
Studying Multimodal Interaction at an Interactive Museum Exhibit on SteamPower Locomotive

Loraine Clarke

University of Strathclyde.
26 Richmond St,
Glasgow, G1 1XH, UK.
loraine.clarke@strath.ac.uk

Eva Hornecker

University of Strathclyde.
26 Richmond St,
Glasgow, G1 1XH, UK.
eva@ehornecker.de

Abstract

This paper discusses an ongoing study of a multimodal installation on the subject matter of steam power locomotives at a transport museum in Glasgow, Scotland. The key issue of the study is the role of multimodal interaction in museum visitors' experience of exhibits, their engagement with the topic and the exhibit. The paper describes the approach taken to answer these questions which has so far involved observational studies.

Keywords

Museum, installation, multimodal interaction, collaboration

ACM Classification Keywords

H.1.2. [**Information Systems**]: User/Machine Systems,- *Human Factors*. H.5.1. [**Information Systems**]: Multimedia Information Systems,- *Audio input/output, Evaluation/methodology*.

Introduction

Engagement and experience in museums is becoming more widely researched in recent years where there has been a shift in interest from aspects such as the average number of visitors stopping at an exhibit, the average amount of time visitors spend at an exhibit or the effectiveness of an exhibit in delivering information to visitors towards questions as to the role an exhibit plays in social interactions, how people make sense of exhibits and the visitor experience [13, 11]. A significant amount of work has emerged from the Exploratorium and other science centres relating to 'hands-on' physical interactions, with or without the use of computer technology in the exhibits [9]. Questions have been posed as to what degree these exhibits also support 'minds-on' beyond merely hands-on engagement [1,15].

Hands-on exhibits are increasingly also finding their place in museums, other than science museums, that are generally associated with showcasing original artefacts, such as natural history or transport museums. Our focus is on how these types of interactive exhibits are integrated in traditional museums. However, we are more specifically interested in exhibits that have some of these tangible qualities combined with several modes of communication between the exhibit and visitors that appeal to more than one of our five senses.

As part of ongoing PhD research, a collaboration between the Riverside Transport Museum Glasgow and the Mobiquitous Lab, University of Strathclyde has been set up with the aim to examine multimodal installations in this museum, focusing on visitor experience of the exhibit in question, engagement with the topic and the

exhibit itself. This paper explains the ongoing study of a single interactive multimodal exhibit called the 'Glen Douglas' which is about the processes involved in getting a steam power locomotive running. The motivation behind the study is to understand the interaction that emerges around the multimodal input and output channels at the exhibit. The goal is to develop in-depth knowledge of how interaction with multimodal exhibits relates to visitors' experience of an exhibit, social interactions, visitors engagement with a topic and with an exhibit. The research intends to examine installations considering the modes of communication between a visitor and the exhibit and their inappropriate or appropriate integration with other modalities, the context, topic and target audience.

From research into experience and engagement with ICT in and outside of the museum domain we have pulled together a number of attributes that can be seen to holistically affect the museum visitor experience [3, 6,7, 10, 11, 12, 13, 14]. Battarbee et al [2] discuss that "experience can be seen as an individual's reaction, but also as something constructed in social interaction". According to Dewey, an experience or emotion is influenced by a combination of several attributes[5]. Similarly we can consider that a visitors experience of a museum exhibit or the emotional response can be influenced by several elements.

Existing research has linked a range of attributes with the museum experience and engagement such as: social interaction, role play, imagination, control, feedback, challenge, surprise (ambiguity), emotional response, enjoyment, accomplishment, diversity of experiences, variety of content on display, expectations, meaningfulness, prior knowledge,

preferences, novelty factor and experiencing something different from outside of the museum [3, 6,7, 10, 11, 12, 13, 14]. Falk and Storkbieck's [4] work highlights three key factors in the quality of a visitors museum experience which are (1) personal context, (2) sociocultural context and (3) physical context.

O'Brien and Toms [10] outline four stages of engagement, which are the point of engagement, periods of engagement, points of disengagement and reengagement. The research explores whether we can make connections between these stages of engagement and the media itself or attributes that have been presented due to the media's physical presentation, modalities or external factors such as challenge or co-experience.

Keeping these attributes in mind, we would like to examine the specific modalities and their relationship to these attributes in the case of an interactive museum exhibit based on a steam locomotive. In doing so we aspire to develop a deep understanding of where tangible embodied interaction coupled with specified modes of communication affects these attributes, thus influencing visitor experience of an exhibit and engagement with subject matter.

Installation Overview

The 'Glen Douglas' exhibit demonstrates and explains the processes that take place within the body of a locomotive when it is working. One of the aims outlined by the museum for the exhibit (in the original design brief we had access to) was to encourage hands-on learning, promote collaboration and task-orientated interpretation. There are a number of steps involved in successfully getting the locomotive running.

