A Virtual Museum of Computing History: an educational resource bringing the relationship between people and computers to life

Geoff Berry
Faculty of Arts
Monash University
Melbourne, Australia
Geoff.Berry@monash.edu

Judy Sheard
Faculty of Information Technology
Monash University
Melbourne, Australia
Judy.Sheard@monash.edu

Marian Quartly
Faculty of Arts
Monash University
Melbourne, Australia
Marian.Quartly@monash.edu

Abstract

Teaching computing history is widely accepted as an important way of helping IT students to better understand their field, especially in its context as an integral part of modern culture. While physical museums have proven constructive in this, the Monash Museum of Computing History (MMoCH) is developing a Virtual Museum Project (VMP), bringing its physical exhibits to life with computer-generated animation. The viewer's human relationship with computers is placed in the context of current developments by way of a short journey into space exploration. The 'virtual tour' takes in the Ferranti Sirius, the PDP-9, and the hand-held HP-65, before concluding back on earth, in the very computer screen before the viewers, who are thus encouraged to recognise their relationship with computing in the dynamic (ongoing) history of IT.

Keywords: history of computing, computer science education, animation, computing museum.

1 Introduction

The idea that students of computer sciences should have some understanding of the cultural as well as technical aspects of their field has been recognized as vital to the future of academic studies in the discipline (Giangrandi and Mirolo, 2006; Lee, 1998; Medina, 2004). Physical museums of computing history go a long way towards introducing students to these societal contexts (Williams, 2003). Some museums also include online or virtual tours to complement the physical exhibition. These are usually static representations of the physical museum, which are easily accessible resources that illustrate the collections but do not bring them to life. An especially successful example can be found at the Computer History Museum website (Computer History Museum, 2010). Others, such as the virtual museum described by Giangrandi and Mirolo (2006), employ an animated guide to help visitors negotiate their way through a virtual environment. This is meant by design to be an abstract exercise, with the idea of a museum being used as a metaphor to help students become immersed in their engagement with the materials. Another example of a virtual museum is the Virtual Museum of Computing, which is, in effect, a collection of links to information about historical computing artifacts and events (Virtual Museum of Computing, 2010).

The Virtual Museum Project (VMP) responds to the challenge of creating and implementing a virtual museum of computing history that goes beyond these approaches. It is designed to bring items from a physical exhibition to life, in a computer-generated animated sequence that is related to real world history and the immediate cultural context of the viewer. The first stage of the VMP constitutes an animation featuring three of the major items on exhibition in Monash University's Museum of Computing History (MMoCH), which is housed on Monash's Caulfield campus in Melbourne, Australia. These items are the Ferranti Sirius (1962), the PDP-9 (1969), and the hand-held HP-65 (1973). The VMP follows the MMoCH's chronological, narrative approach to the presentation of computing history, focusing on the speedy evolution of the computer, in just over a decade, from a bulky, room-sized behemoth to a hand-held device (Ainsworth, Sheard, and Avram, 2008a).

The VMP animation traces this evolution with a journey that begins with the installation of the Ferranti Sirius in the physical museum, and then leaves earth to explore space, before finally returning the viewers to their own computer screen. Thus they are invited to follow a particularly exciting period of computing history, from the early '60s to the early '70s, that brings to life not only the speed of computing evolution but the way these past developments relate to the viewers' own experiences with computers today.

The VMP animation thus highlights the way the relationship between people and computers has changed our experiences of space. Modern technological evolution has resulted in computers becoming exponentially more

powerful and accessible, even as they have reduced in size; meanwhile, international communication has become commonplace, such that the world itself seems smaller. The items chosen for display in the VMP animation reveal the rapidity and extent of this evolution, while the animated narrative places today's student of computer science in its ongoing context.

The VMP design allows for future development of other dimensions of the museum experience, for example animations which link exhibits across museums. This first stage concentrates on a brief but exhilarating animated journey outside of the architecture of the physical museum. This paper outlines the development of this exciting educational resource, gives a brief description of its pedagogical use to date, and presents ideas for its future evolution.

