to fill. The final section takes a look at examples of way-finding technologies and examples of its implementation in the museum domain. This is by no means an exhaustive review of the literature, it is however a carefully selected review of resources intended to piece together and familiarize the reader with the trajectory of certain events in the museum history that has led us to this point and is now able to give validation to the consideration of further research into the field of digital narratives, social media and interactive technology in museum-visitor enhancement.

2.2 From The Old To The New: Digitizing The Museum.

Research into the inclusion of personal digital narratives and social media into museums as yet another approach at bolstering the museum-visitor relationship and consequently improving museum experiences can be predicated on the history of computers in museums. The history of computing in museums is the history of the application of computing technologies to the work of museum professionals beginning with the work done by curators and registrars in the mid- to late 1960s (Burton Jones, 2008). The premise of this research is founded on a paradigm

shift within the museum that has over time necessitated the emergence of a new audience, and consequently the need for a new kind of interaction with the institution. The dexterity of the new audience is based on the availability of interactive technologies, which is inextricably tied to the development of computing in the museum. However, the history of museum computing is not about the development of computing machinery but is the story of how many museum professionals were able to think beyond the constraints of the day and use computing machines and emerging technologies in the service of the museum field (Burton Jones, 2008, P. 9).

Museums began using automation technologies in the early 1960s (Jones-Garmil, 2003, p.35). Two parallel developments in 1963- one at the Smithsonian's National Museum of Natural History (NMNH) and the other at the Institute for Computer Research in the Humanities (ICRH) led to the introduction of data processing systems in museums (David Vance, 1986). The system that resulted from the project at the Smithsonian was known as SELGEM, which stood for Self Generating Master. SELGEM used text data fields that were limited by numeric tags and special characters (Jones-Garmil, 2003, p.36). The system and source code were provided free-of-charge to museums but with the caveat that the Smithsonian could not support the system if changes were made to the source code (Jones-Garmil, 2003, p.36). Professor Jack Heller created a system at ICRH called GRIPHOS- General Retrieval and Information Processor for Humanities-Oriented Studies. Like SELGEM, this was a mainframe system with data field tags and delimited records (Jones-Garmil, 2003, p.36). It was made available to the museums through membership in the Museum Computer Network (Jones-Garmil, 2003, p.36). These two systems, GRIPHOS

and SELGEM, were among the first database management systems used in museums (Burton Jones 2008, p.10).

In 1968, the Museum Computer Network and IBM sponsored a conference on computers and their potential application in museums (Jones-Garmil, 2003). In 1969, David Vance began a standardization project with 12 art museums, which was one of the pioneering efforts in the standardization of museum information, and the project produced a data dictionary that was used by all subsequent GRIPHOS users (Jones-Garmil, 2003, p. 37).

Both GRIPHOS and SELGEM were used throughout the 1970s (Jones-Garmil, 2003, p. 37). The next transformation to occur however was that of computer architecture: moving from mainframe computers to minicomputers to desktop computers and then to client-server models, as museum were able to take advantage of market trends toward lower-cost computing (Burton Jones, 2008, p. 11). This afforded museum professionals, especially the early adopters of GRIPHOS and SELGEM, control over the development of the database system as well as their data (Burton Jones, 2008, p. 12). Database engines such as dBASE, Advanced Revelation, and the like became the basis of commercial products designed solely for that museum market (Burton Jones, 2008, p. 12). During the 1970's the museum community itself began to change. Through the efforts of the American Association of Museums (AAM) professional standing committees were formed for each area of museum work. The job of the registrar was one of the first to take advantage of the possibilities of the museum computing (Burton Jones, 2008, p. 12). Registrars were among the first museum professionals to work with system developers to create the first generation of the collection management system that we use today in museums (Burton

Jones, 2008, p. 12). By the end of the 1970s, imaging technology was making its way into museums in the form of analog videodisc systems. In 1979, IBM and MCA (Music Corporation of America) announced a videodisc product, as did Digital Equipment Corp. and RCA (Jones-Garmil, 2003, p. 41).

The decade of the 1980's brought exciting changes to the area of museum automation. Desktop computers and improved storage devices became available early on (Jones-Garmil, 2003, p. 42). Museums no longer needed to depend on university computing groups or special software consultants to write applications for them (Jones-Garmil, 2003, p. 42). Software written specifically for museum applications became available from companies that worked exclusively in the museum market place. One of these early applications was developed for the Dallas Museum of Art by Willoughby Associates, Ltd., in 1981. The system was called MILAM (Jones-Garmil, 2003, p. 42).

During the 1980s, other vendors of museum software announced systems for database management (Jones-Garmil, 2003, p. 44). Among these were Willoughby Associates' Quixis TM, MIMSY TM and other products; Vernon System's COLLECTION (1984); Quester Systems' ARGUS (1986); and Oaktree's ACCESSION (1989). Systems to support membership and development, ticketing and admissions were also made available. At the end of the decade, an MCN initiative called the Computer Interchange of Museum Information (CIMI) was launched (Jones-Garmil, 2003, p. 44).

Beginning in the 1990s, information and communication technologies (ICT) were introduced into the workplace (Burton Jones, 2008, p. 13). Email is the most notable of these and

is the most ubiquitous with the Internet running a close second since at least 1998 (Burton Jones 2007, p. 13). This technology like all others came with a need for support. Some museum professionals developed skills as system administrators; in many cases, however, museums decided to outsource the support for this service (Burton Jones 2007, p. 13). In 1992, the MCN initiative known then as the Computer Interchange of Museum Information (CIMI) completed its first phase of work (Jones-Garmil, 2003, p. 46). In 1992 and 1993, CIMI began its evolution into Consortium for the Computer Interchange of Museum Information. CIMI membership includes museum and industry partners such as the Getty Information Institute, the Research Libraries Group, the Canadian Heritage Information Network, the Eastman Kodak Company, Corbis Media, the Museum Informatics Project at UC-Berkley, the University of California Office of the President-Division of Library Automation, the Smithsonian Institution- National Museum of American Art, the National Gallery of Art, Washington, D.C., the UK Museum Documentation Association, the RAMA (Remote Access Museum Archives) consortium, the victoria and Albert Museum, the coalition for Networked Information, the Canadian Museum of Civilization, and the Museum Computer Network (Jones-Garmil, 2003, p. 46).

Industry advances in the late 1980s and in 1990s made it possible for museums to begin to incorporate digital images into collections management systems (Burton Jones, 2008, p. 16). This was based on scanning technologies that reduced the amount of heat and light generated per scan making it safer for light sensitive works of art on paper to be reformatted. Changes in the capability of databases to accommodate the storage of digital images in or associated with text record describing the object moved museum collections management from text-only to images

and then other types of digital media i.e., audio, video, etc. (Burton Jones, 2008, p. 16). Digital imaging was an essential piece in moving from visually starved collections databases to those that allowed for a full range of media, as well as shifting from the use of those databases solely to store tracking information to databases that could supply richer information that could be used as a resource for the development of new media products (Burton Jones, 2008, p. 16).

Building on databases and the use of digital images, museums soon moved to creating multimedia products based on visual and textual content (Burton Jones, 2008, p. 16). Early efforts in this area were carried out by the National Museum of American Art, the Barnes Collection (with support from Microsoft), the National Gallery of Art, and many others (Burton Jones, 2008, p. 16). An early and forward thinking project was developed by Michael C. Carlos Museum at Emory University under the direction of Maxwell Anderson, funded by a Lila Wallace- Readers Digest Museum Collections Accessibility Initiative grant. The museum worked with Georgia Tech's Interactive Media Technology Centre (IMTC) to develop interactive programs presented on kiosks in the museum. The goal was to present in-depth information about several objects in the museum including a bat flute and a jagular vessel, both from Mesoamerica. Visitors to the museum could navigate through the kiosk screens through menus or maps (Burton Jones, 2008, p. 17).

Museum professionals began to get a taste of what was possible electronically in the late 1980s and early 1990s and became hungry for more (Burton Jones, 2008, p. 17). The institute for Museum and Library Services (IMLS) has been a primary source of federal funding to allow museums to develop educational projects that make heavy use of technology and of the web

(Burton Jones, 2008, p. 17). The American Association of Museums (AAM) and the Coalition for Networked Information (CNI) among others function as legislative advocates for the museum and library communities (Burton Jones, 2008, p. 17). The AAM distributes information on relevant legislation to its members. During the early 1990s the Museum Computer Network served in an advisory role to the AAM on issues of emerging technologies (Burton Jones, 2008, p. 18). Museum professionals began to see the promise of electronic mail early on and universities had used this form of communication even earlier (Burton Jones, 2008, p. 18). By 1994 email and other Internet communications had been embraced by MCN and MCN worked with AAM and the Getty Information Institute to further the knowledge of these tools throughout the museum community in the United States (Burton Jones, 2008, p. 18).

In 1994, articles and conference papers about the Web began to appear in MCN's journal SPECTRA, Archives and Museum Informatics and in Museum News (Burton Jones, 2008, p. 18).

In 1995, the Museum Computer Network co-sponsored a booth at the AAM Museum Expo in Philadelphia in conjunction with the AAM conference (Burton Jones, 2008, p. 19). A group of MCN members (Johnston, Herman and Bridge) worked together at the booth to develop the first MCN Web site, partly to document the technology events being held at the conference (Burton Jones, 2008, p. 20). These technology showcases continued to be featured at the AAM Museum Expo for the next two years with the sponsored partnership of MCN, AAM, and the Getty Information Institute (Burton Jones, 2008, p. 20). They were important in providing a first look for many museum directors at the Web site representing their own institutions. These Web

sites as we know provide the first impression for many members of the rapidly expanding online audience (Burton Jones, 2008, p. 20).

One of the first more fully formed Web sites was created by Robert Guralnick for the Museum of Paleontology at the University of California, Berkely (Burton Jones, 2008, p. 21). This site featured information on the museum and an online exhibition on dinosaurs. Guralnick wrote several articles for MCN that helped others understand the potential of the Web for museums (Burton Jones, 2008, p. 22). Others followed with due haste. Early adopters of note included the Fine Arts Museums of San Francisco and its "Thinker" image base online in 1997 with over 60,000 images; the Exploratorium and its early interactive education "snacks" features; the United States Holocaust Memorial Museum and its extensive library, archive, and photographic databases; and the Smithsonian National Museum of American Art HELIOS American photography site, where visitors could email comments about photographs that they viewed (Burton Jones, 2008, p. 22).

Museums were transformed by these technological advances that enabled the use of digital information in education and exhibition within the museum and online. New media had not just become ubiquitous in the museum community, but in the art collected and preserved by museums (Burton Jones, 2008, p. 22). In 1998, the Walker Art Center and Franklin Furnace were among the earliest museums to curate art online and deliver art. (Burton Jones, 2008, P. 18).

2.3 Interactivity In The Museum

The inclusion of digital narratives or social media into the museum-visitor experience aligns itself with a modern approach of fostering or improving interactivity in the modern

museum. However, the pursuit of interactivity within the *museological* world dates as far back as the turn of the twentieth century, long before the emergence of the modern museum. As Griffiths (2004) discusses;

> Clues for understanding contemporary museum attitudes toward new media technologies can therefore be found in a number of experimental exhibits proposed (if not always installed) in American and European museums at the beginning of the twentieth century. At one extreme, French scientist Félix-Louis Regnault's turn-of-the-century plan for an encyclopedic ethnographic archive strikingly anticipates contemporary visions of the multi-media museum and web site. In Regnault's imagined ethnographic museum, anthropologists and members of general public could retrieve written texts, sound recordings, and still and moving images of indigenous peoples at the flick of a switch *(find out what's next)* In a more prosaic fashion. The Metropolitan Museum of Art in New York City experimented with interactive exhibits in 1901, when it designed an installation that allowed visitors to turn the pages of an art book by inserting their hands into the side of the display case.

The foundations that could be said to have led to the emergence of modern display techniques in museum, which consequently fostered initial talks on interactivity and ways through which it could be achieved, can be traced back to the 'Museums as Places of Popular Culture' conference held in Mannheim in 1903. Griffiths (2003) discusses three main aims of the conference:

> Firstly, to consider ways in which museums could make themselves more accessible to working people (the upper classes, it was argued, were "above instruction") through the media of photography and magic lantern slides Secondly, Curators at the conference also discussed the need for exhibits to be designed around a coherent idea rather than function as "overcrowded storehouses of material, purposelessly heaped together. Thirdly, observers also criticized display cases for shoddy construction and for their frequently unpleasing or ostentatious design, which competed with the objects on display for spectator attention.

As early twentieth-century museum professionals debated trends in exhibit design, they wrote increasingly of the need to contextualize the objects on display, a shift in philosophy that in many ways prefigures the use of interactive technologies in contemporary museums (Griffiths, 2003). In 1903, British curator F.A. Bather argued that even when there is nothing strikingly incongruous or offensive in the manner of exhibition, the mere removal of objects from their natural environment places them at a disadvantage (Griffiths, 2003. In 1903 Dr. Hecht recommended the use of "stopping points" in galleries, which he defined as displays relating to the primary exhibit but "chosen in order to arouse, from time to time, the interest of the public, to lead their mind from the view of a single animal to larger ideas, to a general conception."[31] Hecht's "stopping points" prefigure one major use of computer installations in contemporary exhibition design, inviting visitors to pause in order to draw connections between an exhibited object and its uses and contexts.

As was earlier stated, the impetus for more research into the museum-visitor experience is grounded in a long history of efforts that have come before. Griffiths (2003), supports this assertion by stating;

> While the recent proliferation of interactive technologies point to an emerging model of museum spectatorship in which context and interactivity play increasingly important roles in structuring the museum experience, it is striking that such ideas were first articulated a hundred years ago. As one curator noted in 1905, "an hour's worth of teaching would not get so much information into the mind of the child as he would get by finding out the information for himself."

An early attempt to make the museum display case more accessible to visitors was the Rotary Cabinet, designed by the Reverend S.J. Ford in 1907, which allowed objects to be viewed at will by the museum spectator, who, by turning a driving handle on the side of the cabinet could rotate for display each drawer in turn (Griffiths 2003).

Since the mid-1980s, electronic media have assumed an ever-greater presence in museums of science, technology, natural history, and art (Griffiths 2003). For the most part, museum directors and curators have embraced new interactive technologies for their promise to democratize knowledge, to offer contextual information on exhibits, and to boost museum attendance (Griffiths 2003).

