

Chapter 2

Virtual Environments

2.1 Technological Limitations

Virtual environments are generally assessed in terms of technological development (the amount or sophistication of data geometry or interaction that they can generate or deliver), or in approximation to reality (how realistic they appear to be).

Technological advances (technology for technology's sake), all too often drive the development and deployment of virtual environments. In the design of digital three-dimensional environments, the pursuit for exact duplication of visual form is all-important, as technological advances rather than content seem to be the main motivating factor of many web-enabled environments.

Technical issues include slowness, and a lack of realism. Other criticisms of virtual environments have pointed to a lack of meaningful content, confusing interface design, orientation and navigation difficulties, and a paucity of useful feedback mechanisms (Campbell 1997; Costalli et al. 2001).

To some extent, this may have been encouraged by limitations of early software, but even though both hardware and software are increasing in power and flexibility, new and more effective means of interaction are yet to appear. We could further argue that interaction is either limited or not appropriate to its context (Mosaker 2001; Turner et al. 2005). For example, Schroeder (1996, pp. 114–117) wrote:

Interaction with virtual worlds mainly consists of changing the appearance of objects... there is little difference in terms of content between VR games and existing computer-based games.

2.2 Lack of Widely Distributed Technology

Part of the problem may be to do with the cost of dedicated virtual environment technology; such as the building and maintaining of CAVes, which stands for Cave Automatic Virtual Environment (Cruz-Neira et al. 1993). In recent times, creating virtual environments typically required an army of programmers, a large space for

front or rear projection, and computers far beyond the purchasing power of the typical home hobbyist.

Although online environments and 3D chat rooms have appeared in the last decade, the user is typically restricted to certain types of online browsers, operating systems, platforms, and graphic cards. On the other hand, where suitable applications exist or have existed (such as MetaStream, Metaplace, Adobe Atmosphere, Blaxxun, Google Lively, Pulse 3D, Shout 3D and Blink 3D), we cannot rely on them being around. Web-based 3D technology companies in particular seem to appear and disappear at a rapid pace.

2.3 Size, Speed and Rendering Issues

Virtual environments (VEs), and Collaborative Virtual Environments (CVEs), are too large in terms of file size or finding areas of interest when inside the environment. They contain too much data for many people to download, and walk through, especially on home computers, or on the computers that schools can afford to both buy and maintain. For example, Moshell and Hughes (2002) argued the following:

For VR to have a significant role in school-based education, several things must occur. These include at least the following:

- Reliable high speed, low cost multimedia systems must become available in schools. The next generation of video games, to appear in late 1999, seems likely to fulfil the performance and reliability requirements that are so clearly unfulfilled in schools by personal computers. However, their acquisition by schools depends on political and economic issues.
- An adequate theory and body of practice of instructional design for virtual worlds must be developed.

...Environment that incorporates live instruction, tangible artifacts, and careful guidance for generalization. Virtual reality is like a field trip – fun, motivating but potentially hard to relate to the curriculum.

2.4 Lack of Meaningful Content

Where content is concerned, there are further varying aims and methods. Some virtual environments are assessed in terms of ergonomics, and their effective usability (Bowman 1997; Bowman et al. 1999). Unfortunately, few environments are directly assessed in terms of useful content (Champion 2002). Some virtual environments are assessed through how well they inspire a sense of spatial presence, negative feelings (phobic reactions), realism or naturalism, and subjective involvement/engagement. These are generally considered factors of ‘presence’ or ‘telepresence’ (‘the sense of being there’ without noticing the experience is mediated by technology).

This field is still in its infancy – there is still confusion and debate as to the meanings of ‘immersion’ and ‘presence’ (Lombard 2000; Schuemie et al. 2001; Slater 1999).

