The Design of Virtual Place for Creative Collaboration

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ABSTRACT

Collaborative Virtual Environments (CVEs) enable creative collaboration by geographically distributed teams. Existing CVEs have solved many engineering problems, but significant design and human factors problems remain. In particular, the transformation from *space for interaction* to *dynamic place for creative collaboration* on real-world tasks is unsolved. This paper describes two investigations (one ethnographic and one practice-based), examines them in terms of existing theories on the design of place for creative collaboration, and proposes a set of design principles to address the issues raised.

Categories and Subject Descriptors

H.5.1 [**Information Interfaces and Presentation**]: **Multimedia Information Systems**–*Artificial, augmented, and virtual realities*.

General Terms

Design, Human Factors, Theory.

Keywords

Creativity Support Tools, Collaborative Virtual Environments, Distributed Teams, Aesthetics, Design Principles, Affordances, Loose Parts, Pattern Languages, Space, Place, 場(ba).

1. INTRODUCTION

When humans are confronted with difficult problems we seek creative solutions. Creativity support tools have been shown to have broad social benefits, and are now receiving prominent notice in the computing literature [Schneiderman 2007].

Rather than being the product of individual genius, creativity emerges from a social milieu and often from a collaborative process [Stillinger 1991]. Geographically distributed teams have access to specialists and a more diverse membership [Edmonds et al. 1999], which when well managed can in itself be a source of greater creativity [Fischer 2005].

CVEs can facilitate this connection by providing a place for remote collaboration. However it is not enough to provide the technical capability for participants to meet. To effectively support creative work the nature of the place provided should be informed by an understanding of the requirements of its inhabitants, and available methods to meet those requirements.

2. WEB3D FOR CREATIVITY SUPPORT

2.1 Social Creativity

Communications technologies can help distributed teams coordinate their efforts, but more can be achieved remotely with collaboration technologies. The World Wide Web has been a powerful tool for asynchronous collaboration [Schneiderman 2007], and has become more so with the rise of multi-user Web-based document sharing platforms such as Google Docs [Google 2008] and Aviary [2008]. These environments for social creativity benefit from the ubiquity of Web access, and from the unifying power of the URI [Berners-Lee 1994].

These asynchronous tools are helpful, but Csikszentmihalyi's [1996] influential work on *Flow* indicates that synchrony is a necessary component of some forms of creative engagement. To support creativity in distributed teams it is therefore necessary to provide effective tools for synchronous collaboration. Early media spaces [Bly, Harrison & Irwin 1993], which allow two-dimensional documents to be shared in real time showed great promise but limited adoption. The success of Web-based asynchronous tools suggests that if synchronous tools can be deployed over the Web they may find similar adoption.

2.2 Virtual Space and Place

The social environment for creativity may also be supported further by the interaction and social cues available in three-dimensional CVEs [Bowers, Pycock & O'Brien 1996], which provide a virtual space in which to meet with collaborators and locate the products of the collaboration as opposed to the "discontinuous and arbitrary" spaces of the 2D media space [Gaver 1992, p. 18].

Web3D is therefore a promising approach to the development of environments to support creative collaboration. However it is important to recognise that an environment is not a *tabula rasa* – to a large extent the design of a place determines what occurs within it. Before committing resources to engineering, it is worth developing some insight into requirements by investigating the ideal nature of that environment.

While the effect of place on behaviour is well understood in the fields of architecture and social geography [Maslow & Mintz 1956; Tuan 1977], it has received less attention in the development of CVEs [redacted 2007]. Within the CVE literature there is much written about collaboration and virtuality, but surprisingly little on the nature and significance of environments. In a notable exception Harrison and Dourish [1996] introduced CVE researchers to the distinction between empty space and meaningful place from architectural theory. In a ten-year retrospective paper Dourish [2006] then drew out the continuum between the two concepts, pointing out that any designed space

has some cultural context imparted by the decisions of its designer and therefore is to that extent a place.

Although this influential paper by Harrison and Dourish [1996] is widely cited, much work in CVEs focuses on engineering and implementation, typically giving only passing mention of the design of the virtual places described, and no rationale for the design choices they embody [redacted 2007]. While in the design of Graphical User Interfaces (GUIs), the desktop metaphor is facing critical review [Blackwell 2006; Reynolds 1998; Johnson 1987; Halasz & Moran 1982], the Virtual Office is still the dominant kind of place built by CVE researchers [Benford et al. 1996], [redacted 07].
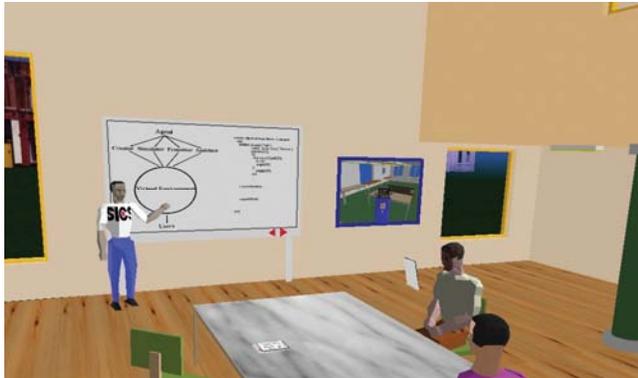

Figure 1. A screenshot of the DIVE system from http://www.sics.se/dive/ as extended by Frécon and Nöu, [1998], showing a virtual office, the most common design for a place in CVE research projects [Benford et al. 1996]

3. INVESTIGATIONS

It is straightforward to assert that real-world knowledge of the effect of place on behaviour should apply to virtual environments as well. In order to apply this understanding however it must be first determined whether this is in fact true, and if so to what extent and in what manner.

