

MEseum: Personalized Experience with Narrative Visualization for Museum Visitors

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Abstract. The technological enrichment of museums serves as a prime area for research on the changing role of mobile and interactive technologies, and the visualization of personal data. While previous research projects have focused on using mobile technology to act as an electronic guide, or as a means for a user to view additional information about the museum exhibits, in contrast this project takes a different approach. It seeks to develop new methods to create a personalized experience and visualize the data collected from a user's visit as a personal narrative. MEseum, our proposed system, allows the user to plan a visit, follow that plan, and construct a presentation that they can use to reflect, communicate, and share their experiences with others. To this end, a museum guidance system and four visual narrative styles were designed, developed, and successfully tested.

Keywords: Museum · Navigation · Interactive · Personalized · Narrative · Visualization

1 Introduction

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 [1]. 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. 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.

The power of narrative is no secret in the museum world where various forms of storytelling have long been employed to engage visitors [2]. 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, as the base for a personalized narrative, 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 through visualization of their personal narratives in different styles each suiting a specific purpose.

2 Related Work

Many museums have begun to use technology to make the experience more interactive. Digital touch screens kiosks have become more prevalent along with large screen installations, video walls, smart badge systems, 3D animation, virtual reality, and increasingly sophisticated websites. Such technologies have changed the physical character of the museum [3].

There have been a number of systems developed in order to try and facilitate storytelling in museums. 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 [4]. Urban Tapestries [5] 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. Tate Modern multimedia tours follow the same approach of using location tracking for personalized or contextualized delivery content. Bletchley Park Text [6] 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) [4]. 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 [4].

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. 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. When storytelling or narratives are mentioned within the museum parlance and in the instances where technology has been employed, we discover that there are no explicit learning goals or incentive to create stories (Story Corps and Urban Tapestry). Presentation of personal narratives of museum visitors in various styles has not been effectively addressed through existing systems.

Marie-Laure Ryan [7] discusses the uniqueness of narrative in digital media and identifies several key elements, including the increased level of interaction and the point of view of the user in regards to the story. Different variations of these two elements can change how the narrative is composed in a drastic fashion [7]. Kosara and Mackinlay [8], provide an example of how narrative visualization requires its own methods in contrast to traditional visualization in the journalistic realm. To this end, new visualization techniques can be found to help convey visual narratives. Hullman and Nick Diakopoulos [9] explore this by examining how visualization can be used to shape meteoric. Edward Segel and Jeffrey Heel [10] also studied different visualizations that the media used to convey stories in print and online, in an attempt to identify and classify broad narrative visualization techniques. They found several different patterns that involved various aspects of presentation such as layout, story structures, and structures used in conveying the story in a visual manner.

3 Research Approach

3.1 Overview

In this paper, we report on the design and evaluation of MEseum (Me-in-the-museum). MEseum has gone through two major phases. In phase 1, the general structure of the system was designed and evaluated. It included general functionality that is required to guide users through a personal experience. While this phase did introduce the notion of timeline as a means of collecting and sharing the narrative information, it included only a simple way of presenting this information. Our phase 2 focused on this presentation and introduced our notion of narrative visualization through various styles. Both phases consists of design, development, and usability studies, as described in the following sections (Figs. 1, 2, 3 and 4).