2 Background and Motivation

The interface between the individual and the computing technology now available to them continues to become more accessible and immediate with every passing year. This proximity – experienced with the desktop PC, portable laptop, reading tablet and even more ubiquitous applications – raises important questions about the relationship between people and computers.

The MMoCH was established in 2001 at the Caulfield campus of Monash University in Melbourne, as a way of exploring these themes in an educational context. The physical museum is unique in that it preserves an evolutionary trajectory of computing both in the wider community and specifically in terms of Monash University's own history of information processing. In exhibiting major artifacts of the technologies involved in this history it makes a significant contribution to their conservation, while acting as an educational resource for school and university students, as well as the wider community (Ainsworth, Avram, and Sheard, 2010).

A chronological organization was chosen for the MMoCH exhibition because this helps to fill in the gaps often perceived between students' appreciation of the technological power of computing and their personal relationship with computers. The MMoCH sought to develop a narrative that would explore the rapid ascent of the 'information revolution,' such that a bridge could be formed between the original technological objects and their cultural context (Ainsworth et al., 2008a; Ainsworth, Sheard, and Avram, 2008b). This approach is supported by Giangrandi and Mirolo's (2006) recent study, which reveals that students of computer science have difficulty placing the history of the technological artifacts (about which they are curious) in a historical perspective. As these authors conclude, such educational efforts can help to change students' attitudes toward knowledge, "so that they will not miss opportunities to broaden their cultural horizons" (p.305). (Giangrandi and Mirolo, 2006)

A thematic motivation for the VMP was provided by the stated aim of the MMoCH to explore the relationship between people and computers. Computing has had a significant impact on the way we do business, run government, supply education and live our everyday lives because it has changed the way we communicate, handle, use and disseminate information. Educational resources such as the VMP can help students, amongst others, to find perspective amongst the social upheavals and dramatic changes in employment patterns and workplace cultures that have accompanied adoptions of this technology (Katz, 1995). Such study helps promote understanding of the societal, economic, and political contexts for the development of computing technology (Katz, 1995).

With judicious choice of exhibitions and a creative narrative approach, then, the relationship between computing power and human culture can be explored. In this way, students learn from IT history as well as from its applications and new developments, as proposed by John Impagliazzo and John A N Lee, consistent advocates for the teaching of computing history (Impagliazzo and Lee, 2004; Lee, 1996a; Lee, 1996b; Lee, 1998). While the MMoCH achieves this as a physical museum, its development into the virtual world allows for a significant expansion in its explanatory and pedagogical powers.

The motivation behind the VMP animation is inspired first and foremost by the Museum's role as a teaching facility. School and university students today typically respond well to computer-animated displays, interactive graphics, and any foray into the world of virtual reality. In this they form part of an ongoing history of people for whom computers became a matter of personal, as well as institutional, use (Ensmenger, 2004). With this in mind it seemed logical that a museum dedicated to education about computing history should utilise the kinds of graphic displays preferred by its intended audience of school students and young adults.

Furthermore, the VMP is an enhancement to the physical MMoCH. The teaching of computing history in its sociocultural context gains from having the technologies discussed available for students to observe or handle. It is useful to have concrete objects to teach abstract concepts, as evidenced when the study of logarithms is aided if students can perform calculations on a slide rule or Napier's bones (Williams, 2000). An example of this approach is the use of an operational PDP-11/10 computer to reinforce the teaching of computing topics such number systems and machine languages (Harms and Berque, 2001). The VMP puts viewers in direct relation to the concepts behind IT evolution by placing the concrete use of computers in the context of the history of computing.