2.5 We Experience More than Tangible Objects

Writers often criticize virtual environments for evoking ‘cyberspace’ but not ‘place’ (Benedikt 1991; Coyne 1995, 1999a, b; Heim 1998; Johnson 1997; Kitchin 1998). In other words, they are attacked for lacking the richness of associations and encounters of meetings that are found in real space. Yet compelling examples and prescriptive writings on exactly which elements help create a virtual sense of place are rare indeed. For instance, Weckström (2004, p. 9) decried the “hollowness” of virtual worlds:

This thesis began from the fact that, when a group of students were exploring and researching other ‘virtual worlds’ in order to begin developing *Marinetta*, they reported that all the worlds seemed empty and hollow, like stage sets. There were neat buildings in these spaces but no sense that these buildings had been built for any real purpose. The students noted that these so called virtual worlds did not seem to be worlds at all, but just architectural spaces that did not give them any feeling of worldliness.

A class of Media students at Arcada in Helsinki also complained to Weckström that virtual worlds were sterile. Weckström’s thesis surveyed simulators, chat-worlds and games, including *Microsoft flight simulator 2004*, *TRANSIMS Visualizer*, *Habbo Hotel*, *The Sims Online* and *EverQuest*. He then declared (2004, p. 38):

...a virtual world has to support the following factors: there has to be a feeling of presence, the environment has to be persistent, it has to support interaction, there has to be a representation of the user and it has to support a feeling of specific worldliness.

Another reason for the existence of sterile environments may stem from a belief that we experience reality as something objective, settled and constant. Solid and immutable objects are also easier to conceptualize and model than what fully constitutes reality. For the real world includes many intangibles, including social behaviors and mental states.

2.6 The World Is More than Visual Stimuli

This issue is evident even in the debate over using the terms ‘virtual reality’ or ‘virtual environment’. For example, Bryson (1995, p. 9.2) offered the following definition:

Virtual reality is the use of various computer graphics systems in combination with various display and interface devices to provide the effect of **immersion** in an interactive three-dimensional computer-generated environment in which the virtual objects have **spatial presence**. [Bold is from original text].

Researchers testing the effects of presence and immersion in digital environments, list the above spatial criterion as only one of four (Lessiter et al. 2001). The four

criteria are physical space, engagement, naturalism or realism, and negative feelings (such as phobia, motion sickness etcetera).

There is still an overwhelming tendency of 3D virtual environment designers such as Bryson (1995) to privilege spatial relations of visual representations over the other criteria found useful by psychologists (such as Baños et al. 2004; Botella et al. 2003).

The above quote from Steve Bryson is part of his more specific argument that objects have to be related to head movement of an observer via head tracking in order to have virtual reality. He also argues that visual fidelity is not necessary to have ‘spatial presence’ but his definitions and examples only relate to the visual medium. According to Bryson’s argument, it would be impossible for a non-sighted person to feel a sense of presence in any virtual environment by definition. Therefore, using a *reductio ad absurdum*, there is either nothing that is not visual in our perceptions of reality (that cannot be simulated by virtual *visual* technology), OR non-sighted people cannot develop a sense of environmental presence. I find either claim to be unconvincing.

An emphasis on visual representation and realism is also not always of primary interest to social scientists, such as (Anderson 2003; Gillings and Goodrick 1996) or to educationalists such as (Roussos and Drettakis 2005). Research indicates that multimodal display of information may be more effective than one medium (Kray et al. 2003). However, many virtual environments are purely visual as seen in the following definition by Czernuszenko et al. (1997):

Virtual Reality (VR) can be defined as interactive computer graphics that provides viewer-centered perspective, large field of view and stereo. Head Mounted Displays (HMDs) and BOOMs (TM) achieve these features with small display screens, which move with the viewer, close to the viewer’s eyes.

While they do mention audio once, the emphasis of Czernuszenko et al is on the visual, not other sensory fields. Nor is ‘interactive’ defined as anything more than that the screen display is regenerated according to where the viewer is looking.

2.7 Different People See Different Things

There is another problem related to the ocular-centric tendencies of virtual environment designers. They seem to have a focus not just with visual fidelity, but a loyalty to a belief that in perceiving the world everybody sees the same thing.

What we see is not necessarily physical reality, but our concept-orientated brain tells us that it is. As soon as reality gets to our brain it has already been filtered not just by our eyes but also by our previous experiences of reality. Virtually everything in our head is put into a conceptual schema, a framework. Without content relating directly to how we perceive the world, an emphasis on formal realism is not creating a virtual reality, but a storehouse of visually represented objects.