Interactivity in museums has evolved from simple constructions like the rotary cabinet, which might as well have been cutting edge for its era to more advanced technology. The entrance of computing technology has increased the level of interactivity and also promises

future avenues through which the relationship between the museum and the visitor can be made more intimate, thus increasing the potential for enhancing the museum-visitor experience. Griffiths (2003) buttresses this point through her statement;

> Digital technologies have found a home in the modern museum in the forms of interactive touchscreens kiosks, CD-ROMs, computer games, large screen installations and videowalls with multiple images, digital orientation centers, "smart badge" information systems, 3-D animation, virtual reality, and increasingly sophisticated websites. Such technologies have changed the physical character of the museum, frequently creating striking juxtapositions between nineteenth century monumental architecture and the electronic glow of the twenty-first century computer screen. Via the World Wide Web, the museum now transcends the fixities of time and place, allowing virtual visitors to wander through its perpetually deserted galleries and interact with objects in ways previously unimagined.

2.4 Social Media and The Museum

From its social role to its internal operations, the museum has continuously, and on multiple levels undergone monumental shifts from most of its long held beliefs and paradigms. Russo, Watkins, Kelly and Chan (2007) declares that museums no longer fit the early modernist model of the nineteenth century museum, with its authoritative narratives; many now offer interactive and open-ended experiences. Social constructivist approaches to communication have helped museums to connect with the memories, identities, and understandings that visitors bring with them (Hein 1998; Watkins and Mortimore 1999). Russo, Watkins, Kelly and Chan (2008)

argue that such approaches have enabled the deconstruction of grand narratives and affirmed the role of audiences in social learning. Museums are now sites in which knowledge, memory, and history are examined, rather than places where cultural authority is asserted (Witcomb 1999; Kelly, Cook and Gordon 2006). These changes have tapped a form of community intelligence and have created a path from modernist certainty and institutional centrality, to social networking and demand-driven intellectual engagement with culture (Russo, Watkins, Kelly and Chan, 2008).

This shift within the museum has resulted in initial experimentation with social media and participatory cultural communication (Russo, Watkins, Kelly and Chan, 2008).

Social media can be defined broadly as tools that facilitate online communication, networking, and/or collaboration. Social software, social networking and Web 2.0 are other terms used to describe tools and platforms that enable similar user interaction. Russo, Watkins, Kelly and Chan (2008) states that social media technologies are designed primarily as network communication tools (unlike telephone or email, which are first and foremost tools of one-to-one messaging). Social media applications—including blogs, podcasts and content shares—have been used to facilitate a participative cultural experience by a number of institutions.

> Pett, (2012), ICT Adviser: The British Museum and Portable Antiquities confirms that;
>
> The use of social media in the digital arena now permeates our life with many of us participating via a variety of methods and devices (the mobile device now becoming especially ubiquitous and presenting its own particular challenges). Individuals and institutions thereby have taken on a wide variety of overlapping and/or conflicting

identities on each. This dialogue mechanism allows for a multi-vocal engagement between institutions and consumers, via community engagement and democratized access to information.

Social media- and in particular Facebook- has become a major tool for discovering as well as sharing information about arts and culture, second only to organic search through Google and other search engines. (Arts Council et. al, 2011). Facebook has undoubtedly transformed the social media, with museums now sometimes even using it as a replacement for a separate online presence of their own (Pett, 2011). Museums employ the use of Facebook 'Posts', 'Likes' and 'Comments' as a medium through which they engage with and get feedback from their audience. Twitter is another social media tool that has found use in the museum. Users are able to 'follow' the activities of museums through this social networking platform and museums in turn can 'tweet' about exhibitions, events etc. in order to keep their audience constantly informed on their activities.

These social networking tools have features built into them that facilitate interaction and engagement similar to the system that the current research proposes. They are however incapable of offering the user an organized and comprehensive way of planning activities, in this case, museum visits. They also fall short at providing tools that specifically facilitate tracking visit, collecting information and multimedia content, and finally finding other museum visitors and sharing content with them.

2.5 Digital Storytelling in the Museum

In 1999, the Exploratorium: Museum of Science, Art and Human Perception put forward a proposal to the National Science Foundation (NSF) for an "Electronic Guidebook" research project. A two-day forum was later held that brought together researchers and developers from industry, academia and the museum world to discuss the latest findings on applications of handheld computers and wireless networks in museum exhibition. Sample projects presented in that forum has been reviewed and it has, in part, acted as a starting point for the research being conducted presently. These projects are of particular interests to the research because they constitute part of a relatively recent and conscious attempt made by a very broad range of stakeholders at equipping the visitor with a tool that enhances the museum experience. The forum saw the idea of the Electronic Guidebook as a potential visitor tool for, Creation, Input and Reflection. The applications and tools presented aimed at providing a more personalized museum visitor experience. These tools included Point of Departure by the San Francisco Museum of Modern Art where great works thought to be difficult by the visitor were selected from the museum's permanent collection and then redesigned with the visitor experience in mind. Others included Sotto Voce by Xerox Parc where the aim was to increase visitor engagement with the environment and facilitate interaction between companions; Kid club communicator by Port Discovery and MUSEpad by Mathers Museum of World Cultures.

More recent projects have illustrated how new digital technologies can make for richer narrative creation and sharing. StoryCorps employs a series of fixed and mobile booths where people can record stories, either alone or in the form of interviews, as digital audio (Walker,

2006). StoryCorps provides a platform where recorded stories are shared on the web, broadcast on national public radio, and added to the U.S. Library of Congress as part of American oral history. Urban Tapestries allow people to link stories to places using mobile devices. When users create a story, using text, audio and/or still images, it is automatically tied to the place where it was recorded using location-tracking technology.

Other instances are CAERUS, a flexible personal guide with a rich mix of media that knows where you are. The motivation with CAERUS is the delivery of learner-centered experiences in outdoor environment. A research conducted by the university of Birmingham, CAERUS is designed to provide both free and guided tour modes. It translates GPS co-ordinates to a position on a map, entering into a region triggers audio and enables access to other media content. Tate Modern multimedia tours follow the same approach of using location tracking for personalized or contextualized delivery content. Bletchley Park Text (Mulholland et al., 2005) goes a step further by allowing museum visitors to construct meta-narratives by combining existing curatorial stories (in the form of interviews with historical figures) (Walker, 2006). By sending text messages via mobile phone from specific exhibits in the museum, visitors create a personalized web page which links their chosen topics in narrative threads, which could be further explored and rearranged (Walker, 2006). The CHIP interactive Tour Guide offers various online and mobile tools to the users to be their own curators, e.g. browsing the online collections, planning personalized museum tours, getting recommendations about interesting artworks to see, and quickly finding their ways in the museum. The CHESS project aims to integrate

interdisciplinary research in personalization and adaptivity, digital storytelling, interaction methodologies, and narrative-oriented mobile and mixed reality technologies.

As novel as these projects are, there is still a lack of provision for actual visitor engagement and co- construction with the museum. What is or has been obtainable is a one way flow of information. When storytelling or narratives are mentioned within the museum parlance and in the instances where technology have been employed we discover that there are no explicit learning goals or incentive to create stories (Story Corps and Urban Tapestry). In the instances where mobile technology has been employed, models that were essentially built as content delivery systems, providing the audience with contextual information during the course of a tour and sometimes doubling as a GPS device, have largely influenced it.

The STAR WARS™ Identities exhibition showcases an interactive exhibition where each visitor is meant to use an interactive wristband that tracks the choices they make as they go through the exhibition creating their own Star Wars™ Identity. At the end of the exhibition, visitors get to scan their bracelets one final time to find out what their Star Wars character would look like. The primary aim of the interactive system is helping the visitor build an avatar (an identity) during the tour of the exhibition. This avatar is built based on certain character values that are part of the Star Wars movie and it is meant to reflect the visitor's identity as best as can be aligned with the options presented to the visitor. As interesting and useful as the interactive system employed in the STAR WARS exhibition is, its features are very much specific to that one exhibition, beyond this, it offers no way of planning and guiding the visitors' activity other than following a linear path. It also excludes the individual phases of the tour and only presents

the visitor with a fully formed avatar (profile) at the end of the tour. Finally, it does not offer an organized way of sharing information and connecting with others.

Several museums have embarked on projects that aim at creating a more intimate and engaging experience with their visitors; however there has been very little application of social media to this process. Russo, Watkins, Kelly, and Chan (2007) argue that social media such as blogs, wikis and digital stories facilitate knowledge exchange through social networking. Russo, Watkins, Kelly, and Chan say that such media create a new forum within which dispersed audiences-including youths, regional and rural communities can engage with museums to actively debate notions of identity, and voice their reflections online. The creation of a rich personal digital narrative can thus be facilitated through the use of social media. Walker (2006) suggests that;

> A more explicit form of construction in learning trails comes after the trail has been created, when the learner reflects and re-orders it for the purpose of sharing. Here, too, is the opportunity for self-reflection, for this is when the trail becomes a story, as the trail is revisited, remembered, reordered, and expanded upon. A simple digital trail is not a story without the nuances that come from narration and dialogue. A narrative trail is not merely a linear path but "a chain of events organized into a coherent schema from a personal perspective (i.e. that of the narrator). And a narrator's perspective brings to light intentions, interpretations, and evaluations related to these events."

This research goes one step further to propose that the creation of such digital narratives can be largely influenced and made richer when a crowd sourcing element is included to the process in

the form of social media. A platform where ideas are exchanged and experiences are shared before, during and after a museum visit adds to the totality of the museum-visitor experience and could potentially acts a sturdy support for the construction of personal digital narratives.

2.7 Way-finding Technologies

As the digitization of the modern museum continues, way finding technologies have been employed in many instances to provide yet another layer of interactivity and engagement with the museum visitor. Passini (1984) describes way-finding as the cognitive and behavioral abilities associated with purposefully reaching a desired physical destination. Mostly employed within the museum to guide visitors from one exhibition to the next, way finding has also evolved within the museum domain from basic printed signage to digital signage solutions that are dynamic and can be used not only for directions but also to transmit messages. Museums use way-finding tools to guide their visitors through exhibitions and galleries in the way that delivers the lessons and meanings intended by the curator. Technologies involved in the creation of efficient way-finding systems in both indoor and outdoor scenarios have encompassed mobile, as well as fixed display configuration along with two-dimensional and three- dimensional navigation content. Kray et al., (2008) investigated requirements and constraints towards developing a location model to support navigation in a building environment with an infrastructure of situated displays.

A similar approach is often employed with way finding technologies in museums. It could either be in the form of adaptive mobile devices or smart kiosks that are designed to assist

the visitor in navigating through the physical space. Multiple options exist in the implementation of these technologies. A few examples are discussed here.

A. Indoor Positioning System

An Indoor Positioning System (IPS) is a term used for a network of devices used to wirelessly locate objects or people inside a building. Instead of using satellites, an IPS relies on nearby anchors (nodes with a known position), which either actively locate tags or provide environmental context for devices to sense. The localized nature of an IPS has resulted in design fragmentation, with systems making use of various optical, radio or even acoustic technologies.

B. Satellite-based techniques

Satellite-based navigation techniques are among the most prevalent solutions to date. Most solutions are based on the American Global Positioning System (GPS). An alternative system has been implemented by Russia, the GLONASS system and a joint European project under current development is the GALILEO system.

In Global Navigation Satellite systems (GNSS), the satellites continually transmit their position and a highly accurate time signal. The receivers measure the time of travel of the signal. The thus determined distance from the satellite combined with the knowledge of the satellite's position in space results with the calculation as a three dimensional arc section in an area of possible locations on the earth's surface in the shape of a circle. The receivers are not equipped with high-precision clocks to measure the time of travel. Thus a fourth signal is required to precisely determine the time.

C. Sound-based navigation

Sound-based navigation systems use ultrasound to measure distances between receiver and transmitter, or directly measure distances between the measuring device and an obstacle such as a wall (Hazas 2006, Minami 2004).

Measurement can take place in an independent manner, where receiver and transmitter are both installed on the navigation device, or by receiver infrastructure being installed in the walls and ceiling of the building to be navigated. These receivers then determine the position by trilateration, using the time of flight of the signal transmitted by the navigation device. An example indoor location system using this technique is the active bat system.

D. Electromagnetic wave-based techniques

Electromagnetic waves include visible and invisible light-based methods and those that are based on high frequency radio waves, in the GHz-ranges. Among the latter techniques are popular candidates such as wireless LAN and Bluetooth positioning or UWB methods (Blankenbach 2006).

Light-based methods usually employ distance measurements through time of flight calculations. These are either infrared-based (e.g. active badge system) or laser-based as used in laser-scanners. In the active badge system, the user wears a badge, which continuously emits a unique sequence of infrared light pulses. One or more sensors in a room or building to be navigated receive this sequence, thus making the resolution dependent on the amount of installed receivers.

Radio wave-based methods usually work either by proximity detection in the case of RFID tags or by measuring the received signal strength (RSSI) of installed infrastructure nodes such as wireless LAN, ultra wide band (UWB) or Bluetooth access points (Blankenbach 2007).

E. Optical methods

Optical methods are techniques that require some means of image analysis by the navigation system. They use visual information supplied either still or continuous images provided by a camera.

These methods can range from optical marker detection such as encoded markers or quick response codes (QR codes), otherwise known as "2D-barcodes" to line detection in hallways and even complex scenery analysis, depending on the computational power of the device. With QR codes, the position determined is then the position of the marker.

The encoded markers need to be distributed around the navigation environment. Each marker's position is then to be predetermined and stored to the desired accuracy. There is, however, a drawback, as the determined position is always the position of the marker. So the navigation device used must be placed in close proximity of the marker to produce a viable position fix. The range depends on the resolution of the utilized camera; the accuracy depends on the accuracy of the measured marker position.

F. Combination of techniques

No technique by itself can claim to address all issues arising when navigating through indoor conditions, i.e. poor or no satellite coverage. Thus, research and implementations attempt to combine techniques to obtain a solution whose combined advantages minimize the individual shortcomings.

The combination of GPS and Inertial Navigation System (INS) is a widely used method, as both techniques complement each other perfectly. The INS cannot be perturbed by external influences and guarantees a continuous and complete navigation solution. Also, the update rate is rather high, which is essential with many applications, especially in the aerospace sector. However, the solution only possesses short-term validity, as the errors tend to accumulate over time. This can be overcome by the combination with a GPS receiver. A GPS receiver provides a precise long-term navigation solution, however no orientation information can be obtained by using only a single antenna. Update rates with standard receivers are relatively low (only about one to four measurements per second). Also, the continuity cannot be guaranteed, as position determination is impossible if less than four satellites are in view. Data fusion is almost exclusively achieved by error state kalman filters, which estimate and correct the error of the INS by using the obtained GPS fix as correction data. Depending on the information used to support the INS, literature distinguishes loosely coupled, tightly coupled and ultra-tight/deep integration by different levels of integration (Wendel, 2007).