The VMP is designed, then, with two aims firmly in mind: to help students understand the history behind the very activity they are engaged in when viewing the animation, and to increase accessibility to the physical resource of a computing history museum, thereby making it more widely available as an educational tool. The VMP allows computer science students to broaden their knowledge of their own field in an interesting way. While the very nature of computer technology is concentrated on rapid evolution, this tendency to look forwards to the future can too easily discard lessons from the past. The VMP, in its animation, concentrates on the way computers have been used to change our world in the past, and how this leads directly to the way things are today. In this sense it fosters understanding of the rationale behind IT development, as well as its technological features (Zhang and Howland, 2005). The

animation can be used in different computing classes such as programming, interface design and computer technology to challenge the students' understanding of the development of computing and reflect upon its relationship to education, work and society. It is left without spoken narration so that lecturers can adapt their own commentary, depending on the specific purpose of their class, and students can make their own interpretation of the history displayed.

3 The Exhibits

While the MMoCH tracks computing history from the earliest computing devices such as the abacus, the VMP begins in more recent history, choosing three signal moments from the early '60s to early '70s and linking them in an animated narrative. Following are the three machines chosen from the MMoCH that appear in the VMP. The images shown are still shots from the animation

3.1 The Ferranti Sirius

The Ferranti Sirius was the first computer installed at Monash University. The model currently on display at the MMoCH is the original one pulled from the crate upon its delivery in 1962 (Figure 1). This momentous occasion was marked with the kind of transport and loading equipment we expect today for a baby elephant or small power substation. Trucks that are now considered classic models, a crane such as we witness in silhouette against the city skyline, and working men directing the delicate operation in their fashions of the day all combine to give a picture of the time. These images form part of the Ferranti Sirius display in the MMoCH, as photographs on backboards and as information panels accompanying the actual computer, and are incorporated from the original materials into the VMP animation.

Figure 1 The Ferranti Sirius computer being prepared for transportation

The Sirius in operation certainly required some hands-on attention. Input was via paper tape which had to be hand-fed into the Creed Paper tape reader, after being punched in the patented Ferranti Westrex paper tape punch. This tape punch, along with a beautifully styled clock (now known as 'retro') and the working innards of the computer, a mass of wires and transistors looped together to carry the binary signals from input to result, are amongst the parts on display in the museum and used in the animation (Figure 2).

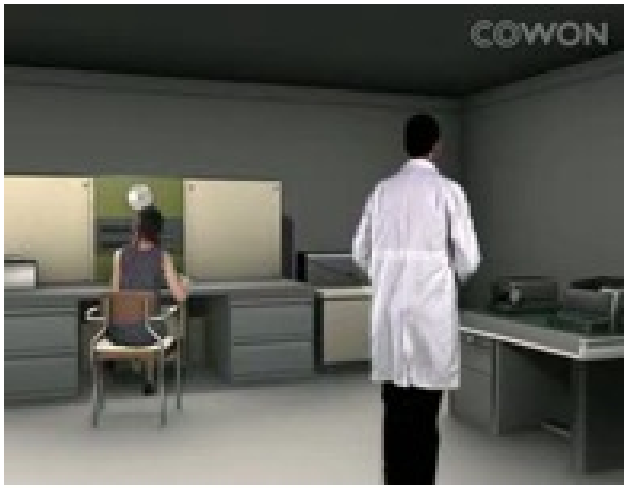

Figure 2 The Ferranti Sirius computer in operation

The technicians would arrive each morning, allowing a couple of hours to calibrate the acoustic delay line storage by hand (which certainly makes the time it takes for our desktops to boot up pale into insignificance by comparison!). The power of the Ferranti Sirius, in all its magnificent bulk, equaled around 1/100,000th of the computing power offered by the modern personal computer.

3.2 The PDP-9

The second major artifact chosen for the VMP is the PDP-9, a stylish burnt orange cabinet model made by the Digital Equipment Corporation (Figure 3). The PDP-9 Programmed Data Processor (PDP) was the name of a series of minicomputers, some of them ground-breaking and very influential. The name 'PDP' intentionally avoided the use of the term 'computer' because at the time of the first PDPs, computers had a reputation of being large, complicated, and expensive machines, and the word 'minicomputer' was not invented yet.