2.8 Personalization Is Missing

Virtual environments typically have no annotation ability; there is no record kept of user-environment interaction history. User-based goals are also inseparable from the overall model.

Most virtual environments are single-user. Where they allow several people to see each other, sharing of information is usually restricted to chat, sending files or hyperlinks; control of social interaction is limited. People being social creatures may want to interact with and be recognizable to other travelers. On the other hand, they might want some control over the quantity or even quality of social interaction.

Interaction is also crucial to learning. The approach suggested here is constructivist, as explained by Weckström (2004):

What is meant by constructivism? The term refers to the idea that learners construct knowledge for themselves – each learner individually (and socially) constructs meaning – as he or she learns. Constructing meaning is learning; there is no other kind. The dramatic consequences of this view are twofold;

We have to focus on the learner in thinking about learning (not on the subject/lesson to be taught).

There is no knowledge independent of the meaning attributed to experience (constructed) by the learner, or community of learners.

Hein (1991) argued that interactivity in exhibits creates more engagement by allowing the user to apply the tool directly to their own life:

... I have watched adults look at a map of England at the dock where the Mayflower replica is berthed in Plymouth, Massachusetts. Repeatedly, adults will come to the map, look at it and then begin to discuss where their families come from. ... Here is an interactive exhibit (even if there is little to “do” except point and read), which allows each visitor to take something personal and meaningful from it and relate to the overall museum experience. For me, the Diaspora Museum in Tel Aviv came alive when I had the opportunity to call up family genealogies on the computer in the reference center. The opportunity to view and manipulate a library of family trees covering several generations and a wide geographical distribution, gave personal meaning to the idea of a Diaspora.

2.9 Lack of Contextual Evaluation

Since most virtual environments are built in laboratories, they seldom reach mass-circulation. Their complexity and unique nature may hinder full-scale evaluation, especially of target audiences. Moreover, when the environments are evaluated, due to the scale or nature of the project, the evaluation findings cannot always be used to help fine-tune further environments.

However, there is also the problem that the academic community is still feeling its way as to which terms and criteria are best used to evaluate virtual environments.

Part of the problem is no doubt compounded by the complexity of the subject, and by the vast range of disciplines interested in virtual environments.

There is also an ongoing debate about the scope and nature of presence itself at <http://www.presence-connect.com>. For example, Slater (2003) posted the following on the presence-connect.org discussion forum:

There is no 'true meaning' to the term 'presence'...The study of how to create emotionally rich, engaging, fantastic, entertaining, meaningful....experiences is very important and fundamental to the field of virtual environments, and to many other fields. However, the study of this is not the same as the study of pretence.

Pretence is concerned with how to achieve successful substitution of real sensory stimuli with artificially generated sensory stimuli. This also involves the requirement that people experiencing such stimuli (participants) have the power to change it, within constraints. ... The quest for high pretence in a virtual environment is not the same as a demand for high realism, i.e., this is not an attempt to 'reproduce reality'. Rather the interest is on what fundamental properties must sensory stimuli have, and how must they be structured as a totality in order to produce the 'pretense response'? ...

Preference is not the same as pretence. One doesn't have to like a situation to be in it.... Our only real disagreement is over the use of a label. We have been using the same label 'presence' to talk about different concepts. While this conflict remains, the field cannot advance since there can be no unifying paradigm that is the object of study of the group of researchers involved. We will always be arguing about true meanings. The term presence has now become so overloaded with different interpretations and meanings, perhaps I should abandon the pretence of working in this field, and use this other term.

The above posting by Slater highlights an ongoing discussion on the nature of Presence Research. One aspect of the research shared by both those attempting realism and those attempting to create engaging (aesthetic) experiences is that they are both concerned with which key stimuli are necessary and sufficient to enable people to feel they are 'there' (in a digitally supported environmental visualization).