Fig. 1. MEseum Plan

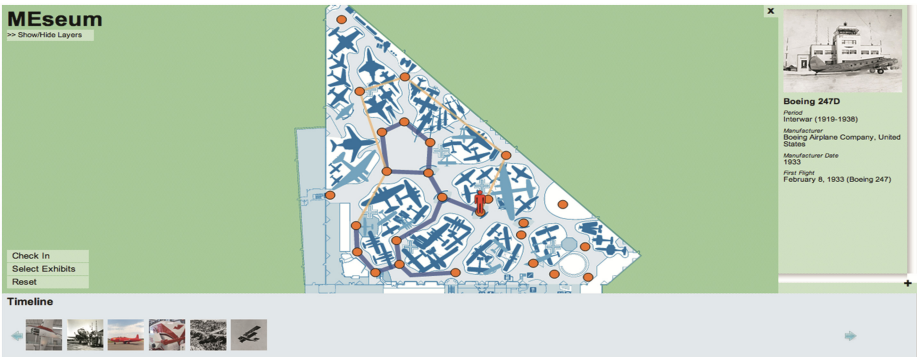


Fig. 2. MEseum Guide

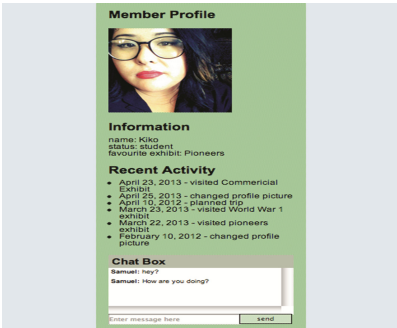


Fig. 3. MEseum Connect

3.2 MEseum System

The research team divided the museum visit into three functionally distinct parts: planning a visit, following the plan, and post-visit access to data. The system and its tools were to correspond to these parts of a visit. MEseum components include:

- 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 can access their data and communicate with other visitors and also the museum.

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, accessed, edited, and shared.

The key concept in MEseum design is timeline, a collection of personal and museum-provide data that define the user experience. MEseum Guide is the tool that generates timeline content, while MEseum Connect allows it to be packaged and presented effectively.

3.3 Narrative Visualization

Based on seven visualization genres suggested by Segel and Heer [10] and the notions of internal vs. External, and exploratory vs. Ontological presentations [7], we define four visualization styles to be used and evaluated for MEseum. The four narrative visualizations are as follows:

Slideshow: This visualization is a rather simple one. It's meant to mimic the existing method of displaying pictures in a slideshow that is commonly used as a presentation means. It was included to serve as a comparison to the other visualization methods. The pictures are displayed very prominently, and fade into each other as the slide show automatically plays and rotates through them all. There is a small queue underneath the viewing area that displays all the photos along with the comment or title.

Categorical: This visualization is focused around giving a clear sense of the information learned. It presents its information impersonally, like a record of what the user learned and visited. Information is arranged in a scientific way by topic. Where the type and category of information they viewed is all laid out for them and they can gain an

understanding of how it is all scientifically related and categorized. Information is presented in a magazine style layout. Information from another source outside the museum is also presented along with a weblink to that source encouraging the user to learn more.

Sequential: This visualization is focused around giving a sense of time and place. Each exhibit is presented like a node on the overall museum floor plan. The user can follow the path they took and view each exhibit they saw and at what time they saw it.

If the user clicks on one of the exhibits a radial menus of nodes is displayed around the central exhibit node. Each child node is a picture of an artefact in the exhibit along with information about that artefact.

Dramatic: This visualization is focused around giving a clear sense of the user's personal experience visiting the museum. There is a sense of linear narrative to it where the user scrolls and is able to see the results of what they saw in the museum in a way that resembles pages of a scrapbook. The background is textured and the font playful. Any pictures the user take are displayed like Polaroid photographs with their comments written on them. Information about the exhibit is kept to a minimum. The system will also comment about what they saw. Such as "Next time try to find the largest meteor on display. It's bigger than you think." If the user missed taking pictures of any prominent exhibits they will be displayed as 'blank' squares next to the Polaroid's. These blank squares are meant give a sense of what the missed.