The PDP-9 helped ensure the safe lunar landing of 1969 and the MMoCH displays the very computer featured in the Australian/American film The Dish, which commemorates the vital part played in this historic moment by Australian engineers.

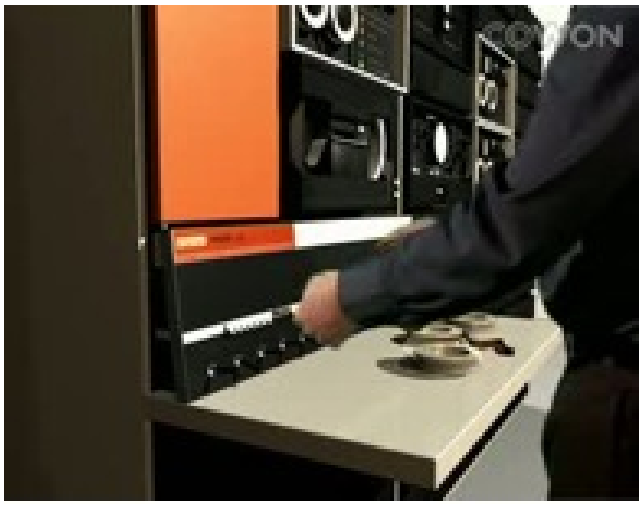

Figure 3 Operating a PDP-9 computer

3.3 The HP-65

The HP-65 was the first computer in space. When held in an astronaut's hand in 1973, it could never have been imagined the extent to which the 'personal computer' (this was the first time such an idea had been introduced) would revolutionize everyday life across the world. With its red flashing numbers, the HP-65 packed enormous punch (for its time!) in terms of the processing it carried out (Figure 4).

Users could write programs up to 100 lines in length and record them on blank cards, or they could buy pre-programmed cards. These tiny cards had magnetic media on one side and a writable surface on the other. After passing one through the calculator, the card could be slid into a slot just above the top row of keys, where the writable side of the card served as key labels for the calculator's five program-defined keys.

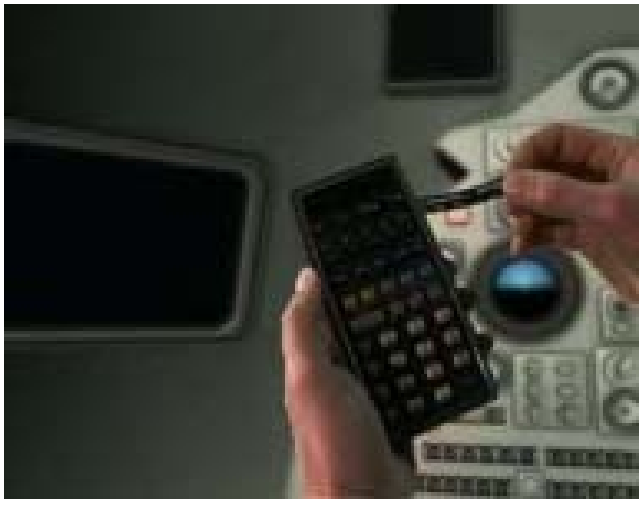

Figure 4 The HP-65 in space

4 The Animated Narrative Approach

Studying the meteoric history of modern computing should not only be mandatory for today's 'net savvy youth – it should be available in the language to which they have become accustomed. To this end the VMP design team created a storyboard for its animators that would reflect the information-rich cultural world that students of today inherit. While seemingly traditional in its chronological approach, the animated narrative format explores important shifts in computing history in a way that makes it both accessible and meaningful to the student.

The three artifacts chosen to represent a short period of computing history in the VMP animation are represented from two related perspectives: the context contemporary to their use (and thus their relevance as information processing inventions in their own right), and their position in relation to the current state of technological evolution. In this way the animated narrative engages the interest and intelligence of the museum 'visitor' by providing frameworks of understanding both historical and immediate in import.