Museums are employing such technologies as part of efforts to enhance the visitor's ease of exploring the museum and consequently the visitor's experience. The Queensland Museum in 2011 embarked on a 108 days refurbishment of the museum that included the SpinetiX-Digital Signage Installation[1]. The aim was to improve the way finding and internal promotional capabilities of the museum. Another of such example is the MACBA way finding project[2]. The

[1] http://www.madisontech.com.au/CaseStudies/CS_QLDMuseum-DigitalSignage.pdf
[2] http://en.avanti-avanti.com/projects/wayfinding-project

aim of the MACBA way finding project is to improve the accessibility, location and orientation for the visitors once they enter the museum.

2.7 Summary

A consistent effort has been made over time to make the museum more accessible to its audience. This is evident from the long history of computing technologies employed in the museum to either make content accessible or ease the day to day operations of the museum and its curators. Ingenious inventions like the design and use of the rotary cabinet, long before digital technology became ubiquitous highlights the fact that the museum, despite the relatively recent entrance of digital and interactive technologies into its operations has always understood the importance of visitor satisfaction and have taken steps to maximize the relationship that exists between both parties. So, one could argue that the recent rush in museum-visitor enhancement is more of a renaissance- same objective as before but the use of more effective mediums to achieve the purpose. The shortfall however is that this process has been a reserve for the museum, and just in the same way that the museums of old constructed grand narratives and dictated when and how the audience should experience or interact with an artifact or exhibition, the modern museum is employing digital technology to do the same. The audience or visitor is still being fed all of this information and very little provision is made for her own input in the process of interaction. A more ideal situation, in the attempt to maximize the visitor experience will be an elevation of the visitor, from a passive to an active participant. The visitor should be equipped to not only visit but also participate along side with the museum in the construction of narratives. The museum and the visitor should be able to make meaning together.

Chapter 3: Research Approach

This chapter is divided into five sections. The first section discusses the design concept of the prototype, what informed the features that were built into it and how it fits with the goals of the research. The second section describes the research method used in this study, the third explains the sample selection and the fourth describes the procedure used in designing the instruments employed for the study. The final section provides a brief explanation on the Canada Aviation and Space Museum and the motive for partnering with the museum for this project.

3.1 Design Concept

The features that were to be implemented directly influenced basic design decisions for *MEseum*. These features were in turn influenced by the basic concept underlying the research. In very simple terms, the aim was to build a system or set of tools that could assist the visitor in;

- Customizing her museum visit,
- Creating a digital narrative of the experiences that resulted thereof, and
- Sharing those experiences with other people.

In other words, the system was to allow for personalization, social interaction and the digital construction of narratives, in no particular order.

Falk and Dierking (1992) describe three key elements that influence the way visitors experience museums: the physical context, the personal context and the social context. Physical context mainly covers the physical layout of the exhibition space. Personal context covers the prior knowledge of the visitors, their personal aims and expectations, and their current state of

mind. Personal context and its influence on the learning experience have also been studied by means of evaluation teams and learning theories such as constructivism and Gardner's multiple intelligences theory. Social context covers the social interaction during the museum visit between the visitors and their immediate companions, as well as other visitors and museum staff

The research team divided the museum visit into phases and as the design process unfolded, it became apparent that for any system to be efficient, it had to cater not just to the needs of the visitor while she is physically present at the museum, seeing an exhibition but it had to extend its functions within the walls of the museum, and in both directions too. The system had to be functional for the visitor before she arrived at the museum and after she leaves. The challenge that arises from such desire is how to make the system relevant all through the entire span of the museum visit. Unlike other efforts that have been made at enhancing the museum-visitor experience, the research team decided to explore the option of implementing these functions within a social media context. This introduction meant that the museum visit could somehow be interwoven into the shared interests of an ever-present online community that constantly affirms and provides opinions on museum related activities and are present to participate and share in the memories and experiences of the visitor. The different phases in the museum visit became instrumental from this point on. The system and its tools were to correspond and be functional to each phase. *MEseum* Plan was designed at the tool that provided the visitor with efficient planning information. *MEseum* Guide offered a navigation system that helped the visitor move from one exhibition to the other while digitally creating a narrative trail of things experienced through the help of the check-in and timeline features. *MEseum* Connect

becomes the platform where the visitor is in constant communication with other visitors and also the museum. The visitor is able to belong to this community and every now and again narrate her museum experience.

Museum learning theories are intertwined with the notion of 'communities of practice' where the importance of learning is not only central to the individual but within a process of co-participation within a social context (Kelly et al 2006). The ubiquity of interactive technologies in museums and the model upon which most of these technologies are predicated enhances the experience of the individual over the communal. Lave and Wenger (1999) propose that learners should be active contributing members of communities and that learning is made possible through involvement with, participation in and acceptance into a community

True interactivity allows for a two-way conversation and also co-participation. The passivity that has become synonymous with the museum visitor drives a certain need for empowerment. The museum visitor should not only be able to experience the stories told by the museum but in the course of interaction, should be able to construct her own narratives too and also deliberate with others on what such experiences mean, how they affect the way she perceives the society and how such memories should be preserved. This role evolution that has to occur with the museum visitor has necessitated the design of *MEseum*.

The essence of the proposed system is that the museum experience (learning and engagement) be not contained or limited to space or time. That the visitor is actually able to not only receive contextual information through a linear narrative that has been set up by the museum in audio tours or interactive screens but that the visitor becomes a partner-in-

construction, authoring and sharing personal narratives through the way they want to and the way they have engaged with the museum. Mott et al (1999) says, "By enabling learners to be co-constructors of narratives, narrative-centered learning environments can promote the deep, connection building, meaning-making activities that define constructivist learning."

The three components of *MEseum* are independent but complimentary. The development of a system that is designed to enhance the museum-visiting process will, and by its very nature have a set of tools with functions that overlap. *MEseum* Plan is the canvass upon which the visitor draws her museum visit based on tailored preferences from information gathered. *MEseum* Guide in turn implements the visit that has already been constructed by the visitor in *MEseum* Plan. It does this by using navigational features and other tools that enables the visitor collect digital information and she progresses along her tour. At the end of one's visit, the visitor might decide to share with others, all of the memories that have been made. *MEseum* Connect provides the platform by which all of the memories made and recorded can be preserved, edited and shared.

The component that is however fundamental and is directly related to the current study is *MEseum* Guide as it deals with the visitor's ability to digitally document her museum experiences and construct a digital narrative of her museum visit.

3.2 Research Methods

A descriptive research design was used for this study. A survey was administered to a randomly sampled group of participants from a specific population[3]. Surveys are used to obtain data from individuals about themselves, their households, or about larger social institutions e.g., museums. Sample surveys are an important tool for collecting and analyzing information from selected individuals. They are widely accepted as a key tool for conducting and applying basic social science research methodology (Rossi, Wright, and Anderson, 1983).

Descriptive research does not fit neatly into the definition of either quantitative or qualitative research methodologies, but instead it can utilize elements of both, often within the same study (Knupfer and McLellan, 1996). The term 'survey' is commonly applied to a research methodology designed to collect data from a specific population, or a sample from that population, and typically utilizes a questionnaire or an interview as the survey instrument (Robson, 1993). Parfitt (2005) describes the questionnaire survey as an indispensable tool when primary data are required about people, their behavior, attitudes and opinions and their awareness of specific issues. The study, through the use of *MEseum* sought to determine the extent to which the use of social media and digital technology in the development of a personalized and narrative based interactive application could enhance the visitor experience. For this reason, the researcher chose the descriptive research methodology and designed a questionnaire survey instrument to assess the functionality of such a system in enhancing the museum-visitor experience. Survey data can be broadly classified into three types: Data that

[3] Participant selection was restricted to the Ottawa area.

classify people, Data that relate to the *behavior* of people and Data that relates to the *attitudes*, *opinion* and *belief* of people (Parfitt, 2005, P. 79).

The research has consulted and adapted where necessary the main stages of the questionnaire survey process as prescribed by Parfitt (2005) in developing the methodology for this study. The main stages are set out in the box below:

General activity	*Specific tasks*
Initial research idea: refine and develop analytical design	Developing aims and research objectives. Literature review/secondary data sources. How much is known already?
Design of research	Hypotheses formation; basic research design. Consider dependent, independent, controlled variables. Choice of survey methodology: postal, telephone, Internet, personal interview? Drafting questionnaire.
Further refinement of the research instrument and sampling	Pilot work. Post-pilot revision of questionnaire. Sampling: sampling frame. Think about possible sampling biases. Consider systematic/purposive techniques
Main fieldwork	Interviewer briefing (if appropriate) Assess response rates as questionnaires completed/ returned.
Processing/ analysis of data	Data processing control, manual edit checks, coding of data. Data transcription from questionnaire to computer. Machine edit checks. Statistical analysis, production of tabulations.
Results	Results, hypothesis testing. Research report: conclusions in relation to research hypotheses.

Table 1. The stages of a questionnaire survey

As with many research processes, the starting point is hard to define, and the research idea is forever being modified as data are collected and further insights obtained (Parfitt, 2005). The same proved to be true for this research. The early days of this study was heavily influenced by a stint with Interactive media and digital art[4]. The subsequent creation of an interactive virtual tour project for the Azrieli Pavilion[5] at Carleton University inspired the idea for the potential use of digital media in navigating indoor spaces. From a virtual tour system, intended to enhance the experiences of prospective out-of-city students, it morphed into an indoor navigation system for big commercial spaces such as airports and malls, and eventually it evolved into a museum-visitor interactive system that supports way finding, guidance and the construction of personal narratives in the course of visiting a museum.

Once the museum domain was selected and the feasibility of securing a research partner was established, the aim and objective of the study were progressively developed over the course of 10 months, from the summer of 2012 through the winter of 2013. This research is aimed at enhancing the museum-visitor experience through the use of social media and interactive technology. The basic concepts underlying the research are:

a. A new approach to the museum-visitor experience as a customizable interactive narrative
b. A social context within which that experience is implemented and
c. The use of various interactive technologies to facilitate the experience, including but not limited to social media and way-finding tools.

[4] SYSC 5807- Advanced Topics in Computer System- Interactive Media and Digital Arts.
[5] Course requirement and evaluation

The core objective of the research is to develop an experience model that is able to redefine the museum-visitor experience based on these concepts in order to provide a more engaging and educational experience. The existence of a vast amount of secondary data sources on the museum-visitor experience contributed immensely in the refinement of the initial idea. It was in sifting through these resources on museums, visitor experience and interactivity that the gap in knowledge was magnified. The museum-visitor experience has gone through a very interesting evolution, and one could argue that attempts to enhance the museum-visitor's dates as far back as the turn of the twentieth century (Griffith, 2004). There is however very little research on how social media might enhance interactive experiences in museums (Russo, Watkins, Kelly & Chan, 2007) and even less research on creating narratives out of museum experiences. These are the gaps that this research intends to contribute towards.

3.3 Sample

The study alludes to an emergent generation of museumgoers and the need to cater to that specific generation. Chapters 2 focused on the evolution that has taken and is currently taking place between the modern museum and the visitor. Interactivity in the modern museum demands a basic knowledge of technology and its operations. This singular factor informed the use of the purposive/ non-random sampling method for the study. The Sage dictionary of Social Research Methods (2006) describes purposive sampling as;

> A form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria, which may include specialist knowledge of the research issue, or capacity and willingness to

participate in the research. Some types of research design necessitate researchers taking a decision about the individual participants who would be most likely to contribute appropriate data, both in terms of relevance and depth.

Following the above description, three criteria were considered in selecting participants for the study. These are:

1. Participant-Technology Proficiency

   Participants were expected to be proficient with information access, evaluation, processing and application. They were at least supposed to be able to effectively navigate the World Wide Web and should have had prior experience with either web or desktop applications.

2. Age

   When we consider the modern museum, its digitization and the emergent generation of the 'tech savvy museumgoer' then age becomes an important factor in participant selection. Although the study aims at creating a system that will be just as easy to use by the elderly demographic, a conscious decision was made at this time to limit the age bracket of participants to those who are more attuned to the PC/Web/IM/blogging/ and mashing culture of interactive electronic and digital media.

3. Geographical Boundary

Participant selection was restricted to the city of Ottawa. This was done in part because of the proximity of the research and its processes to the Canada Aviation and Space Museum. It was also assumed that participants who were sampled from within the city had a higher probability of being familiar with the museum.

In order to ensure diversity in the sample, participants were also chosen across varying ethnic backgrounds, with a wide range of occupational endeavor.

3.4 Instruments

The research developed a proof of concept prototype for an interactive museum-visitor system with which to support the exploration of the research questions. Named *MEseum* (Me-in-the museum), the prototype combines social media functions and interactive technologies aimed at enhancing the museum-visitors experience by fostering communal intelligence at the various stages of the museum visit, increasing planning and guidance efficiency and extending visitors learning and educational capabilities through the creation of digital narratives. *MEseum* served as the primary instrument for the study. A survey questionnaire was drafted for the study and was used as the main data-gathering instrument for the study. The survey questionnaire was divided into two sections; a pre user study survey and post user study. The pre user study survey questionnaire (See Appendix A) contained socio-demographical information of the participants such as Age and occupation. It was also structured to elicit responses that provided insights into how participants currently interact (if they do) with and planned their visits to the Canada Aviation and Space Museum. The post user study survey questionnaire (See Appendix B) was administered after the user study was conducted and contained questions that sought to measure

the functionality of *MEseum* in meeting the objectives of the research. The research sought to answer three primary questions. These are:

- Will the implementation of customizable experiences improve the visitors' experience?
- Are user controlled narratives proper ways of storing and sharing visitor experience and also making those experiences more attractive and its content more accessible?
- Will the inclusion of a social media structure in the design of an interactive museum system enhance the museum-visitor experience?

These three over arching questions of the research informed the questions asked in both surveys. The aim of the surveys was to first, collect data on participant's preferences when interacting with the museum and then see how consistent those preferences are when participants are provided with a system that functioned along the lines of those preferences.

In this survey type, a likert scale was used and five possible responses were provided for every question or statement. The choices represent the degree of agreement on each given question. The scale below was used to interpret the total responses for the entire participant for each survey question.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

Table 2. 5-point likert scale.