In fact, we could say there are three divergent schools of thought in presence studies. The first, like Slater, believe that presence is acting or reacting as if one was acting or reacting to real world stimuli (a phobic sense of presence relies on evocative or phobic triggers). The second school believes presence is gained when the virtual environment is to all intents and purposes indistinguishable from the real world. This school of thought seems more and more evident in developing notions of presence. For example, Meehan et al. (2002) wrote:

We hypothesize that to the degree that a VE seems real, it will evoke physiological responses similar to those evoked by the corresponding real environment, and that greater presence will evoke a greater response. If so, these responses can serve as objective surrogate measures of subjective presence.

The third school believes that presence is best reached when the participant has an experience of great aesthetic or sensory interest, and they leave the cares and concerns of the real world behind them (Riva et al. 2004). The aim of the first school (and the most challenging aim) would be of interest to people attempting to prove the power of the technology to simulate reality. The aim of the second school may be useful for curing phobias or for selling products (advertising). The aim of

the third school may be useful for artists and designers. However, these distinctions are not *yet* widely distributed in the academic presence literature.

2.10 Summary of Implications for Virtual Environments

I argue that VR (or, as I refer to it here, virtual environments), before it can go forward, needs to address several issues that have prevented widespread realization of its potential. Many virtual environments lack meaningful content due to a paucity of meaningful interaction, few have feedback and evaluation mechanisms, most are devoid of a sense of place, do not offer personalization (such as annotation), there is no filtering of data, and no ability to adjust the ‘difficulty level’ of the interface to suit a particular user or experience.

Undoubtedly there are many successful uses for virtual environments. Yet virtual environments that have the noblest of aims are too often only showcases. For example, a major portal for virtual heritage, <http://www.virtualheritage.net>, records the most popular articles, but not the popular virtual heritage models. Virtual heritage models are still not considered worthy intellectual content even by societies dedicated to their advancement.

Major conservation organizations do not know of the potential of virtual environments to preserve both the formal specifications of the objects, and their cultural associations. In 2001 (but since updated) the ICOMOS (1988) charter did not list digital media as one of the many listed media to record cultural heritage.

In order to satisfy users of a virtual environment, they need to know the goals and significance of an environment—the reasons why they should immerse themselves in virtual environments and what they should particularly look out for and attempt to learn.

Meaningful interaction seems to be a crucial issue here. Research surveys indicate that when presented with realistic visual fidelity users also expect highly realistic interaction in order to be engaged (Mosaker 2001). While others have indicated that meaningful interaction is preferable to photo-realism (Eiteljorg 1998).

Visual depiction of objects does not automatically lead to full understanding of the social and cultural properties of these objects. Social critics have written that in creating authentic-looking objects, even our understanding of tourism has become *fetishized* (Crang and Franklin 2001). Many virtual heritage sites have brilliantly detailed temples, but are missing the element that ‘places’ the temple in its context.

That missing element is people, and the driving forces that compelled them to inhabit and modify their ‘world’. Every group of people has their own viewpoints, issues, and outlook on the world. Without understanding this specific cultural agency, there is a danger that we may see the virtual heritage site only in terms of our own cultural perspective. This limited ability to represent social processes and ‘intangible’ heritage can create a second danger. The typically static and apparently immutable features of digital simulations can imply a certainty of knowledge that we actually do not possess.

Too many scientifically accurate virtual heritage environments lack the ability to store interaction history. The actions and paths taken by its visitors affect a truly interactive environment. Yet many virtual environments do not record traces of what happened. Visitors may be able to change part of the environment but seldom does the environment ‘remember’ the visitors, their paths, actions, or discoveries.

For both these reasons, visualization-based environments are only rough approximations for the conserving and preserving of history. Given interaction is needed in order to experience and learn about other cultures, there is still little research on which types of interaction are required.

Which varying modes of interactivity add to the experienced significance of, and engagement in, a virtual tourist environment? Do inbuilt evaluation mechanisms compare favorably to more traditional and formal feedback mechanisms when gauging engagement in an interactive virtual environment?

The survey by Mosaker (2001) on the missing elements of the user-experience of high-tech virtual reality museums is both unique and timely. There are indeed many technical issues to be resolved, but until we also resolve appropriate content issues, virtual environments may become highly usable, but they are unlikely to be useful (Davis et al. 1996, p. 3). In the following chapters I hope to show (with the focus on virtual heritage environments), that there are four major content-related issues blocking the development of useful virtual environments: place, Cultural Presence, experiential realism, and meaningful interaction.