The narrative chosen as a storyboard for this animation concerns the way computing history can be considered in light of the current global phenomena of enormously increased access to computing technology. It begins with the installation of the gigantic Ferranti Sirius at Monash University in 1962, the physical dimensions of which are revealed in visuals of computer scientists feeding in and retrieving the paper tape it used to input and output data.

The animation then passes a bank of cupboard-sized information processors. These whirring machines, with their circular tape reels rotating against a backdrop of box-like compartments, represent an almost iconic image of computing days now a thing of the past. The visual journey then passes into a room where the PDP-9 features, depicted in its role in helping to facilitate the Apollo space exploration.

After lingering on this seminal piece of computing history, the viewer's attention is drawn towards a window, through which we see a scene of the night sky. We zoom into the window frame and then out into the night sky, where a satellite crosses the sky and approaches the moon. This trajectory suggests the famous Apollo moon-landings and the viewer's focus now turns to the image of an astronaut holding the HP-65 in his hand.

The astronaut then proceeds to punch some information into the hand-held HP-65 with their finger, before the 'shot' zooms again through the space vehicle's window frame towards the earth, which is seen hanging in space. Utilising NASA photographs of the planet at night, we now see a series of twinkling cities against the dark background of earth's continents (Figure 5). This image introduces the final phase of the storyboard.

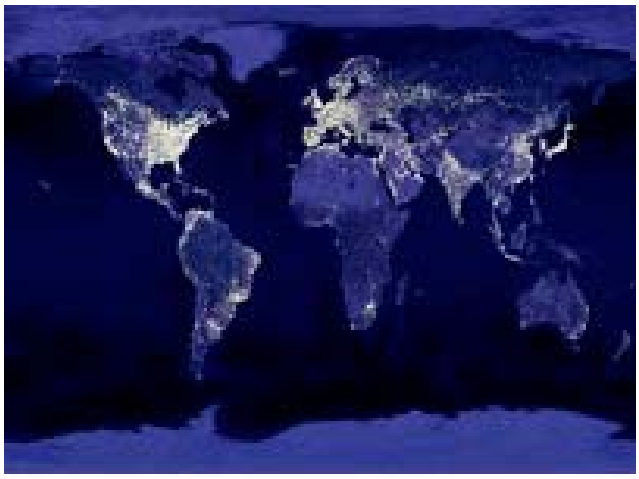

Figure 5 The earth at night as viewed from space

This final phase of the narrative is dedicated, beyond the history of the three computer artifacts represented, to the contemporary diffusion of computing power, its increased capacities and decreased size, and people's everyday access to it. In order to link the historical exploration of space to the immediate situation of the VMP viewer in front of their screen, a storyboard was created that returns to earth while pointing out the way computer users are interconnected by a network that links people with each other via their computing technologies (Figure 6).

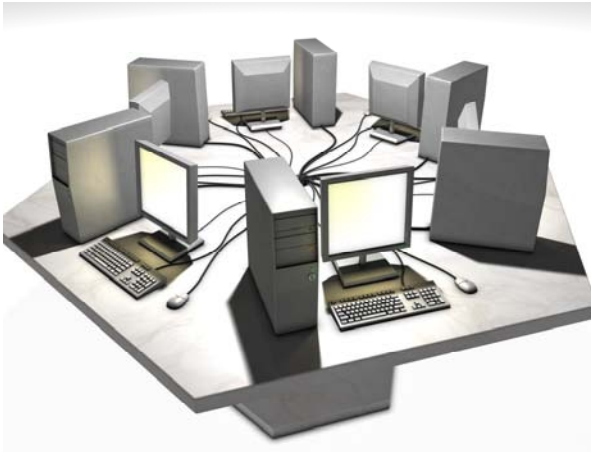

Figure 6 Networked computers

A brief note on the history of technological evolution helps explain this part of the animated narrative. One relevant aspect of technological development is the way it has expanded our physical capacities. This can be seen, for example, from the simplest tools of early agricultural settlements to the more recent microscope and telescope. In the twentieth century our vision followed explorations into space, thereby, paradoxically, drawing us closer together as we recognised the planet as a unity.

