5th Report, Innovative Interfaces

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1 What's Real About Virtual Reality

1.1 Summary

The paper [1] from 1999 by computer luminary Fred Brooks is a survey on the current state of Virtual Reality (VR), and a look at places VR had been adopted in industry and research. Brooks distinguishes four main classes of technologies that comprises VR, these are displays, graphics rendering, tracking and graphics modelling. Each of these are considered and compared against what they were five years before (in 1994). A point of general interest was that in 1994 VR hardly existed in any production systems (apart from vehicle simulations and entertainment). Five years later VR had seen additional deployment in fields such as design reviews for manufacturing, astronaut training, psychiatric treatment and probe microscopy.

1.2 Context and Evaluation

The term virtual in VR dates at least back to 1965 (the concept existed in fiction, and entertainment, but nothing had yet been done before related to computers), Ivan Sutherland described the computer display as a means of peering into a *virtual world* [8]. In the time following Sutherland made several pioneering contributions in 2 and 3D computer graphics (such as the Cohen-Sutherland line clipping algorithm [3]), and graphics related hardware (e.g. Sketchpad [7]), these were important precursors to virtual reality. In terms of VR his most notable contribution was the invention of a functional Head Mounted Display (HMD) [9], considered the world's first computer VR system. It projected wireframe models on miniature CRTs (suspended from the ceiling), and would update the viewport in response to the user's head position. Even though the technology was coarse Sutherland had solved the principles of VR. It included all the elements that Brooks describes as crucial; graphical rendering, immersive displays and a tracking system. Notable developments since are Myron Krueger invented the CAVE system in the 70s for entertainment purposes [4]. The first production VR systems were flight simulations for pilot training.

While technology in the time after the paper by Brooks has improved, the number of viable applications for VR is similar. One of the factors preventing it's more widespread adoption may be because the user interface is fundamentally different from traditional GUIs. There are unique I/O devices, perspectives, and physiological interactions. Any particular applications requires a wider breadth of engineering considerations, and not all traditional usability methods apply to the evaluation of VR systems.

2 Bridging the Physical and Digital, in Pervasive Gaming

2.1 Summary

Pervasive gaming [5] is a type of gaming experience where elements of the real and virtual world are blended together. The interpretation of what counts as a pervasive game is quite broad, but seems to hold when elements of either the real world is mixed into a computer game, or vice-versa, where elements of a computer game is in some way brought into a real context. For example the location of a real-world agent may be interpreted as a position in a virtual world of a computer game, such as the borders of London may match that of the game boundaries. Another example augments one's reality into a Pacman-like playing field where real-world objects become re-interpreted in an HMD as cartoon-like drawings, and additional elements can be added to conform with some game experience. For example an antagonist may be rendered by some distance given in terms of real-world coordinates (in this scenario safety may be a concern).

2.2 Context and Evaluation

Jesse Schell argues [2] that games are more than frivolous pursuits, but are important. They are part of defining our culture, and are tools for communication, learning and self-realisation. Because of their commercial interest they are also one of the most important factors in driving technology, which includes virtual reality, augmented reality, artificial intelligence and all their dependencies. The technologies observed in this paper may soon break old interaction models. In the past games have mostly been limited to pointer and button-based interactions. Mixing reality in games implies several new dimensions of possible innovation. Considering using ones whole body as a means of input, new types of tangible interfaces, and augmented and immersive displays. Some of these are starting to appear in mainstream markets, such as the Kinect and 3D displays.

3 Pragmatic Research Issues Confronting HCI Practitioners When Designing for Universal Access

3.1 Summary

This paper [6] is about practises and research issues of usability design for technology products. Most software programs are not always designed with much concern for people with disabilities, they may for instance only be tested on fully-abled individuals. Common disability issues are motor impairments (such as use of only one hand, or slower than normal reflexes), visual (colour blind or poor sight) and cognitive (we vary in ability to remember and understand). The effect is that software and hardware products may not be usable for a large fraction of the intended population. To solve this problem we need to understand the variation of users better, and understand what kind of designs have more universal acceptance. Based on both observation and cognitive models, one approach is to divide the users into groups with different capability. It would be preferable to vary the interface depending on the type of user.

3.2 Context and Evaluation

Considering univeral access in today's systems. For example web browsers have ability to vary the sizes of the elements, which solves for some types of visual impairments, but not for colour-blindness. Microsoft Windows have superficial disability features such as a magnifying tool and ability to synthesise text into audio, but in general desktop or mobile applications have limited support for disabled users. This may be true because the cost of developing for an additional, say 10-20% of potential users, may be higher than the expected return, it may also be because pushing technological development is a higher priority than universal access.

A major roadblock is that applications do not distinguish neatly between functionality and interface (this also includes issues of data-formats that are widely proprietary). If it would have been possible, it may be better for application design to be modular. In this paradigm, an application's main concern are operation on and interaction with data, but neither the interface or the data should necessarily be specific. HW has to some extent adopted this type of horizontal segregation, SW may be lagging because of lower engineering boundaries and higher a rate of breaking old models. The type of modular approach is probably sound and extends just issues of universal access. It is likely we will see more established conventions over time.

We can note that with respect to the other technologies considered, for example virtual reality, a new set of universal access problems arise, since these issues are closely tied with the interaction methods. Finally, it is worth nothing that while technology may also be served to enhance the disabled user into a state of enhanced ability (for example through the use of glasses or magnifying lenses). It is still important to design for universal access for many people where technology is either not available or too expensive to address their disabilities, this will at least be true for some time in future markets in the developing world.

References

[1] F. Brooks. What's real about vitual reality. *Computer Graphics and Applications, IEEE*, pages 16–27, Dec. 1999.

[2] Jacko J. *The Human-Computer Interaction Handbook*. Human Factors and Ergonomics, 2008.

[3] Foley J.D. *Computer graphics: principles and practice*. Addison-Wesley, 1996.

[4] Kruger M. Videoplacean artificial reality. *ACM SIGCHI*, 1985.

[5] Benford S., Magerkurth C., and Ljungstrand P. Bridging the physical and digital, in pervasive gaming. *Communications of the ACM*, 48, Mar. 2005.

[6] Keates S. Pragmatic research issues confronting hci practitioners when designing for universal access. *Univ Access Inf Soc*, 2006.

[7] I. Sutherland. Sketch pad a man-machine graphical communication system. *Proceedings of the SHARE design automation workshop*, 1964.

[8] I. Sutherland. The ultimate display. *Information Processing Techniques Office, ARP*, 1965.

[9] I. Sutherland. A head-mounted three dimensional display. *Proceedings of the fall joint computer conference*, 1968.