The Likert survey was the selected questionnaire type as this enabled the respondents to answer the survey easily. In addition, this research instrument allowed the research to carry out the quantitative approach effectively with the use of statistics for data interpretation. In order to test the validity of the questionnaire used for the study, the researcher tested the questionnaire to five respondents. These respondents as well as their answers were not part of the actual study process and were only used for testing purposes. After the questions were answered, the researcher asked the respondents for any suggestions or any necessary corrections to ensure further improvement and validity of the instrument. The researcher revised the survey questionnaire based on the suggestion of the respondents. The researcher then excluded irrelevant questions and changed vague or difficult terminologies into simpler ones in order to ensure comprehension.

Results of the responses and questions were collected and analyzed. The questionnaire was also reviewed and approved by the Carleton University Research Ethics Board. These procedures resulted in the questionnaire used in this study.

3.5 Partnering with the Canada Aviation and Space Museum

The Canada Aviation and Space Museum is recognized as having the most extensive aviation collection in Canada, one that ranks among the best in the world. Although this serves as a brilliant incentive for a research in any capacity, this research however is primarily driven by the need to foster, through the use of interactive technology, a deeper relationship between Canadians and the museum. The Aviation and Space Museum is a history museum, which displays and represents a historical narrative. An argument has been made for the authentic

relationship that exists or should exist between a museum and its visitor. A history museum, unlike any other kind is inextricably tied to the very essence of the people (society) from which it has derived its collection. That shared history and narrative, as we would see later is one of inestimable value that should be front and center in the process of enhancing the museum-visitor experience.

Canada is now embracing the idea of shared history and narrative. The Canada Museum of Civilization is in the process of being rebranded as the Canadian Museum of History to reflect a focus on the country's social and political history.

The aviation industry, from its little beginnings has played an important role in Canada's history;

> "From that first short flight from the ice of Bras d'Or Lake in Nova Scotia by the Silver Dart on February 23, 1909, to the present day, aviation has grown from Alexander Graham Bell's small group of adventurous experimenters to a massive industry. It has served to explore, develop, and defend this enormous country, tying it together and linking it with the world (Smyth, 2006).

The remarkable story associated with the history of the aviation museum is one that is hidden away in Rockliffe, behind artifacts on display. It is the desire of the researchers that through this study, a museum-visitor interactive system will be designed that will galvanize Canadians to become aware of this story and where the Canadian Aviation and Space Museum fits in Canadian history.

Chapter 4: System Design and Implementation

The fourth chapter describes the system design for *MEseum*. It details a description of the different parts of the system and outlines their functions. The chapter is divided into four sections. The first is a description and overview of the *MEseum* Sytem. The second lists and describes the various system tools. The third section reviews the system features. The fourth takes a closer look at *MEseum* Connect, the social media platform of the system and details its features. The chapter ends with a user scenario as to how *MEseum* might be used in an ideal situation.

4.1 Descriptions and Overview

MEseum (Me-in-the-museum) is a museum-visitor interactive system that enables the museumgoer construct digital narratives while interacting with or visiting a museum. It provides the museumgoer with the ability to customize and or personalize these narratives within a social media context. *MEseum* incorporates three basic functions into its design; these three functions have been designed to cater to the phases *(Pre-visit, in-the-museum, and Post-visit)* that make up the museum visit. They are

1. Planning
2. Guidance
3. Reflection and Connectivity

Following a user-centered approach, *MEseum* has been designed and developed with a set of tools that on the one hand facilitates the museum's ability to engage with its audience at a more

intimate and engaging level and on the other, extends the learning experience by transforming its audience, from passive observers into active participants. *MEseum* provides the museum visitor with the ability to own the museum experience through the construction of personal digital narratives across the various phases of the museum visit. *MEseum* implements all of its function within a social media parameter that allows for the free flow of ideas, uninhibited communication among museum enthusiasts that are tied by similar interests, and also the distribution and sharing of museum experiences in the form of digital narratives. The Basic concepts that guides the design of the system, as mentioned before, are:

1. A new approach to the museum visitor experience as a customizable interactive narrative.
2. A social context within which that experience is implemented and
3. The use of various interactive technologies to facilitate the experience, including but not limited to social media and way find tools.

USAGE SCENARIO

Using *MEseum* Plan, our user builds a tour path that is specifically tailored and customized to her interests. It also suggests default tour paths that she might be interested in based on past activities or real time preferences. Through *MEseum* Connect, she connects to an online community of aviation enthusiasts and engages in conversations about exhibitions on display and suggestions about the tour she is presently putting together. Once in the museum, with the help of *MEseum* Guide, she retrieves and follows the tour path she had previously built with *MEseum* Plan. *MEseum* Guide dynamically adapts to accommodate her real time decisions as she navigates her way between exhibitions on the museum floor. She 'checks in' to different exhibition spaces using *MEseum* and uploads photos, videos and makes comments on various exhibitions that are automatically saved in a Timeline. This accumulates into a digital narrative and is presented in a format that can be shared with friends and family.

4.2 *MEseum* Tools

MEseum consists of three tools. These tools have been created to enhance all three phases of the museum visit as was described earlier. They are (a) *MEseum* Plan (b) *MEseum* Guide (c) *MEseum* Connect

4.2.1. *MEseum* Plan

This tool has been designed to enhance and support the planning phase of the museum visit. It provides the visitor with a digital representation of the physical space of the museum, the one intended for visit. It functions essentially as the first point of contact for the visitor and with the features that have been built into it; the visitor is able to engage in a *pre-visit* with the museum. *MEseum* Plan allows the visitor create a personalized tour path by directly manipulating an interactive floor plan of the museum. The visitor is able to view the layout of the museum and the exact location of the various exhibitions and thus, has access to the content of an exhibition or artifact right where it is currently being displayed in the museum. *MEseum* Plan offers the visitor a unique kind of familiarity with the museum's physical space, its provisions and exhibitions which helps in setting a very powerful and useful expectation for the visitor long before she arrives at the museum building. The visitor is able to plan detailed tours, save and edit them at any point during her visit. This can be done online through specific booths in the museum, on a personal computer or through a mobile device.

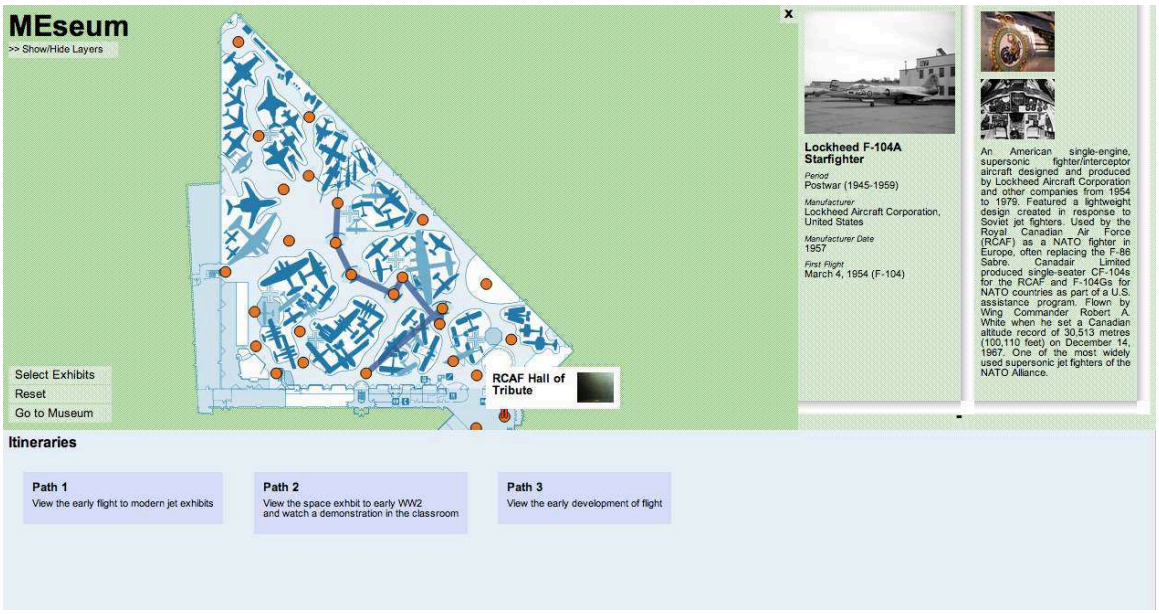

Figure 1. *MEseum* Plan. The interface contains four main interaction parts. (Top left) Menu pane, includes 'build tour', 'default tours' 'show hotspots' (center) Interactive floor plan with hotspots, airplanes and their description (bottom left) Menu pane, includes options for 'select exhibit' and 'reset' and 'Go to Museum' (Bottom across) Itinerary; container that holds default exhibitions suggested by the museum.

4.2.2. *MEseum* Guide

This is the guidance and way finding tool of the *MEseum* system. Customized tours that have been built or created in *MEseum* Plan are synced with *MEseum* Guide and can be retrieved at the start of the visitors' tour in the museum. *MEseum* Guide functions in part as a location tracker. Through localization, it attains the position of the visitor once the tour begins and constantly updates the visitors' position, providing navigational directions in between exhibitions. *MEseum* Guide also provides the visitor with a 'check in' feature. This feature is central to the primary task of the *MEseum* system as a whole. The visitor is able to 'check in' to various exhibitions (or artifacts) as she navigates her way through a tour. *MEseum* Guide collects the information from the different 'check in' points and organizes them in a *Timeline.* This

becomes the visitors' digital journal, her documented story for the visit, her narrative. This tool is primarily used on a mobile device.

Figure 2. *MEseum* Guide. The interface contains four main interaction parts. (Top left) Menu pane, includes 'show me', 'show others', 'show planned paths', 'show check in path' and 'Show hotspots' (center) Interactive floor plan with hotspots, airplanes and their description and also the trail of the hotspots that the visitor has checked in to (bottom) Timeline; container that holds the information from the various check points.

4.2.3 *MEseum* Connect

This is the third and final tool in the *MEseum* system. It is a social networking feature that provides the visitor with the ability to connect and interact with other aviation enthusiast before, during and after the visit. The visitor is able to run an account in *MEseum* and have a user profile, add friends, join groups, have newsfeeds, upload videos and photos among many other things. The visitor has access to the other tools through the account and is able to share her digital narratives with other museum visitors through this tool.

MEseum Connect functions typically as a social networking platform. Previous chapters have described its purpose and function and how it ties into the strength of *MEseum*. *MEseum* Connect allows the visitor to access community intelligence of sorts. Visitor are able to stay in constant connection with both the museum and other visitor during the course of a visit; before-during-after. A visitor has the option of seeking information or opinions from the museum or other visitors on topic ranging from current or upcoming exhibitions to regular or casual visits. *MEseum* connect essentially acts as the melting pot where the experiences of the visitor is shaped and framed. The tools and features have been designed to facilitate a framework that supports communality and shared experiences. *MEseum* Connect features includes:

A. Visitor Profile

Profiles are often used as a point of contact between users; *MEseum* provides flexible architecture and modules to publish information about its users in a convenient way, respecting their privacy settings.

B. Timeline Output

Museum visitors who own accounts, have set up their museum-visitor profiles and have also connected with other museum visitors are able to view the narrative trail of other museum visitors. These digital narratives are made available on the visitor's real time updates after a museum visit has been completed.

C. Support for Open ID and Janrain Engage

OpenID[6] allows the museum-visitor to log into *MEseum* without performing the time-consuming registration process and remembering your credentials. Janrain Engage[7] goes even further by integrating major online services, so that the museum-visitor will be able to log in by using credentials from Facebook, LinkedIn, MySpace and other major social networking systems.

D. Friendship Modules

Different terms describe the "friendship" or "connection" concept for different community types, but in all cases it is the fundamental feature of all social networks. *MEseum* provides a flexible set of modules for displaying and managing friend lists.

E. Blog engine

MEseum includes a fully featured multi-user blog engine with support for comments, ratings, tagging and automatic anti-spam protection. Each user can have unlimited number of blogs, blog posts, tags and categories.

F. Photo albums

Each *MEseum* user can upload and organize photos using the album infrastructure. Thumbnails for common image file types are generated on the fly and stored on the server.

[6] http://openid.net/
[7] https://dashboard.janrain.com/signin?dest=

G. Groups

Groups allow museum-visitors on *MEseum* Connect to interact with each other around a common topic. Modules such as walls, forums, albums, file galleries can all be utilized in the group context.

H. Discussion boards

MEseum Connect discussion boards allow visitors to easily post messages and comments to the museum community in a way that all the responses will be viewable no matter how much time passes between each post.

I. Media galleries

MEseum Connect support a generic architecture that allows museum-visitors to host videos, photos, resumes, or any other kind of physical files.

J. Activity streams

Museum visitors can track the activity of their friends and be instantly notified when the museum or another visitor publishes an interesting blog post, uploads a photo or joins the museum community.

K. Messaging

Messaging is essential to all community sites as it allows users to communicate with each another (or a whole group) directly, resembling the look and feel of traditional mail clients.

L. Video conversion and Sharing

In addition to standard media gallery functionality, *MEseum* Connect supports third-party plug-ins for video conversion that allow users to upload any kind of video material and have it converted to standard Flash formats.

M. Walls

Wall is a kind of virtual space on every museum visitor's profile or group page that allows visitors to post messages for other visitors to see. In essence, this is the central gathering point for all users of the museum community on *MEseum* Connect.

N. Comments

Comment modules allow museum visitors to interact with the content and other members of the museum community. *MEseum* flexible infrastructure enables administrators to attach comments to virtually any kind of content: wall notes, blog posts, images, etc.

O. Ratings

Ratings can be a very important part of any community-based content site. They allow the whole community to be in charge of what content takes precedence on the site.

P. Tags

Similar to comments and ratings, tags can be attached to different types of content, allowing museum visitors to build an independent form of navigation and/or categorization.