The viewer of the VMP animation is treated to a compact version of this narrative of technological evolution. After escaping the earth's bounds with a brief flight into space, the viewer is returned to earth and its glittering cities courtesy of a landing in one of those bright centres of activity in Australia. Following a trajectory down to Melbourne, the animated narrative shows how each city is in fact connected to the others by pulses of light, such that they can be visualised as clusters joined by shafts of information. When the landing is complete, and the viewer is reminded that they are looking now at their own computer terminal, the connection is completed: the miniaturisation and proliferation of computers brings all users together.

The animated narrative is open to other interpretations which can be explored in an educational context, making it a valuable teaching tool for computer science educators seeking to give their students greater comprehension of the history of their subject. For example, the animation can be used to show the changing relationship of people with computing technology in terms of accessibility, affordability and the skills needed to use the technology.

5 Design and Implementation

The VMP design team created the storyboard for the animated narrative, before presenting it to members of the Multimedia Department of Monash University. The animators took the artefacts chosen for the VMP and created three-dimensional visual images of them. Once drawn, these figures could be manipulated, as if from any camera angle, so that the viewer's perspective of them seems to be manoeuvred around the 'space' of the screen. Animated sequences, forming part of the narrative, were then produced using these figures. These were then combined with still images and movie segments to complete the storyline.

In consultation with the animators, it was decided that high quality graphics should take precedence over the provision of interactivity at this stage. Students expect high quality graphics as a minimum standard, so this should be the starting point for any teaching tool seeking successful engagement with this audience. These graphics can then be utilized in later developments towards interactivity. The VMP's narrative format could further be adapted to interactive games, education applications, as well as being linked to artifacts and educational aids from other museums. Endless manipulations are available as further developments of the narrative storyboard chosen for the VMP.

For now, however, the VMP concentrates on the pedagogical aim at its genesis: increasing accessibility to a tool for teaching computing history in a way that is exciting and relevant to today's students of computer science.

6 Educational Applications

The VMP animation has been used in computing classes at institutions in Australia and Finland. The animated narrative has been explored from a number of different aspects relevant to a broad range of computer science courses. For example:

- Interface Design – the film was used to show early computer interfaces. This was used as a lead in to a discussion about the concept of an interface and how interfaces have evolved with the changing emphasis from the computer to the human
- Introduction to Computing – the film was used to show students examples of early computing applications and demonstrate the fast evolution of the technology
- Computer Technology – the film was used to illustrate aspects of the evolution of technology, showing the dramatic decrease in size of the computers, the widening contexts in which computers could be used in as well as the different input/output media associated with it
- Programming – the film was shown to demonstrate how the tasks involved in loading and executing a program have changed

Initial student and staff responses to the animated narrative have been positive in regards to its potential to bring to life the recent history of computing in an educational context. Further evaluation of the educational potential will be conducted before the next stage of the VMP development.

7 Conclusions and Further Work

The main collaborators in the original, physical MMoCH project concluded that computers "are present in all aspects of life in the 21st century. It is the Museum's role to record this technological development, particularly as it relates to the Australian context, and the impact of this development on our society." (Ainsworth et al., 2008a) The VMP presents an innovative and highly accessible way to not only fulfil this mandate but to extend it in accord with the MMoCH's focus on the relationship between people (especially students!) and their computing machines.

Its high quality graphic animation makes the VMP attractive to secondary and tertiary students of computer science in a way that opens up new opportunities for them to understand the history of the technical tools they access on a daily basis. It does this with reference to the physical museum of computing history from which it has evolved, showing that the aim of teaching the history of computer science can be grounded in real artifacts at the same time as it moves outside of the limits of the physical museum. The benefits of this to the field of teaching computing history to students are immediate but also lend themselves to further development.