References

- Anderson, M. (2003). *Computer Games and Archaeological Reconstruction: The Low Cost VR, Enter The Past*. Paper presented at the CAA 2003 – Enter the Past + Workshop 8 – Archäologie und Computer Conference, Vienna, Austria.
- Baños, R.M., Botella, C., Alcañiz, M., Liaño, V., Guerrero, B., & Rey, B. (2004). Immersion and Emotion: Their Impact on the Sense of Presence. *CyberPsychology and Behavior*, 7(6), 734–741.
- Benedikt, M. (1991). *Cyberspace: first steps*. Cambridge, MA: MIT Press.
- Botella, C., Baños, R.M., & Alcañiz, M. (2003). *A Psychological Approach To Presence*. Paper presented at the Presence 2003 Conference: The Sixth Annual International Workshop on Presence, Denmark.
- Bowman, D. (1997). Interaction Techniques for Immersive Virtual Environments: Design, Evaluation, and Application. Invited talk at the Human Interface Technology Laboratory, University of Washington. Retrieved 1 January, 2009, from <http://people.cs.vt.edu/~bowman/pubs.html>
- Bowman, D., Johnson, D.B., & Hodges, L.F. (1999). *Testbed evaluation of virtual environment interaction techniques*. Paper presented at the ACM Symposium on Virtual Reality Software and Technology, London.
- Bryson, S. (1995). Approaches to the successful design and implementation of VR applications. In R. A. Earnshaw, J. A. Vince & H. Jones (Eds.), *Virtual reality applications* (pp. 3–15). London: Academic.
- Campbell, D.A. (1997). Explorations into Virtual Architecture: A HIT Lab Gallery. *IEEE Multimedia*, 4(1), 74–76.

- Champion, E. (2002, October). *Cultural Engagement in Virtual Heritage Environments with Inbuilt Interactive Evaluation Mechanisms*. Paper presented at the PRESENCE 2002 Conference: The Fifth Annual International Workshop on Presence, Porto Portugal.
- Costalli, F., Marucci, L., Mori, G., & Paternò, F. (2001, 3–7 September). *Design Criteria for Usable Web-Accessible Virtual Environments*. Paper presented at the ichim01: Cultural Heritage and Technologies in the Third Millennium Conference, Milan Italy.
- Coyne, R. (1995). *Designing information technology in the postmodern age: from method to metaphor*. Cambridge, MA: MIT Press.
- Coyne, R. (1999a). *Technoromanticism: digital narrative, holism, and the romance of the real*. Cambridge, MA, London: MIT Press.
- Coyne, R. (1999b). The Embodied Architect in the Information Age. Richard Coyne Inaugural Lecture delivered 16 February 1999 at the University of Edinburgh. Retrieved 11 April, 2009, from <http://www.caad.ed.ac.uk/Coyne/Inaugural/>
- Crang, M., & Franklin, A. (2001). The Trouble with Tourism and Travel Theory? *Tourist Studies*, 1(1), 5–22.
- Cruz-Neira, C., Sandin, D.J., & DeFanti, T.A. (1993). Surround-screen projection-based virtual reality: the design and implementation of the CAVE, *Proceedings of the 20th Annual Conference on Computer Graphics and Interactive Techniques* (pp. 135–142): ACM.
- Czernuszenko, M., Pape, D., Sandin, D., DeFanti, T., Dawe, G.L., & Brown, M., D. (1997). The ImmersaDesk and Infinity Wall projection-based virtual reality displays. *SIGGRAPH Computer Graphics*, 31(2), 46–49.
- Davis, S.B., Huxor, A., & Lansdown, J. (1996). The DESIGN of Virtual Environments with particular reference to VRML [Electronic Version]. Retrieved 10 May 2010, from <http://www.agocg.ac.uk/reports/virtual/vrmlides/title.htm>
- Eiteljorg, H. (1998, Fall). Photorealistic Visualizations May Be Too Good. *CSA Newsletter*, XI (2). Retrieved 12 February, 2010, from www.csanet.org/newsletter/fall98/nlf9804.html
- Gillings, M., & Goodrick, G. (1996). Sensuous and Reflexive GIS Exploring Visualisation and VRML [Electronic Version]. *Internet Archaeology*, n.p. Retrieved 10 May 2010, from <http://intarch.ac.uk/journal/issue1/>
- Heim, M. (1998). *Virtual realism*. New York: Oxford University Press.
- Hein, G.E. (1991). *Constructivist Learning Theory*. Paper presented at the Museum and the Needs of People CECA (International Committee of Museum Educators) Conference. Retrieved 28 April 2010, from <http://www.exploratorium.edu/IFI/resources/constructivistlearning.html>
- ICOMOS. (1988). Australia ICOMOS Guidelines to the Burra charter [Electronic Version]. Section 2.1, from <http://www.icomos.org/australia/burrasig.html>
- Johnson, S. (1997). *Interface culture: how new technology transforms the way we think and communicate*. San Francisco, CA: HarperEdge.
- Kitchin, R. (1998). *Cyberspace: the world in the wires*. New York: Wiley.
- Kray, C., Laakso, K., Elting, C., & Coors, V. (2003). *Presenting Route Instructions on Mobile Devices*. Paper presented at the IUI 03 Conference, Miami Beach, FL.
- Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoper. Virtual Environment*, 10(3), 282–297.
- Lombard, M. (2000). Resources for the study of presence: Presence explication. Retrieved 12 June, 2007, from <http://nimbus.temple.edu/~mlombard/Presence/explicit.htm>
- Meehan, M., Insko, B., Whitton, M., & Brooks Jr., F.P. (2002). *Physiological measures of presence in stressful virtual environments*. Paper presented at the 29th Annual Conference on Computer Graphics and Interactive Techniques, San Antonio, Texas.
- Mosaker, L. (2001). Visualising Historical Knowledge Using Virtual Reality Technology. *Digital Creativity*, 12(1), 15–25.
- Moshell, J.M., & Hughes, C.E. (2002). Virtual environments as a tool for academic learning [Electronic Version]. *Handbook of virtual environments*, 893–910. Retrieved April 30, 2010 from <http://depts.washington.edu/edtech/moshellHughes.pdf>