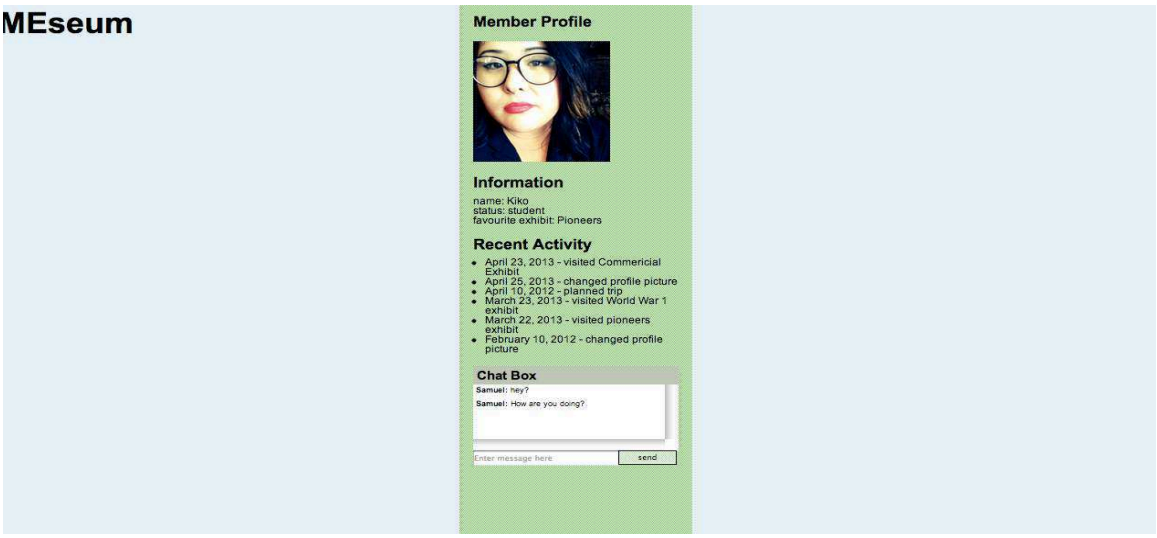

Figure 3. *MEseum* Connect. The interface contains three main interaction parts. (Top half) profile (Middle) Recent Activity (bottom half) Chat box for interacting with friends

4.3 System Features

MEseum incorporates certain basic features into its design. These features enable *MEseum* to efficiently perform its primary functions. These features are:

4.3.1 Interactive Floor plan

The floor plan of the Canada Aviation and Space Museum was retrieved from the 'Visitor's Guide' Section of its website and converted into an SVG map. This allowed for a basic level of interactivity such as 'click and drag' and 'zoom in and out' features using the mouse. The floor plan then became the base layer upon which all other features of *MEseum* were built upon. The Map contains a *Content Layer*, A *Path- finding/creation Layer* and a *People Layer*.

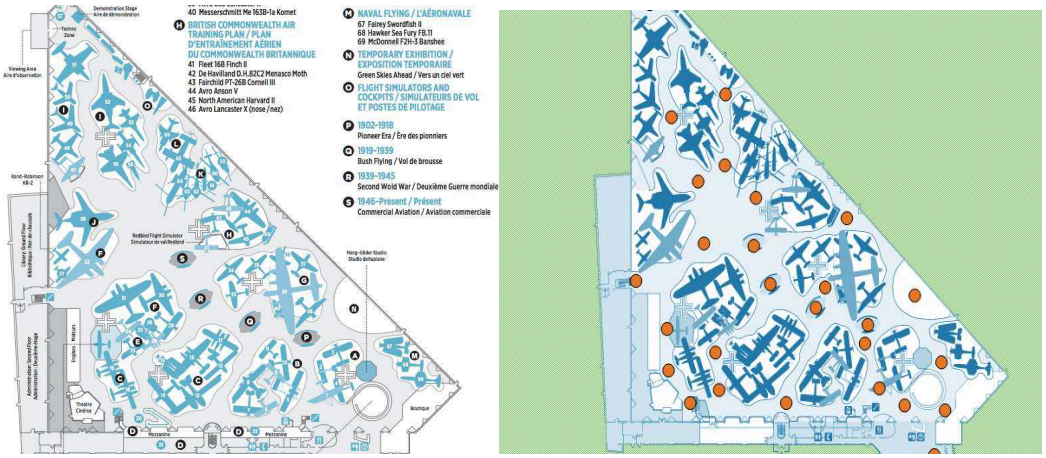

Figure 4: Interactive Floor plan (Left) original floor plan from the Canada Aviation and Space Museum. (Right) SVG Map of the floor plan with clickable hot spots and interactive features.

A. Content layer

As was initially described, *MEseum* assists the visitor in building an efficient museum trip. The content Layer of *MEseum* is thus embedded with information (interactive photos, audio, text etc.,) from exhibitions that are currently being displayed on the floor of the museum. It also provides access to other provisions of the museum such as museum boutiques, coat check, washroom, parking lot etc. The content layer transforms the floor plan into an interactive map where the visitor is able to ‘click’ or ‘tap’ on anything that is so desired and retrieve detailed information on that specific object or area.

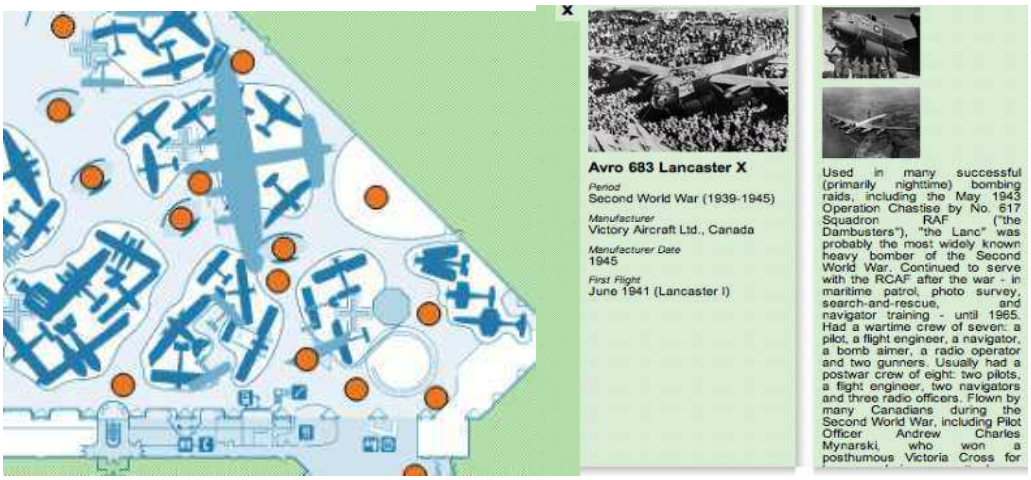

Figure 5. (Left) Interactive floor plan B shows highlighted plane after the user rests mouse on it. (Right) Pop up of photo and text information of the selected plane in an exhibition.

B. Path building/ Creation Layer

A procedurally created path from 0-point 10 has also been built into the floor plan. This allows the user build paths of interests between two or more tour points, or exhibitions.. This becomes essential for building personalized visits based on the visitor's preferences. The user is able to click on various hotspots, get detailed information on these hotspots, which are representative of exhibitions and then build tour paths in whatever order the she desires. These paths can be edited at any time before or during the visit.

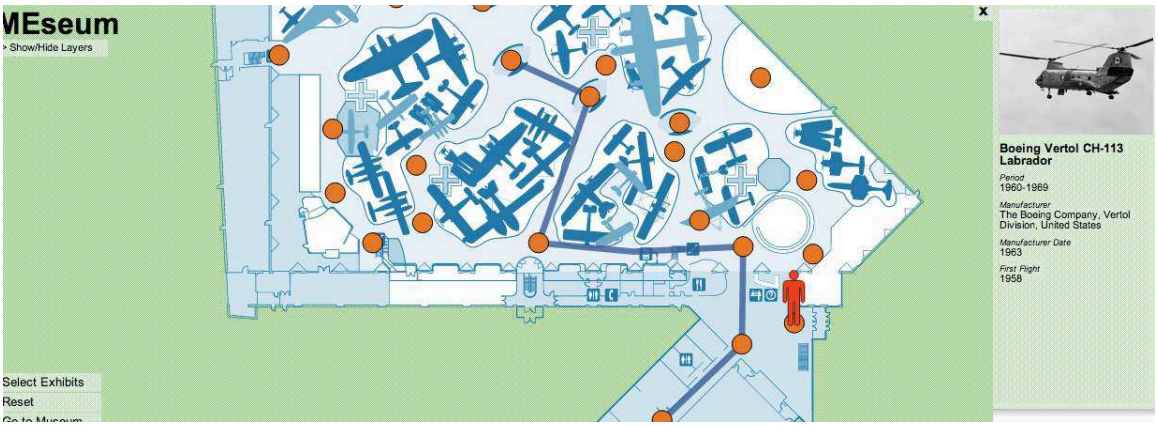

Figure 6. Built tour path between various hotspots. *(These paths are shown in blue)*

C. People Layer

This is the third layer that has been built into the interactive floor plan. It ties in neatly with the social media function of *MEseum*. This layer functions in two ways; Firstly, it shows and allows communication with other museum visitors that might be in the physical space of the museum during a visit and secondly, it acts as a medium through which visitors can engage in continuous interaction at every phase of the museum visit, thus having the potential of fostering a community of like minded individuals.

Figure 7. People layer showing other people who are currently at the museum.

4.3.2 'Check-in'

The 'Check in' feature allows visitors who wish to record their arrival at a specific exhibition or particular place in the museum 'click' or 'tap' on a "check in' menu that automatically

updates their timeline. After checking in at an exhibition, the visitor has the option adding media content to his timeline which in turn starts to progressively build his digital narrative. *MEseum* provides the visitor with the option of auto 'check in' and manual check in. Automatically, *MEseum* employs the use of a GPS tracker to check in to pre planned tour paths that the visitor might have created before the start of his museum tour. Once the visitor gets close enough (20 feet) to a chosen exhibition, *MEseum* automatically checks the visitor in to that exhibition and updates their timeline with default content from that exhibition; a photo, symbol etc. The museum visitor is then able to add even more content to her timeline once she checks in to a particular exhibition. She is able to take personal photos of artifacts from her mobile device and upload them directly to her timeline and comment (written) on entire exhibition or on specific artifacts within exhibitions. She is also able to record audio (personal or interviews) and also upload it to the timeline. All of these activities are time stamped and show up on the timeline in the order in which they have been experienced. As the visitor continues on her tour to the next exhibition, *MEseum* 'checks out' on all interaction with the previous exhibition and opens another for the next 'check in' spot based on the planned tour path previously created by the visitor.

4.3.3 Timeline

The Timeline works directly with the 'Check in' feature. It is the container that holds and organizes all the content that is at the disposal of the visitor during her visit. As the visitor navigates her way across the floor of the museum, one exhibition at a time, she is able to build up her timeline with various media contents from different 'Check-in' spots. Once the visitor

checks in to an exhibition either automatically or manually, she begins to build up content on her timeline that can later be reviewed, reordered and shared. At the end of a visit or a tour, the visitor has the option of editing and creating a digital story of that particular museum experience and sharing it. The timeline offers multiple formats by which the visitor can output all of the content on the timeline.

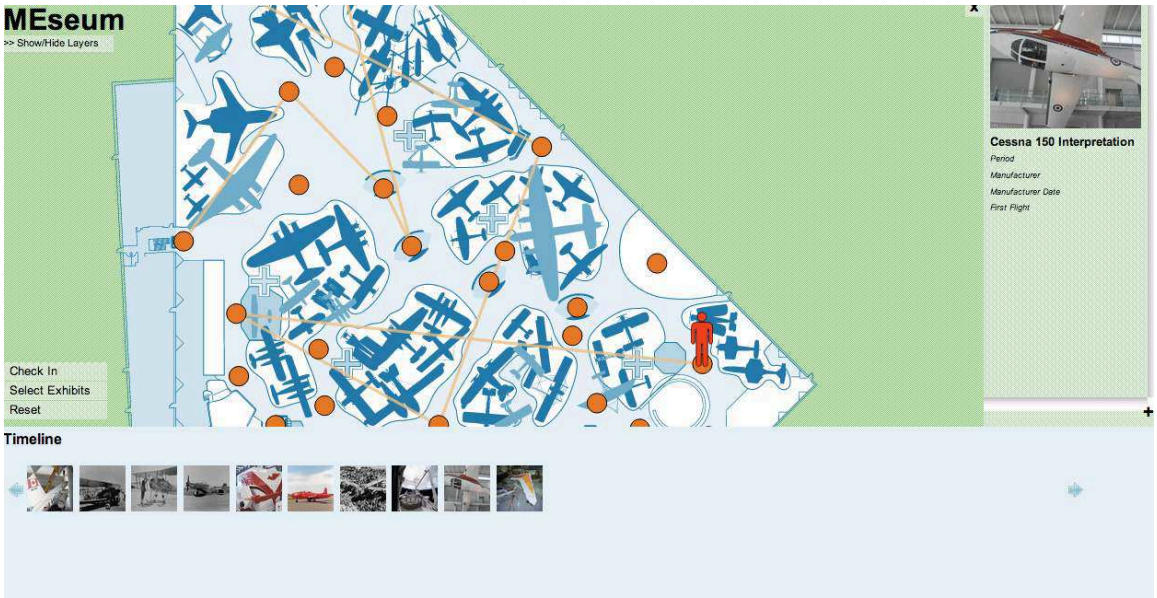

Figure 8. Check in feature in use, as the timeline is automatically updated.

4.4. Technology Used

PHP/HTML5: For creating dynamic content, as well as future proofing as future versions will use databases for content.

Javascript: For creating dynamic and animated content

- Libraries used:

jQuery (http://jquery.com/): For easily using Javascript to create animated and dynamic content. E.g. creating slide-in views, or changing content based on button presses.

Raphael SVG (http://raphaeljs.com/): For flexible, and jQuery-like, rendering on dynamic SVG (vector-based imagery). This allows for zooming and panning of the map without any image quality loss.

LightView (http://projects.nickstakenburg.com/lightview)**:** Used to show images in larger forms via pop-ups.

Jquery Carousel (http://sorgalla.com/jcarousel/)**:** Used to create the timeline feature at the bottom of the page (images put alongside each other with the ability to scroll between them).

4.5 Brief Overview and Implementation

Interactive Map: Created using an SVG map, which in then overlayed by individual SVG image pieces (i.e. the hotspot and hotpot line). Using Raphael each plane in animated so then on mouseovers their scale is animated. On mousepress they are added to a path-finding algorithms.

Timeline: The timeline is created using jQuery and jQuery carousel. When a user checks into a hotspot on the interactive map a new timeline object is dynamically added to the timeline with with an image and other textual information. Each timeline image can be clicked on tp reveal a larger image and textual information using LightView.

Check-In: Check-in is handled using jQuery and Raphael. When a user clicks on a SVG hotspot object (circles) an event is sent to the system to add to the timeline.

Select Exhibits: Select exhibits is also handled by jQuery and Raphael to select exhibits when the "select exhibits" button is pressed signifying to the system to add selected exhibits to the path-finding algorithms.

Path-finding: The path-finding algorithm used is a variation of the A* algorithm (http://en.wikipedia.org/wiki/A*_search_algorithm). By saving the list of nodes and then calculating whether the next path is a lower heuristic relative to the all other "next node" options we can decides on an iterative node-by-node basis which gets us to our destination in a lesser distance until we reach the final node destination.