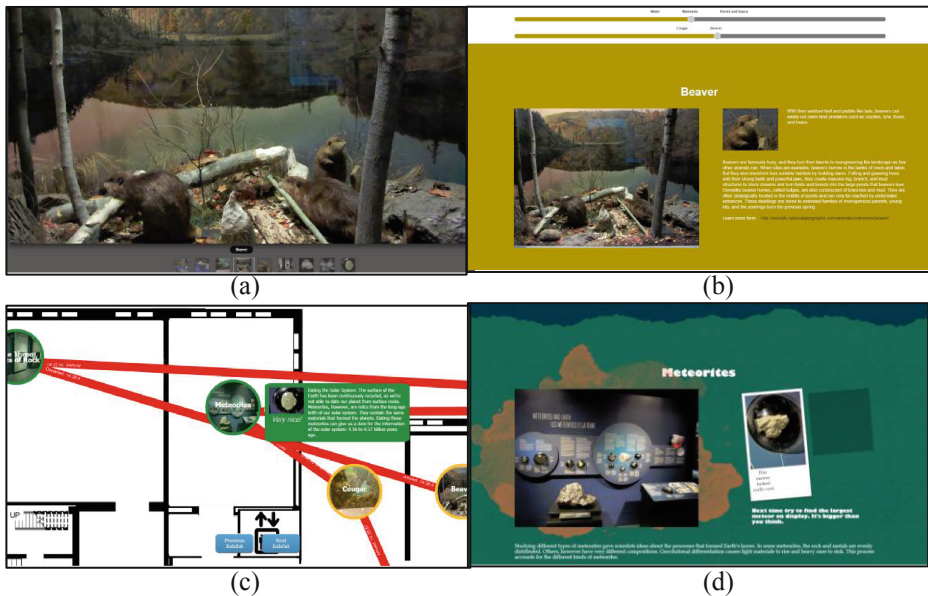


Fig. 4. Narrative visualization styles. (a) Slideshow, (b) Categorical, (c) Sequential, (d) Dramatic

3.4 System Features

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

3.4.1 Interactive Floor Plan

The floor plan of the Canada Aviation and Space Museum (or any other partner museum) is 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 three layers:

- Content layer, embedded with information (interactive photos, audio, text etc.,) from exhibitions that are currently being displayed on the floor of the museum. 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.
- Path building / Creation Layer, a procedurally created path connecting points of interest has also been built into the floor plan. This allows the user build paths of interests between two or more tour points, or exhibitions. It 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.
- 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.

3.4.2 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 of adding media content (provided by the system or created by the visitor such as photos, notes etc.) to his timeline which in turn starts to progressively build his digital narrative. MEseum provides the visitor with the ability to manually ‘check in’ so there is no need for expensive infrastructure for location tracking. Various indoor positions systems can potentially be added to automate this process.

3.4.3 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.

4 Experimental Results

4.1 Phase 1

The phase-1 survey participants were invited through posters, mailing lists and word of mouth. Total number of participants was 26. Participation was online and no physical visit to the museum was necessary as the evaluation was focused on the planning and potential uses rather actual real usage in a museum. Participants had almost equal gender distribution (some did not provide the information) and had various occupations from university student to retired. The age range was 23 to 60 with average of 33.

Two URL were shared with the participant. The first URL redirected the participant to the Canada Aviation and Space Museum, our partner museum’s Visit Us page. 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 CASM. The participant was also provided with a user scenario and a set of user tasks that include locating exhibits, planning paths by using points of interest, checking in (virtually), creating timeline content, and accessing profile features such as sharing and messaging.

Table 1 shows the number of each response options for the significant survey questions. During the pre-survey, 22 participants agreed to some level that having a tool to plan museum visit based on personal interest will enhance their experience (pre-survey question 1). While 23 out of 26 stated that they would consider using a museum visit system, only 17 of them were optimistic about the usefulness of such system. The post-survey responses show that majority of participants found MEseum functional and potentially helpful in achieving its goals. More than 20 participants agreed that MEseum was a successful design for exploring the museum, interaction with content, planning and documenting, and creating a community. On the other hand, only 13 agreed that it was intuitive and easy to use.

Additional comments by participants acknowledged the early state of interface design and mentioned the need for improvements, addition of music and audio, consideration of the Internet connection, supporting video in timeline, and a list of exhibits and features.

Table 1. Distribution of answers to survey questions (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree)

	SA	A	N	D	SD
Pre Survey Questions					
Will having the ability to plan your visit based on specific interests/preferences enhance your museum-visitor experience?	12	10	4	0	0
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?	10	9	6	1	0
Will 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 enhance your museum-visitor experience?	11	6	7	1	0
Do you think that such a system will be of use to you when planning your museum-visit?	10	7	8	1	0
Will you consider using such a system when planning your museum-visits?	9	14	3	0	0
Post Survey Questions					
MEseum was functional in exploring the museum and it's exhibitions.	12	8	4	1	1
Access to the museums exhibitions and layout in this way increased my ability to plan a more efficient museum-visit?	13	6	5	2	0
MEseum provided a more interactive way to engage with the museum and its contents.	10	11	4	1	0
MEseum helped to set expectations for my museum-visit before arriving at the exhibition space.	13	10	2	1	0
MEseum was functional in planning a personalized/customized museum-visit.	9	11	3	2	1
MEseum was functional in documenting and creating a narrative of my museum experience.	9	11	3	2	1
MEseum was functional as an educational tool for the museum and its exhibitions.	10	12	2	2	0
MEseum can help build and foster an online community of aviation enthusiasts.	8	12	5	1	0
MEseum was intuitive and easy to use.	8	5	4	7	2
MEseum makes me feel more of a participant than a mere visitor.	8	9	5	4	0