- Riva, G., Waterworth, J.A., & Waterworth, E.L. (2004). The Layers of Presence: A Bio-Cultural Approach to Understanding Presence in Natural and Mediated Environments. *Cyberpsychology and Behavior*, 7(4), 402–416.
- Roussos, M., & Drettakis, G. (2005). *Can VR be Useful and Usable in Real-World Contexts? Observations from the Application and Evaluation of VR in Realistic Usage Conditions*. Paper presented at the HCI International 2005, The First international conference on virtual reality, Las Vegas, NV.
- Schroeder, R. (1996). *Possible worlds: the social dynamic of virtual reality technology*. Boulder, CO: Westview Press.
- Schuemie, M.J., van der Straaten, P., Krijn, M., & van der Mast, C.A.P.G. (2001). Research on Presence in Virtual Reality: A Survey. *CyberPsychology and Behavior*, 4(2), 183–201.
- Slater, M. (1999). Measuring Presence: A Response to the Witmer and Singer Presence Questionnaire. *Presence: Teleoperators and Virtual Environments*, 8(5), 560–565.
- Slater, M. (2003, 18 August). I'm only pretending -- response to the core of presence by J & A Waterworth. Retrieved 12 February, 2010, from <http://presence.cs.ucl.ac.uk/presenceconnect/forum/viewmessage.asp?forumid=14&messageid=104>
- Turner, P., Turner, S., & Carroll, F. (2005). The Tourist Gaze: Towards Contextualised Virtual Environments. In P. Turner & E. Davenport (Eds.), *Spaces, spatiality and technology* (pp. 281–287). Dordrecht, The Netherlands: Kluwer.
- Weckström, N. (2004). *Finding 'reality' in virtual environments*. Unpublished Masters, Arcada Polytechnic, Helsingfors/Esbo.



<http://www.springer.com/978-1-84996-500-2>

Playing with the Past

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2011, XXII, 214 p., Hardcover

ISBN: 978-1-84996-500-2