Chapter 5: Experimental results and Discussion

This chapter discusses the method used in participant selection. It also details the process of the user study, data analysis and results. It concludes with an interpretation of the results how it affects future research.

5.1 Data Collection

Upon the approval of the Ethics Protocol Clearance for *MEseum* (project #14-0075) (See Appendix C) by the Carleton University Research Ethics Board, dates for the usability testing were fixed. A poster (See Appendix D) notifying the general public to the user study and also seeking for participants was created and put up at strategic locations across the university campus and also at strategic places in the city. Interested participants contacted the researcher after which a screening was done based on the criteria earlier mentioned. Participants who met the basic requirement to take part in the study where then sent an email with a scheduling link which enabled them to book a usability testing session for times that were at their convenience. Immediately the researcher confirmed testing times and dates, a confirmation email (See Appendix E) detailing the procedure of the session was sent to the participant. This email had attached to it a participant consent form (See Appendix F) that was signed, scanned and emailed back to the researcher. Next, the researcher sent out a pre-survey questionnaire to the participant using fluidsurvey[8]. The participants were expected to fill out this survey before their scheduled testing sessions. Following this, a GoToMeeting[9] invite (See Appendix G) was sent out to

[8]A do-it-yourself online survey tool that allows customers from around the world to create their own surveys, collect data from respondents, and analyze results.

[9] An online meeting, desktop sharing, and video conferencing software that enables the user to meet with other computer users, customers, clients or colleagues via Internet in real time.

participants providing them with a URL[10] to the testing sessions and also a meeting ID to gain access into the meeting. The researcher promptly logged into the GoToMeeting room 15 minutes before a scheduled session. The researcher welcomed the participants after they arrived, informed them that the session was going to be recorded and then began recording. The researcher read out a brief instruction to the participant. After this, the researcher shared two URL with the participant in the chat box. The first URL redirected the participant to the Canada Aviation and Space Museum's 'Visit Us' page[11]. This link was simply used to show the participant what currently exists on the website with regards to tools that support the activity of 'visiting' the Canada Aviation and Space Museum. Like most museums, the only tool currently available to help guide a visitor in navigating his way around the museum is a PDF copy of the museum's floor plan that can be printed out. After this link was briefly viewed, the other URL was accessed and it redirected the participant to *MEseum*. Participants were not expected to compare the website with *MEseum*, it was purely used for illustration purposes. The participant was then provided with a user scenario and a set of user task (See Appendix H) that the researcher explained and walked the participant through. The participant then proceeded to complete the user task, all the while thinking aloud and engaging in minimal conversation with the researcher. After the completion of the testing session, a post user survey questionnaire was sent out to the participant also using fluid survey. Responses to both surveys were retrieved and then analyzed.

[10] A uniform resource locator abbreviated URL, also known as web address.
[11] http://aviation.technomuses.ca/visit_us/at_the_museum/visitor_guide/

5.2 Data Analysis

The data analysis consisted of examining the surveys for correctness and completeness. A pivot table was used to separate the responses into 'yes or no' and to determine how many participants responded yes/no to each question. These responses were then converted into percentages in order to know the percentage of participants that either responded yes or no to a particular question, or one of the other options on the Likert scale employed on the survey. All incomplete surveys were discarded from the analysis.

Results from the survey revealed an interesting pattern that enabled the research draw certain conclusions about the data collected and the objectives of the user study. As was stated earlier, two surveys were administered to each participant. The first set of survey questions were intended to gather information on certain museum habits and preferences of the participants. These questions were carefully structured to determine the level of consistency in responses on visitors' expectations and preferences with regards to interacting with the museum and when they were actually presented with a tool that met those expectations. With the first set of survey questions, the research wanted to find out what participants thought about a having a different option of interacting with their museums, particularly when it had to do with planning visits. Participants were asked if they thought that the provision of a system that offered customizable tour paths, access to collective museum intelligence and the ability to save and share memories would actually enhance their museum-visitor experience. As would be discussed later on in this chapter, the goal of the user study was scaled back as the research progressed. However, the primary aim of conducting the user study, which was to poll the opinion of a diverse sample

selection about *MEseum* and its functionality within the parameters that had been defined were upheld.

Of the 15 participants that were surveyed, 78% had never visited the Canada Aviation and Space museum. This isn't a direct representation of any one factor intended to bias the result of the study but its outcome nonetheless proved to be vital in helping the research arrive at its conclusions. *MEseum* had been designed to help, among many other things, set an expectation for the museum-visitor. The participant was provided with a graphical representation and in most instances, real photos of the CASM's exhibitions as it was currently displayed on the floor of the museum. Having a fairly large percentage of participants that had not visited the CASM prior to the user study, in some way helped to create that option for validation, if indeed *MEseum* could function in the capacity of framing an experience for the museum-visitor even before she got to the physical space of the museum. This initial response of the 78% set the tone for most of the responses that were gathered. For the other 12%, the ones' who had been, the research was interested to see the level of their reception to a different approach at interacting with museums or if they thought that such previous visits could have been better planned an or conducted and if the interaction with the museum could have been a more engaging one. Figure 9 below shows the responses of participants when asked if they thought that planning an interest/preference based trip would enhance their museum experience. Options that had zero responses have been excluded from the charts for the purpose of clarity.

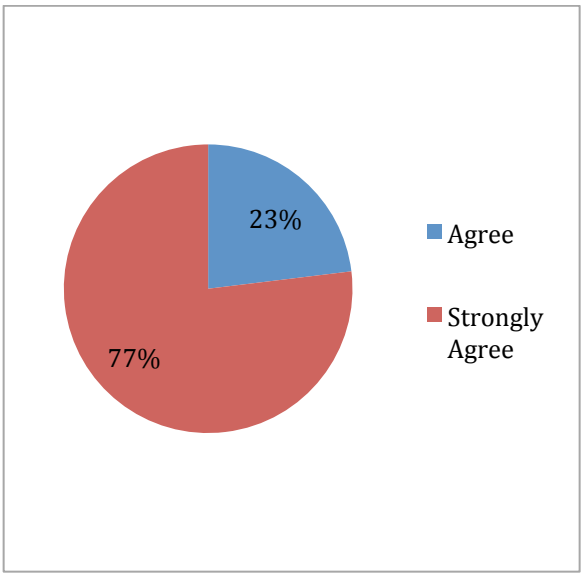

Figure 9. Interest and preference influence

A similar pattern was noticed when a more specific follow up question was asked. The research team was interested to see how the participants felt about the option that would offer them ownership of their museum experiences. 69% of participants strongly agree and 31% of participants on the same question agree that a customized and personalized approach to planning and interacting with the museum will enhance their museum experience. See Figure 10 below.

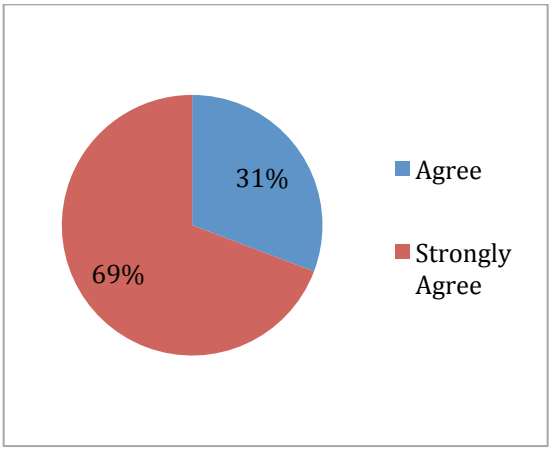

Figure 10. Customized and personalized influence

There are multiple ways by which the museum visitor experience could potentially be enhanced. From the intentional design of the museum exhibition space to the creation of special events for museumgoers. However, the study primarily considered the use of digital and interactive technology to provide the museum-visitor with specific features. Thus, the need to find out if participants were specifically interested in the use of a digital system to assist their museum experience became imperative. On this question, 80% of participants strongly agree that the use of a digital system will enhance their museum experience, 13 % agree and 7% were neutral. See Figure 11. When participants were asked if they would consider the use of such a system to interact with the museum and perform such functions as planning their visits, communicating with other museum visitors and sharing their experiences, 62 % of participants strongly agree that they would. The other 38% of participants on the same question agree that they would. See Figure 12.

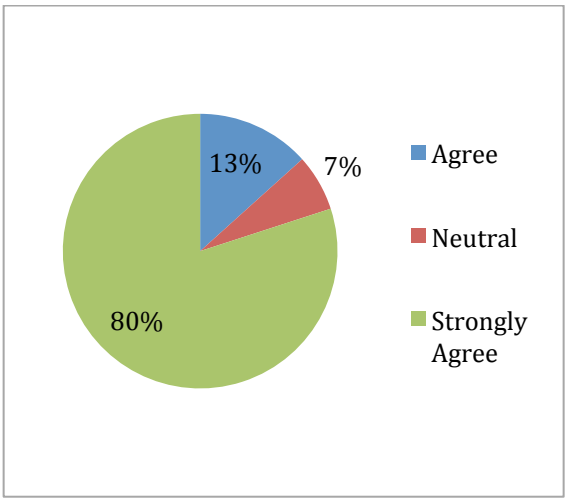

Figure 11. Enhancing your museum visit through a museum-interactive system

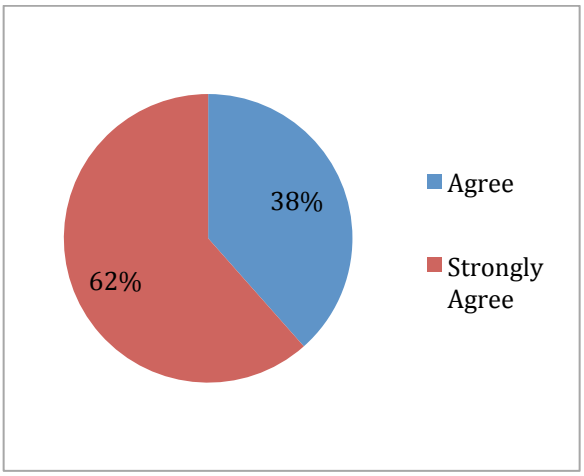

Figure 12. Consider the use of the system

The need to administer a pre and post user survey was to track a consistency in the responses gotten from the participants. Most of the responses gotten after the user study appeared to be consistent with those that were given prior to conducting the user study. Participants were tasked with accomplishing a usage scenario performing a series of user tasks with the aid of *MEseum*. 54% of participants strongly agree that *MEseum* would be functional in planning a personalized and customized visit. The other 46% of participants on the same question agree that they would. When participants were asked if *MEseum* was functional with regards to documenting and creating a digital narrative of their museum experience, 60% said they strongly agree, 33% said they agree and 6% were neutral.

The user study was designed to validate the concept of a museum interactive system that could function in the capacity of a digital journal while at the same time assisting the museumgoer through the different phases of the museum-visit. The survey was conducted with *MEseum*, a proof of concept prototype that is currently a front end web application with most of the features still being developed, hence the user study was structured to get initial responses on

the concept and measure some basic functionalities which can be seen from the survey results. After participants carried out the user tasks, they were presented with another set of questions that alluded to the system's capacity to meet the goals of the research. Figure 13 below shows participants' responses when asked if *MEseum* was efficient in exploring the museum and its various exhibition.

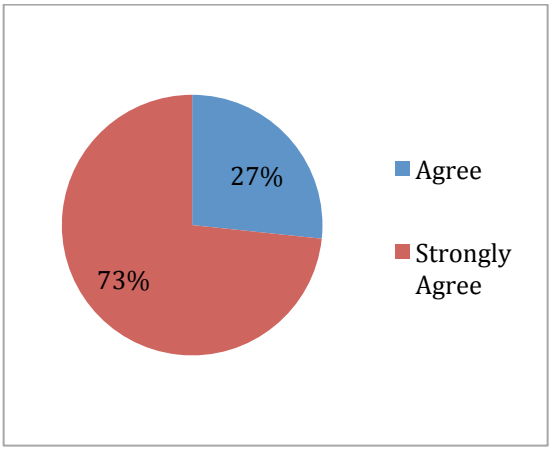

Figure13. MEseum: Functional in exploring the museum and its exhibition.

A key part of the system design was to provide the user with a close enough representation of the exhibition they intend to visit, hence the use of the actual floor plan retrieved from the CASM. Figure 14 below shows the percentage of participants' responses when asked if access to the museum's layout and information in the way it was designed facilitated better museum-visitor interaction.

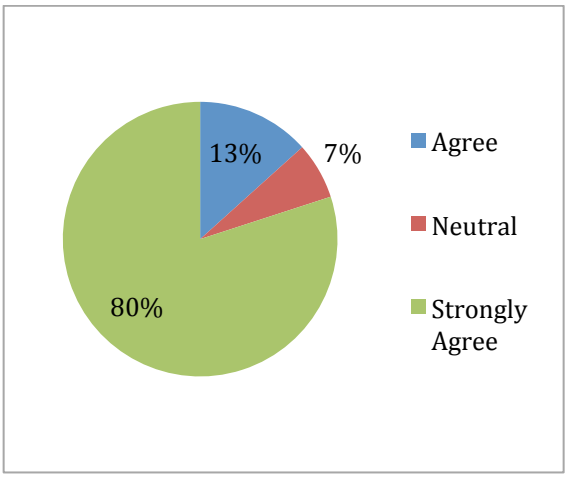

Figure14. *MEseum*: Efficient layout

Participants were also asked if as a tool, *MEseum* provided them with a more engaging way to interact with the CASM and its content. Interactivity and engagement is essential to whatever approach is taken to enhance the museum-visitor experience. Figure 15 below shows participants' response.

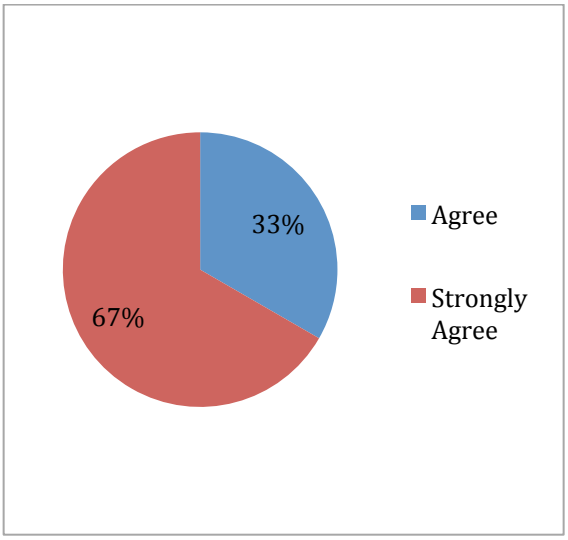

Figure 15. *MEseum*: Interactive and engaging.