4.2 Phase 2

The second phase of our study focused on the issue of timeline and narrative visualization. The experiment was broken up into two sub-tests:

- **Sub-Test 1, Construction:** The first test dealt with a user visiting a virtual (simulated) museum and building a narrative visualization based upon what they experienced. Our hypothesis was that the user would prefer the narrative visualizations to the more traditional methods. Our criteria to verify this hypothesis included effectiveness, operability, satisfaction, and flexibility, all measured through a questionnaire.
- **Sub-Test 2, Viewing / Presentation:** The second test was based on a user sharing their Visual Narrative with others. In this scenario the user is looking at visualizations of another person's visit to a museum that they have not visited. The two main goals that this user scenario has in mind are *sharing* and *communication*. Our hypothesis was that each visualization would succeed at conveying its themed content in a

satisfactory manner to the user. We used similar evaluation criteria as in sub-test 1, but replaced flexibility (more suitable in case of construction) with sociability (more suitable for this sub-test). We again used survey questions to measure.

20 participants were tested in all. There were 8 females and 12 males and they ranged in age from 20 to 61 with varying degrees of computer literacy that they were asked to rate themselves on (Tables 2 and 3).

Table 2. Sub-Test 1: Construction

Criteria	Result (Combined average rating)	Number of Questions
Effectiveness	5.7 out of 7 with 0.62 std error.	3 seven-point Likert scale
Operability	6.1 out of 7 with 0.2 std error.	3 seven-point Likert scale
Satisfaction	<i>See Sect. 4.2</i>	3 Ranking Questions
Flexibility	5.48 out of 7 with 0.29 std error.	3 + (two others detailed below)

Table 3. Sub-Test 2: Viewing / Presentation

Criteria	Result (Combined average)	Number of Questions
Effectiveness	5.65 out of 7 with 0.21 std error.	6 seven-point Likert scale
Operability	45.77 s with 8.09 std error.	Timed Task
Satisfaction	<i>See Sect. 4.2</i>	3 Ranking Questions
Sociability	4.6 out of 7 with 0.35 std error.	3 seven-point Likert scale

The ranked satisfaction questions were useful to tell which visualization preformed best in a variety of aspects. Overall the results were a bit inconclusive where for some questions the participants gave all the narrative visualizations clear majorities in terms of rank but for others there would be no clear majority.

Thus three main variables where used to determine the ranking: mode ranking, average ranking, and the various proportions of users who gave it a certain rank versus other ranks. The results, while not wholly conclusive, were analyzed in this regard to determine broad trends which are summarized as follows:

Subtest-1

- Reflection: Dramatic, Sequential, Categorical, Slideshow
- Uniqueness: Sequential, Dramatic, Categorical, Slideshow
- Satisfaction: Dramatic, Categorical, Sequential, Slideshow

Subtest-2

- Engagement: Dramatic, Categorical, Sequential, Slideshow, File Browser
- Learning: Categorical, Dramatic, Sequential, Slideshow, File Browser
- Clarity: Dramatic, Categorical, Sequential, Slideshow, File Browser

5 Conclusion

The research reported in the paper investigated the use of social media and digital technology in enhancing the museum-visitor experience. This has been done through a user study and 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, with 85 % of participants in favour of such planning and guidance tool. Users were generally able to plan customized visits by defining various paths. Users were also able to document their museum experiences through the creation of digital narratives on their timelines. Features implemented in the system were 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 museum visitors in a constructed museum scenario.

- A more streamlined interface where general map, timeline overview, available actions, and information on selected items.
- Check-in process and data collection by visitor can be integrated into one action using object recognition algorithms that can allow the system to know where the visitors are when they take pictures.
- The system should be integrated with existing social networks.

Acknowledgement. This work is funded by Social Sciences and Humanities Research Council of Canada (SSHRC) through IMMERSe Network. The authors would like to thank the Canadian Aviation and Space Museum for the support in phase 1 of the research.

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