The VMP has the potential to further evolve this style of teaching computer science and history, for instance, by expanding its focus from high quality animation to an interactive or virtual reality application. Another possible development linking the VMP to the physical MMoCH could be the provision of hand-held, on-site devices that enable interactivity and access to further information on each computing machine. This application of location-based services (LBS) has proven to be effective in the development of innovative applications such as individual tours, educational games, and even virtual tour guides for visitors (see (Hsi et al., 2004) and (Brown et al., 2003) for examples of these).

This article forms part of the overall project for explaining the animation to teachers of computing history and can be used as a valuable aid when read alongside it. The animated narrative that is the result of the VMP is available for viewing at:
http://www.youtube.com/watch?v=N0f0MU-vfGg

It is also linked to the MMoCH site at:
http://www.infotech.monash.edu.au/museum/

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References

Ainsworth, A. B., Avram, C. and Sheard, J. (2010) The Monash University Museum of Computing History: Ten Years On. In A. Tatnall (Ed.), *History of Computing. Learning from the Past* (Vol. 325, pp. 216-227): Springer Boston.

Ainsworth, A. B., Sheard, J. and Avram, C. (2008a) The Monash Museum of Computing History: Part 1. *ACM SIGCSE Bulletin inroads 40*(2), 31-34.

Ainsworth, A. B., Sheard, J. and Avram, C. (2008b) The Monash Museum of Computing History: Part 2. *ACM SIGCSE Bulletin inroads 40*(4), 31-34.

Brown, B., MacColl, I., Chalmers, M., Galani, A., Randell, C. and Steed, A. (2003) *Lessons from the lighthouse: Collaboration in a shared mixed reality system.* In proceedings of the Conference on Human Factors in Computing Systems, Ft. Lauderdale, Florida, USA.

Computer History Museum, California, USA. www.computerhistorymuseum.org [accessed 14 August 2010]Ensmenger, N. (2004) Power to the people: Toward a social history of computing. *IEEE Annals of the History of Computing*.

Giangrandi, P. and Mirolo, C. (2006) *"Numeri e Macchine" - A virtual museum to learn the history of computing.* In proceedings of the ITiCSE 2006, Bologna, Italy.

Harms, D. and Berque, D. (2001) *Using a PDP-11/10 to teach content and history in courses.* In proceedings of the ACM SIGCSE 2001, Charlotte, North Carolina, USA.

Hsi, S., Semper, R., Brunette, W., Rea, A. and Borriello, G. (2004) *"eXspot: A Wireless RFID Transceiver for Recording and Extending Museum Visits".* In proceedings of the Proceedings of UbiComp.

Impagliazzo, J. and Lee, J. A. N. (2004) Using computing history to enhance teaching. In J. Impagliazzo & J. A. N. Lee (Eds.), *History of Computing and Education* (pp. 165-175). Boston: Kluwer Academic Publishers.

Katz, K. (1995) The present state of historical content in computer science texts: A concern. *ACM SIGCSE Bulletin 27*(4), 43-50.

Lee, J. A. N. (1996a) History in the computer science curriculum. *ACM SIGCSE Bulletin 28*(2), 15-20.

Lee, J. A. N. (1996b) "Those who forget the lessons of history are doomed to repeat it" or, why I study the history of computing. *IEEE Annals of the History of Computing 18*(2), 54-61.

Lee, J. A. N. (1998) History in the computer science curriculum: Part II. *ACM SIGCSE Bulletin 30*(2), 11-13.

Medina, E. M. (2004) Beyond the ballot box: Computer science education and social responsibility. *ACM SIGCSE Bulletin inroads 36*(4), 7-10.

The Virtual Museum of Computing (VMoC) [accessed 14 August 2010]

Williams, M. R. (2000) Do we teach computer science as religion or as history? *ACM SIGCSE Bulletin inroads 32*(4), 4-5.

Williams, M. R. (2003) The computer history museum. *ACM SIGCSE Bulletin inroads 35*(4), 12-13.

Zhang, C. and Howland, J. E. (2005) Brief and yet bountiful: The history of computing, why students need you? *JCSC 20*(4), 308-314.