Providing the museum-visitor with a pre-visit experience is a key element for *MEseum*. This ties in neatly with the level and quality of information available to the museum visitor even before her arrival at the museum. Figure 16 below shows participant's response when asked if *MEseum* helped in setting their expectation.

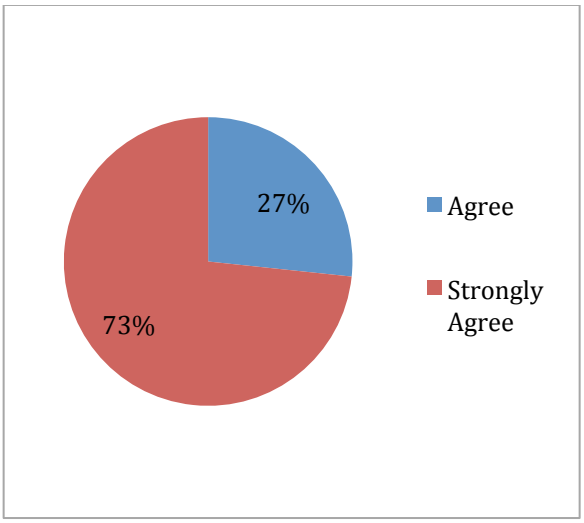

Figure 16. *MEseum*: Setting expectation

Two integral functions of *MEseum* are to allow for the customization and or personalization of museum experiences such as visits and to act as a digital journal for the museum visitor, a tool with which the visitor is able to digitally document all of her museum experiences. The basic design of the system supports these functions. Figure 17 and 18 below show participants' responses when asked if *MEseum* achieved this.

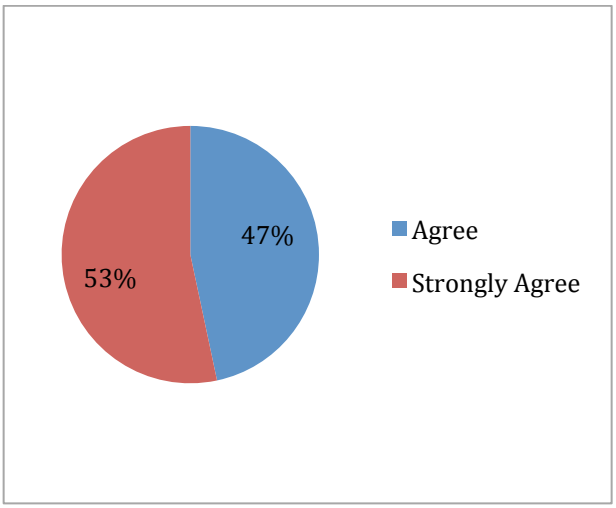

Figure 17. *MEseum*: Functional in personalized and customized museum visit.

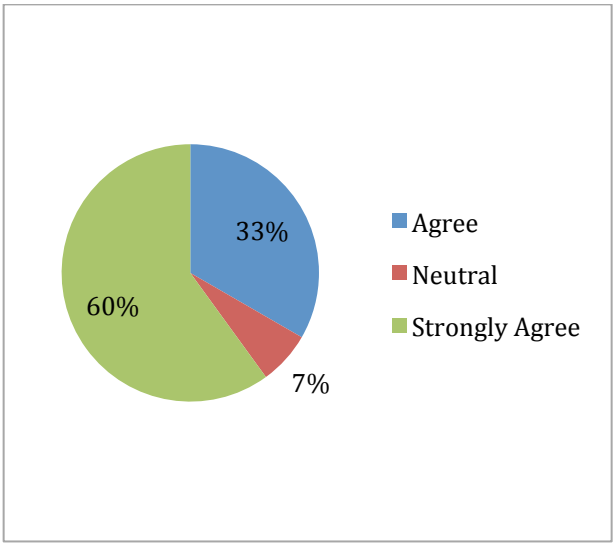

Figure 18. *MEseum*: Functional in creating digital narratives.

Implementing both features of personalization and digital narrative creation within a social media context that allows for unencumbered communication and the sharing of digitally generated narrative is the component that puts it all together. Figure 19 shows participant's responses when they were asked about *MEseum*'s ability to foster an online community of museum visitors with similar interests.

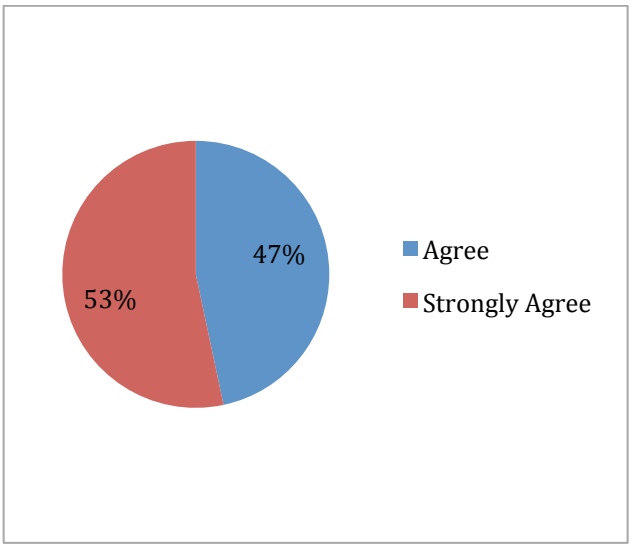

Figure 19. *MEseum*: Building online community.

Participants were also asked specifically for comments and feedback on possible additional features to the system. Below is a list of additional comments from the user study.

a. "I am sure this is still in development phase. I would recommend a very graphical, very user-friendly colorful experience"

b. "I would suggest that Internet connection and electronic devices that will be used to maximize the use of *MEseum* be factored into the plan. I would also love a touch of musical/ Narratives to be included in *MEseum*"

c. *MEseum* would be more functional if images of the exhibitions are backed up with short audio clips describing something about the exhibition.

d. I found *MEseum* to be interesting, interactive, creative and a lot of fun however I would like the development to consider "Adding videos to the timeline"

e. "You may want to try having Wifi at the museum. By the way, is there free Wifi at the museum? I suppose there probably already is, however if there isn't,

you should consider offering that service once the app is up and running, so visitors would feel more comfortable using the app knowing that it wont affect their data".

f. "Having a master list of the exhibits available will be great too. If you click on a specific exhibit in the master list, it would highlight it on the floor plan so you could know exactly where it was. The list would also tell you up front exactly what you can expect to see on that particular floor".

g. "A legend telling me the functions would have been nice. Maybe the scale of the map on my screen was a little out of range. But having a button to return to full view would be nice. I had no idea the entrance was down below unless I scrolled down. May be a ring/tone to accompany the little orange dots when all of the hot-spots were shown and I am not sure why the color was great from point A to B, but I was expecting a more vibrant color (i.e. red) and maybe a label underneath the dot to indicate A and B too".

h. "There is a geographical information aspect that has not been played up in the application. I believe adding coordinates information will be useful to some users. I think the design and presentation of the prototype can go up a notch. The interface could be more interactive. I suggest looking at some location based application for ideas e.g. rentfaster.ca"

5.3 Discussion

Analysis of the data collected suggests that the design of an interactive museum system with tools that facilitates the visitor's ability to access, collect and share museum memories has the potential of elevating and enhancing the way the visitor experiences and interacts with the museum.

A general approval of *MEseum*, its concept and functionalities can be inferred from the user study. Participants were generally positive towards the idea of a system that could serve as a digital journal of their museum experiences for the purpose of preserving and sharing those experiences. Most participants also embraced the idea of having an online community of people with similar interests that could act as a support for the process of constructing digital narratives. Responses on the three primary goals of the study were generally positive although participants believed that the design and general presentation of *MEseum* could be improved; for instance, little attention has been devoted to the system's user interface at this time. Design decisions were made almost exclusively for their functionality and not necessarily to promote or enhance user experience. A participant commented on this saying; "I am sure this is still in development phase. I would however recommend a very graphical, very user-friendly colorful experience". In addressing this, further research should focus more on user experience and user interface design in the second version of *MEseum*. Media content for *MEseum* is also currently limited to only text and still images. One participant suggested "*MEseum* would be more functional if images of the exhibitions are backed up with short audio clips describing something about the exhibition". Initial design plans for *MEseum* considered the use of more content forms such audio, animation,

video etc. but these were not implemented in time for the user study. These are features that should most certainly be introduced in the future iterations of *MEseum*. These should also include the capability of adding other media content to visitor's timeline. Another participant commented on an important aspect of *MEseum* that is not presently functional, saying; "There is a geographical information aspect which I think has not been played up in the application. I believe adding coordinates information will be useful to some users". *MEseum* Guide is designed to incorporate features that aid guidance and tracking. This feature has also not been implemented. Knowing the approximate time frame of a built tour path is another feature that should be considered in the further research.

Participants were of the opinion that *MEseum* when completely developed could personalize their visits and customize their museum experiences, help in the construction of digital narratives and also foster an online community that could make the museum visit a more engaging and interactive experience. Based on the feedback received during the user study, a different approach in the execution of *MEseum* might be considered in future works. Firstly, a more qualitative or mixed method may be more suitable for a study of this nature. Secondly, and with regards to the design of the system, isolating the different components of *MEseum*, redesigning and testing their usability and efficiency independently might be a better approach. After considerable progress has been made in establishing core functionalities with regards to basic user requirements and UI design, then integrating the various components into one system might prove to be a more efficient approach.

The research acknowledges the Hawthorne effect[12] and the fact that it might have contributed to the overwhelming positive results from the user study. The primary researcher conducted the user study and this fact might have affected the participants' performance and evaluation. However, the subject of effectiveness was not so much the interface or performance of participants during the user study as it was the acceptance or rejection of the idea of a museum-visitor interactive system with features that has been earlier described.

The average age of participants surveyed for this study is 19 years. Although, this study subscribes to the emergent and technologically inclined museum visitor, the connection between the average age of the participants sampled and the overwhelming acceptance of the concept, design and technology cannot be over looked. This has left a gap for an older demographic that has not been captured by this user study. Even though the effect of age will be evident in the effective use of such technologies, a concerted effort will be made not to isolate other demographics in continued research. It was also stated earlier in this chapter that the user study had been scaled back due to certain limiting factors such as time and resources. What has been developed and used in conducting the usability study is a proof of concept and not a full system. This constrained the user study to be conducted entirely on a front-end web application with simulations of the basic features implemented, instead of an actual deployment of *MEseum* at the Canada Aviation and Space Museum. Three criteria were used in the selection of participants for the user study. These are Geographical boundary, Age and Technology proficiency. Chapter

[12] Originating from studies conducted at the Hawthorne Plant of the Western Electric Company in the 1920s and 30s, the term 'Hawthorne Effect' now has come to mean changes in the behavior of subjects that originate solely from their being the subject of research.

three details the need for this selection process in the course of the research. In retrospect however, the extent to which these criteria influenced the results of the study might be sufficient to affect a significant bias. A younger generation had been targeted in the study primarily for the fact that the particular demography would be more inclined to the nuances of new technology and as such the learning curve with regards to familiarizing themselves with *MEseum* might be shorter. The consequence of such decisions is that the study might not have necessarily captured an all inclusive and true representation of the demography that the museum currently services and this would no doubt have positively influenced the results. Opening up the age bracket to include the middle aged (31-50) will be a more inclusive study.

The task of physically visiting the museum was simulated through the component of *MEseum* Guide. An ideal scenario would be to have a functional system that was deployed at the Canada Aviation and Space Museum and have participants actually visit the museum during the course of their planned tour. However, this was not to be the case because of limiting factors such as time and finance. The other two components, *MEseum* Plan and *MEseum* Connect, are parts of the system that are expected to be accessed by the participant online or virtually, either through a desktop or mobile device. Chapter 4 shows a detailed design of *MEseum* and its components and the motivation behind basic design decisions. The use of the current floor plan of the Canada Aviation and Space Museum was purposeful in the attempt to design a digital representation of what is available at the museum with regards to floor layout and the display of exhibitions. Although the current version of *MEseum* has not quite captured all of the nuances

that exist in the museum's physical space, the interactive floor plan that it uses is primarily a mirror image of the display area at the museum. To this end, it was hoped that such content would help in establishing a level of similarity between what the participants were exposed to through *MEseum* and what was applicable or present at the museum.

The impact of this fact as it affects the results of the study cannot also be understated. How that the responses could have varied can only be assumed. In spite of this constrain, the results from the user study are sufficient to provide answers to the questions that were outlined at the start of the research. Interests in customizable or personalized museum experiences, the construction of personal digital narratives as a means of storing and sharing museum experiences and the impact of social media to the museum visitor's experience are themes that continuously run through the research and logically, were issues the research sought to address.

The researcher asked the following questions:

A. Will the implementation of customizable experiences improve the museum visitor experience?

B. Are user-controlled narratives proper ways of storing and sharing visitor experiences and also making those experiences more attractive and its content more accessible?

C. Will the inclusion of a social media structure in the design and development of an interactive museum system enhance the museum visitor experience?

Participants' responses suggest that the inclusion of all three features into an interactive museum system could potentially enhance the visitors' interaction and engagement with the museum. 53% of participants surveyed strongly agree that *MEseum* was functional in providing them with the option of personalizing the museum experience and that also having the option to engage with the museum based on individual preferences and interests could enhance their level of interaction with the museum. The other 47% of participants on the same question agree that *MEseum* could potentially assist in personalizing museum experiences.

The ability to create, store and reorganize digital narratives was also a key component in the visitor experience model that the research proposes. 60% of participants strongly agree that being able to construct digital narratives for their museum experience through the use of the timeline and also having the option of saving and sharing such content could potentially enhance the way they interact with the museum. 33% of participants on the same question agree that *MEseum* and its tools could also potentially facilitate the construction of digital narratives. 7% of participants on this question were however neutral.

53% of participants surveyed strongly agree that introducing social media elements in the design of *MEseum* could potentially build an online community of people with similar interests and having access to such a group could enhance their museum experience. As was previously stated, there was limited functionality of this component at the time of the user study. However, participants generally agree that the inclusion of a social media platform that offers access to other museum visitors through out the process of a museum visit could possibly enhance their museum experience.

Table 3. Means and standard deviation user study questions.