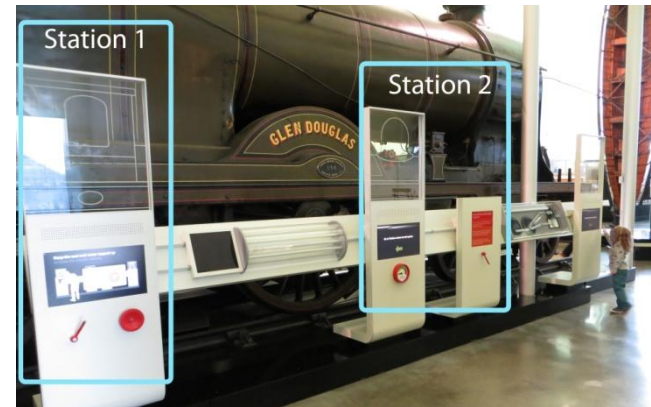


figure 1. Overview of Glen Douglas Exhibit: Input areas

The exhibit requires a visitor to add coal and water to the firebox to heat the boiler by turning the lever and wheel at station 1, shown in figure 1. Upon doing so a graphical representation of the reaction is presented on the screen in front of them, tubes light up blue and red for water and coal and the fire display is lit up, (figure 2). In order to get the model of the locomotive moving, visitors must increase the pressure by adding more coal and water according to the instructions presented at station 2 in figure 1. These instructions are not shown at station 1 (where one can control adding coal and water). The person at station 2 needs to following the instructions at station 2 or work with another person who communicates what to do. If too much coal is added, the fire gets choked and goes out. If too much water is added the boiler cools down too much and the locomotive stops. Additionally, the pressure needs to be released when it builds up by turning the lever at station 2 in figure 1. To know when to release the pressure, visitors need to pay attention to the pressure

gauge displayed at station 2 in figure 2. Adding coal or water and attending to the pressure regulation needs to be carried out at the same time at stations 1 and 2. It is expected that people will work in teams to get the locomotive running or, alternatively, an individual could run between stations to monitor when to add more water and coal and when to release the pressure. The spatial layout of the exhibit, placing feedback relevant to input at station 1 at station 2 was intended to encourage dependence on other visitors or group members. This could be interpreted as a conscious attempt at Embodied Facilitation [8].

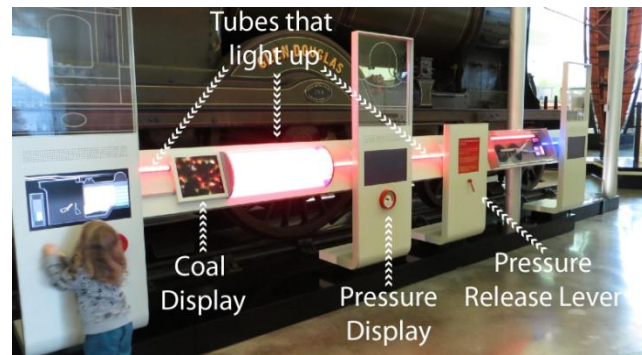


figure 2. Overview of Glen Douglas Exhibit: displays

The exhibit has some elements of tangible interaction where levers and knobs are used for user input. However, the output is not displayed through the same medium. It is dispersed over a variety of visual outputs and displays, and some audio feedback of locomotive whistles and chugging noises when the locomotive is working. The visual feedback is presented on 3 non-interactive screens (see Figure 1), via light displays simulating tubes or pipes, a display showing the coal

fire (Figure 2), a physical model of the locomotive's wheels (Figure 3) and a pressure gauge (Figure 2) placed along the length of a real locomotive. The spatial layout of exhibit is spread along the side of the engine of a locomotive, aligning the interactive exhibit's features in approximately the same location as they would be in the real life locomotive.

The (spatial layout) distribution of the controls for the locomotive makes it difficult for a sole person to (1) input at both input areas and (2) gain feedback via the outputs placed along the exhibit without moving themselves physically to the other end or communicating with others.



figure 3. Close-up of the part of the installation showing the simulated wheels of the locomotive

Proposed Research Questions

The research study examines how the use of tangible media as an input means in this exhibit, combined with other output channels, supports engagement with the

subject matter, shared experience (Co-experience - Battarbee 2003) and the individual visitor's experience.

Visitors may use a range of resources available to make meaning of an exhibit such as other people's actions, conversations, gestures as well as the installation feedback (visual, audio, tactile, priorception). Our study aims to explore in what way people utilise these resources, combining them to make meaning, how this relates to their experience of the exhibit and their engagement with the topic. In order to do this we reflect on the attributes associated with museum visitor installation experience and engagement to form questions to determine how to carry out the study.

Some of the interactions between people that the study will examine concern the modes of communication between people: seeing what others are doing, speaking, gesturing to each other, touching to stop one other or pointing. More importantly, the modalities between the digital media and visitors will be analysed considering the patterns of visitor behaviour (touching, turning, running, gaining overviews, pausing, listening) relevant to the patterns of media output.