	Mean	Standard Deviation
MEseum: Efficient layout	0.4	0.41
MEseum: Personalized planning	0.5	0.04
MEseum: Functional in exploring the museum	0.5	0.32
MEseum: Interactive and engaging	0.5	0.23
MEseum: Set expectation	0.5	0.23
MEseum: Documenting and creating digital narratives	0.3	0.27
MEseum: Foster Online Community	0.5	0.04
MEseum: Intuitive and Easy to use	0.25	0.20
MEseum: Educational tool	0.03	0.27
MEseum: Feel like a participant	0.03	0.18

The social implications behind personalized and interactive museum technology is one that has raised cause for concern (Woodruff et al., 2002), and rightly so. Questioning the impact of online content delivery over the physical presence of the visitor in the museum is a legitimate cause and one that should be taken seriously. The primary aim of developing tools of this nature is to ultimately make the visitors' physical presence at the museum a pleasurable, efficient and worthwhile activity and certainly not to keep the visitor away. A balance should be found where such concerns arise. Just enough online content to lure the audience through the museum doors would be a logical response but this balance can only be defined through repeated design efforts, which would be influenced by continuous research.

The proliferation of these tools and their impact on curatorial accuracy and museum authority could also be cause for concern. Having a platform that facilitates a continuous online discussion of museum matters may indeed provide the curator with a new medium to set his agenda more effectively and give more depth to issues that might not be possible in a traditional tour model. The continuous availability of the museum, through its curators in a virtual space can clarify many concerns and or questions that visitors might have before or after a museum visit. *MEseum* acknowledges these concerns and has made an attempt at creating a balance between visitor curatorship and museum authorship and accuracy. Aside from the access to museum authority that has already been described, *MEseum* Plan offers 'default paths' where museum curators can define a tour experience the way they best see fit. These paths are offered as suggestions to the visitors.

Chapter 6: Conclusions

This research has sought to develop a museum interactive system that enables the creation and sharing of digital narratives while fostering a community of similar and shared interest through the application of social media. The research has been conducted primarily with the intent to explore ways through which the museum-visitor experience can be enhanced. It sought to do this by examining the demands of the emergent generation of museumgoers vis-à-vis the proliferation of digital (interactive) technologies in the modern museum and then considered an approach that might help facilitate the quality of interaction between the museum and this new generation of visitors. Specifically, it investigated the use of social media and digital technology in enhancing the museum-visitor experience. The execution of this goal in a fashion that could be measured through a user study led to the design and development of a museum interactive system called *MEseum*. The system is primarily designed to support the different phases of the museum visit and in the process, give the visitor the capability to build a personal digital narrative that she is able to share with the museum and other visitors.

Overall, the results from the user study conducted show that *MEseum* can potentially enhance the museum-visitors' experience. Users were generally able to plan customized visits by defining various paths. This was carried out based on the preferences and interests of the user. Users were also able to document their museum experiences through the creation of digital narratives on their timelines. Features of the social media component of the system-*MEseum* Connect was very limited and as such user tasks that involved that part of the system was consequently limited. Based on these initial results as a next step, further research is expected to

refine *MEseum* and also conduct subsequent user studies with real Canada Aviation and Space Museum visitors in a constructed museum scenario. Future research will be influenced both by lessons learned from the *MEseum* project current study and also by information gathered. Beyond the scope of this thesis, a second version of the *MEseum* system is currently in development and the researchers have continued on in partnership with the Canada Aviation and Space Museum to improve on the study that has been done already with a view of developing a fully operational *MEseum* system that can be deployed at the museum.

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APPENDIX A

If your response to question 1 is YES, continue with this section, otherwise please skip to section B.

PRE USER STUDY

Have you ever visited the Canada Aviation and Space Museum?

- ☐ Yes
- ☐ No

How did you source for relevant information to plan your visit?

- ☐ Museum's website
- ☐ By Telephone
- ☐ Via Email
- ☐ In-person
- ☐ Others, please specify _____

What type of information were you particular about?

- ☐ Exhibitions
- ☐ Hours of operation
- ☐ Tours
- ☐ Aircrafts
- ☐ Others, please specify _____

Did you find the available information sufficient to plan your museum-visit?

Strongly Agree

- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Do you think that you could have planned a more efficient museum-visit?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Do you think that a more customized and personalized approach to planning and experiencing museum-visits will impact the quality of your museum-visitor experience?

Strongly Agree

- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Do you think that the ability to plan your visit based on specific interests influenced by collective museum intelligence will enhance your museum-visitor experience?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Do you think that a system that offers customizable and personalized tour paths, access to collective museum intelligence (social networking), and the ability to save and share museum memories will enhance your museum-visitor experience?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral

☐ Disagree

☐ Strongly Disagree

Do you think that such a system will be of use to you when planning your museum-visit?
Strongly Agree
☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

Will you consider using such a system when planning your museum-visits?
Strongly Agree
☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

☐ Section B

Provide answers to this section if you skipped section A.

If you were to visit the Canada Aviation and Space Museum, how would you source for information to plan your museum-visit?
☐ Museums's Website

☐ By Telephone

☐ Via Email

☐ In-Person

☐ Others, please specify _____

What kind of information would be important to you?
Exhibitions

- ☐ Hours of Operations
- ☐ Tours
- ☐ Aircrafts
- ☐ Others _____

Will having the ability to plan your visit based on specific interests/preferences enhance your museum-visitor experience?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Do you think that having a more customized and personalized approach to planning and experiencing your museum-visits will impact the quality of your museum-visitor experience?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Will a system that offers customizable and personalized tour paths, access to collective museum intelligence (socialnetworking), and the ability to save and share museum memories enhance your museum-visitor experience?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral

☐ Disagree

☐ Strongly Disagree

Do you think that such a system will be of use to you when planning your museum-visit?
Strongly Agree
☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

Will you consider using such a system when planning your museum-visits?
☐ Strongly Agree

☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

APPENDIX B

Section C
POST USER STUDY SURVEY

This section should be completed after the participant has performed the user task using the MEseum application

MEseum was functional in exploring the museum and its exhibitions.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

Access to the museum's exhibitions and layout in this way increased my ability to plan a more efficient museum-visit?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

MEseum provided a more interactive way to engage with the museum and its contents.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

MEseum helped to set expectations for my museum-visit before arriving at the exhibition space.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

MEseum was functional in planning a personalized/customized museum-visit.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

MEseum was functional in documenting and creating a narrative of my museum experience.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

MEseum was functional as an educational tool for the museum and its exhibitions.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree

☐ Strongly Disagree

MEseum can help to build and foster an online community of aviation enthusiasts.

☐ Strongly Agree

☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

MEseum was intuitive and easy to use

☐ Strongly Agree

☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

MEseum makes me feel more of a participator than a mere visitor

☐ Strongly Agree

☐ Agree

☐ Neutral

☐ Disagree

☐ Strongly Disagree

☐

What other features would make MEseum more functional?

_____

_____

_____

Any other comments?

_____

_____

_____

APPENDIX C

Carleton UNIVERSITY
Canada's Capital University

Carleton University Research Office
Research Ethics Board
1325 Dunton Tower
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada
Tel: 613-520-2517
ethics@carleton.ca

Ethics Clearance Form

This is to certify that the Carleton University Research Ethics Board has examined the application for ethical clearance. The REB found the research project to meet appropriate ethical standards as outlined in the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans, 2nd edition* and, the *Carleton University Policies and Procedures for the Ethical Conduct of Research*.

X New clearance
□ **Renewal of original clearance** **Original date of clearance:**

Date of clearance	**15 May 2013**
Researchers	**Ali Arya, Ph.D.**
Department	**School of Information Technology**
Project number	**14-0075**
Title of project	**MEseum**

Clearance expires: **31 August 2014**

All researchers are governed by the following conditions:

Annual Status Report: You are required to submit an Annual Status Report to either renew clearance or close the file. Failure to submit the Annual Status Report will result in the immediate suspension of the project. Funded projects will have accounts suspended until the report is submitted and approved.

Changes to the project: Any changes to the project must be submitted to the Carleton University Research Ethics Board for approval. All changes must be approved prior to the continuance of the research.

Adverse events: Should any participant suffer adversely from their participation in the project you are required to report the matter to the Carleton University Research Ethics Board. You must submit a written record of the event and indicate what steps you have taken to resolve the situation.

Suspension or termination of clearance: Failure to conduct the research in accordance with the principles of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans, 2nd edition* and the *Carleton University Policies and Procedures for the Ethical Conduct of Research* may result in the suspension or termination of the research project.

[redacted]
Andy Adler, Chair
Carleton University Research Ethics Board

[redacted]
Louise Heslop, Vice-Chair
Carleton University Research Ethics Board

APPENDIX D

USABILITY STUDY

MEseum

an interactive way-finding and guidance system

Test conductors: Efetobore Mike-Ifeta & Ali Arya

STUDY DESCRIPTION

We are testing the usability of the system in assisting the user (museum visitor) in building personalized tours and recording museum experiences for sharing purposes.

Our goal is to enhance the museum-visitor experience through the efficient combination of digital technology and social media. The aim is to develop a personalized narrative-based system that provides the users with a more engaging and educational experience.

DURATION

During a **45-minute session**, participants will explore the functions of MEseum and then proceed to build a personalized tour path and create a digital journal of their museum experience. Participants will also be asked to complete questionnaires about the test.

CONTACT

If you are interested in participating in this usability test, please email Efe Mike-Ifeta at EfetoboreMikeIfeta@cmail.carleton.ca as soon as possible to schedule a time.

**** Tests will be conducted online!!!***

This study has been reviewed and approved by the Carleton University Research Ethics Board

APPENDIX E

Dear Participant,

Thank you once again for your willingness to participate in the usability study for my Graduate Thesis Research.This email will provide you with details on how the study has been structured and will be conducted.

The testing will be remotely conducted using screen sharing, powered by GoToMeeting from Citrix. The testing session will last approximately 20-30 minutes and will be facilitated by myself, however, online questionnaires will also be provided to participants prior to their scheduled sessions and also after its completion. Both questionnaires should take approximately 10 minutes to complete.

During the session, we will be unveiling a *proof of concept* for **MEseum**. **MEseum** is an interactive way-finding and guidance system that is currently being developed in partnership with the Canada Aviation and Space Museum in Ottawa. Still in its very early stages of conception, we will be asking you to complete a user task of planning a simple tour path and also building a timeline of your museum experience that becomes a digital journal that can be shared. We will also be asking for your feedback on the session and the concept itself.

Your screen and audio will be recorded so that we may review and analyze the session later. Confidentiality will be maintained. People involved in the usability study may also review the session.

Following this email, you will receive two invitations; the first will be inviting you to complete a short questionnaire and the other will be providing you with a link to access your GoToMeeting session for your scheduled user test.

I have also attached a participant Informed Consent Form to this email as it is the requirement to do so. I do understand that it might not be possible for you to sign and send it back at this time, so a mail that acknowledges its content will work for now. The document will be signed at a later date as long as you are comfortable with going ahead with the usability testing.

Finally, a compensation of $10 dollars will be given for your time in participating in this user testing. I hope you do enjoy participating in my research and I look forward to the sessions. If there are any questions do not hesitate to contact me via email or by phone.

APPENDIX F

Participant Informed Consent Form

You have been solicited as a research participant for our project entitled:
MEseum: An interactive way finding and guidance system.

The research is being conducted by:

- Dr. Ali Arya, School of Information Technology, Carleton University, Ottawa, Canada, [redacted]
- Efetobore Mike-Ifeta, Human Computer-Interaction, School of Information Technology, Carleton University, Ottawa, Canada [redacted]

Purpose

The purpose of this user test is to evaluate the extent to which the application of social media and interactive technology in the design of a guidance and way-finding system can enhance an individual's interaction with a museum.

The functions to be evaluated at this stage of development are:

- The user's ability to independently plan a tour (build a tour path) based on the level of information that the application provides.
- The efficiency with which the user builds that tour path
- The effectiveness of the system in carrying out the desired task

Task description

The user's task in this usability test is to plan a two point tour path using the MEseum system, edit or modify that tour path with the inclusion of a third tour point and share her timeline (tour path) with another individual.

Dissemination

This research is a part of a project supervised by Dr. Ali Arya (School of Information Technology) and conducted by Efetobore Mike-Ifeta (M.A Candidate, Human Computer Interaction, Department of Information Technology) towards a Master's degree at Carleton University. The result of this research will be used in Mr. Efetobore Mike-Ifeta's thesis and might also be published and/or presented in conferences and/or journals, as well as grant applications.

Anonymity/Confidentiality

You may choose to provide your names and emails or choose to remain anonymous. If you do provide your name and email, however, they will not be used or published in the research, as they will only be kept for possible future verification.

Risks

There are no known risks associated with this activity.

Right to Withdraw

As a participant, you may withdraw at any time for any reason.

Compensation

Participants will be compensated with a 10$ gift card for their time.

This research has been reviewed and cleared by the Carleton University Research Ethics Board (REB) and questions and concerns can be addressed to the REB chair.

Research Ethics Board:
Professor Andy Adler, Chair
Research Ethics Board
Carleton University Research Office
Carleton University
1125 Colonel By Drive
Ottawa, Ontario K1S 5B6
Tel: 613-520-2517 E-mail:[redacted]

Your signature below indicates that you have read the above and voluntarily agree to participate. If you have any questions, please ask them before signing.

***** I have read and understand the above information *****

Participant's name (mandatory): _____
Phone number (optional): _____
Email (optional): _____

Gender (mandatory): _____
Age (mandatory): _____
Occupation (mandatory): _____
Nationality (optional): _____

Signature (mandatory): _____ **Date (mandatory):** _____

APPENDIX G

Hello Participant,

Please join the session at your scheduled time (2:15pm on Saturday, June 22nd) with the link below.

https://global.gotomeeting.com/join/388597349

You will be connected to audio using your computer's microphone and speakers (VoIP). A headset is recommended.

Meeting ID: 388-597-349

I have also attached a user guide for instructions on how to join the meeting.

NOTE: PLEASE CONNECT A FEW MINUTES EARLY SO THAT WE CAN START THE SESSION ON TIME

Thanks and I hope you enjoy participating in this study.

Regards,
Efetobore Mike-Ifeta
Storyteller/Interaction Designer

APPENDIX H

User Task.

START

1. Locate the 2nd World War Exhibition
2. Located the first World War Exhibition
3. Plan a tour path between both Exhibitions
4. Find the 'Go to Museum' option and arrive at the Museum.
5. Follow previously built tour path
6. Check in to Exhibitions on your tour path
7. View the digital narrative on your timeline.
8. Locate the 'Show others' option
9. Click on the avatar of a museum visitor on the interactive map
10. View the profile of that visitor
11. Leave a message for the visitor

END