It is anticipated that this data may reveal connections between media and visitor reactions, where the media may be triggering certain actions. What elements are encouraging or hindering social interaction? Is there a division of labour where certain people start to take different roles, eg. directing others? Do people show signs of intentionally sharing elements of the experience with others, eg. drawing somebody's attention to an aspect they find interesting? What bodily movements and gestures emerge between the visitors and the exhibit and each other? And do visitors

enjoy using the Glen Douglas? We aim to identify points of engagement, sustained engagement, disengagement and re-engagement [10] and to determine whether these points can be linked with the exhibit's media and means of communication between exhibit, visitors and other visitors. We will also identify points when visitors seem to be confused or express they are, and look for signs of challenge, motivation and accomplishment.

Study Outline and Data Collection

The study initially started capturing data using ethnographic-style observations supported by detailed notes, sketches and photographs. From here some initial analysis was carried out in order to guide the direction of the research questions relating to this exhibit and the overall PhD research goals. There are a number of areas requiring more in-depth observations and analysis of the data such as multi-group usage, where visitors sometimes disturb others and occasionally work in a team with strangers. Often, at some point during their interaction with the exhibit visitors stand back and appear to attempt to gain an overview of the whole exhibit, trying to work it out. Most visitors appear to be confused as to the function of the input controls even after a quick initial action, re-action test. These are only initial observations from the field notes and require a more detailed systematic analysis.

Subsequently, more observations were carried out along with video data collection and a number of open ended interviews with visitors after they used the exhibit. Approximately 6 hours of video data was captured using 4 cameras to capture several different angles and areas of the exhibit along with audio recordings at both input stations. This data now needs

to be analysed with regard to the stated research questions.

Having identified the questions to be focused on, we have decided to complement data collection from an observational point of view, with an investigation regarding visitors' insight of their experience and thoughts when interacting with the exhibit. We are interested in their reflections of what they say drew them into this exhibit, and what elements they found interesting. Following a first analysis of the video data collected so far, we thus aim to carry out further ethnographic style observations and interviews with a more focused approach on connections and findings that emerge from the data already gathered.

Future Work

The Riverside Museum has expressed they would like to use the findings gathered from this study to carry out a re-design of the Glen Douglas installation. If this were to happen, then it is possible that the current study will turn into a larger study where an additional analysis of the re-design can be carried out, documenting an iterative process of re-design in a museum of a multimodal exhibit.

Acknowledgements

We thank the Riverside Transport Museum staff for their continuously support with the study and the opportunity to work on the project with them.

Citations

[1] Allen, S. Designs for Learning: Studying Science Museum Exhibits That Do More Than Entertain. *Science Education*, 88, 1 (2004), 17-33.

[2] Battarbee, K. Co-experience: the Social User Experience. *Proc. of CHI 2003*, ACM Press (2003).

[3] Dindler, C. and Iversen, O. L. Motivation in the Museum - Mediating Between Everyday Engagement and Cultural Heritage. *Engaging Artifacts 2009*. (2009).

[4] Falk, J. and Storksdieck, M. Using the contextual model of learning to understand visitor learning from a science center exhibition. *Science Education Journal*, 89, 5 (2005),744-778.

[5] Forlizzi, J., Disalvo, C. and Hanington, B. On The Relationship Between Emotion, Experience and The Design of New Products. *The Design Journal*, Berg Publishers, 6, 2 (2003), 29-38.

[6] Haywood, N. and Cairns, P. Engagement with an Interactive Museum Exhibit. *Proc. of HCI 2005*. Springer-Verlag London Limited (2005), 113-129.

[7] Holtzblatt, K. What makes things cool?: intentional design for innovation. *Interactions*, ACM Press, 18, 6 (2011), 40-47.

[8] Hornecker, E. and Buur, J. Getting a grip on tangible interaction: A framework on physical space and social interaction. *Proc. of CHI 2006*, ACM Press, (2006).

[9] Humphrey, T. et al. Fostering Active Prolonged Engagement: The Art of Creating APE Exhibits. *Left Coast Press*, (2005).

[10] O'Brien, H. and Toms, E. (2008). What is User Engagement? A Conceptual Framework for Defining User Engagement with Technology. *Journal of the American Society for Information Science and Technology*, 59, 6, (2008), 938-955.

[11] Pekarik, A. et al. Exploring Satisfying Experiences in Museums. *Curator: The Museum Journal* , 42, 2 (1999),pp.152-173.

[12] Sandifer, C. Technological Novelty and Open-Endedness : Two Characteristics of Interactive Exhibits That Contribute to the Holding of Visitor Attention in a

Science Museum. *Journal of Research in Science Teaching*, 40, 2 (2003),121-137.

[13] Vom Lehn, D. and Heath, C. Accounting for New Technology in Museum Exhibitions. *International Journal of Arts Management*, 7, 3 (2005), 11-21.

[14] Vom Lehn, D., Heath, C., and Hindmarsh, J. Exhibiting Interaction: Conduct and Collaboration in Museums and Galleries. *Symbolic Interaction*, 24, 2 (2001), 189-216.

[15] Witcomb, A. Chapter 21. Interactivity Thinking Beyond Pedagogies. In *A Companion to Museum Studies*, Wiley-Blackwell (2006).