To this end I have conducted two investigations. First, an ethnographic study of a distributed team. Observations conducted in four virtual places within a virtual environment demonstrated that the character of place affects collaborative behaviour. Second, a practice-based enquiry into a real place of creative collaboration (Jorn Utzon's studio in Hellebaek during the design of the Sydney Opera House) conducted by reconstructing it as a virtual place.

As well as demonstrating the importance of the design of virtual place, each investigations afforded particular insights into the particular design principles that have greatest effect in this context.

The first study demonstrated that to be used for real-world tasks a virtual environment must not be hermitically sealed; instead it must connect with participants' familiar tools and resources, both offline and offline. Furthermore, it must provide the team with a persistent place of their own, configurable to their requirements.

Reflection on the second study indicates that the aesthetic qualities of the exemplary studio arise from, and are secondary to, its true affordances. For virtual place to promote creative collaboration it must prioritise these affordances so that it can be adapted by its inhabitants.

3.1 Trapped in the Walled Garden - an Ethnographic Enquiry

The first investigation took place within Second Life [Linden Labs 2008], a mass-market CVE primarily supporting social interaction, but which includes in-world 3D building capabilities.

This study followed the methodology of Action Research [Lewin 1946], a form of interventionist ethnography which entails the introduction of a new tool or process to an existing group. In action research the observer acts as facilitator, and may reconfigure or redesign the introduced element over time to better suit the requirements of the group.

3.1.1 Participants
First, participants were recruited. I received permission to study a geographically distributed group of creative individuals, with the leader in Tokyo and other members on the east and west coasts of the USA and in Canada; one member was temporarily in Europe.

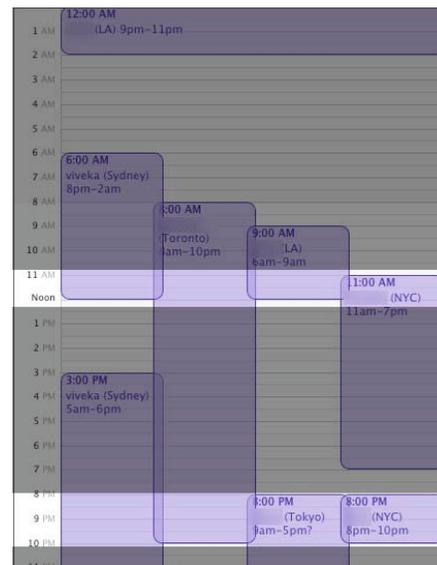**Figure 2. Participant Time Zones**

Figure 3. Participant Availability

The group has a number of collaborative projects under way, but no effective means of synchronous remote collaboration.

Table 1. use of instant messaging protocols; user accounts are marked with an X.

Participant:	1	2	3	4	5
MSN	X				
iChat/AIM		X	X		
IMVU			X		
iVisit				X	

Note the lack of convergence here: each user has chosen a different Instant Messaging (IM) platform, incompatible with the others. The only exception is iChat/AIM used by two participants. One participant did not use any instant messaging technology. This divergence makes communication over IM problematic.

Table 2. use of groupware and VR platforms, with successful use marked with a YES, unsuccessful use marked with a NO, and neutral use marked with an X.

Participant:	1	2	3	4	5
Yahoo Groups	X				
Google Docs		YES			
Video Conferencing			NO		
There.com				X	
Project Entropia					X

Once again divergent results indicated that this group would have difficulty collaborating with their existing groupware choices.

Table 3. use of Second Life, with frequency marked with an X.

Participant:	1	2	3	4	5
Frequently					X
Once				X	
Never	X	X	X		

All but one of the participants were largely unfamiliar with the virtual environment, its modes of interaction, affordances and constraints. In the event, in each interaction we spent from 6 to 10 minutes from first contact to assembling in the same virtual place, and up to 30 minutes in total on orientation for new participants. We therefore established the orientation period as the first agenda item for each meeting.

3.1.2 Meeting in Virtual Places

The participants were taken to a number of diverse virtual places within Second Life with the aim of collaborating in the design of an online publication.

3.1.2.1 A Social Place

Figure 4. Welcome Area 2, where many avatars gather to greet new arrivals, gossip and flirt.

Chat in this area is chaotic. A sample:

[19:54] LC: im more savage in type anyway

[19:54] AD: You don't have to stay

[19:54] GG: typefag

[19:54] LC: FINA CLOSE UR MIC ASSRABBIT

[19:55] JJ: have you ever seen the movie my fair lady

[19:55] GP: are you jewish

[19:56] JJ: is who jewish

[19:56] GP: SPAGHETTI

[19:56] JJ: oh

[19:56] GP: are you jewish

[19:56] GV: no voice?

[19:56] GP: your avatar looks sort of jew

[19:56] JJ: i'm catholack

Although the area is rated [G], a large nude avatar was conspicuously floating above the crowd (Fig. 4), causing one entrant to exclaim:

[20:00] RB: Hey, Nudee. Bye!

Instant messages within the group included "this place sucks", "do you get terrible frame rate here?" and "where else can we go?".

Figure 5. A Streaker Interrupts a Virtual Meeting.

The meeting attendees flew to a nearby pavilion, out of "hearing" (text chat with strangers is range-limited) but still in sight of the crowd.

As we continued an avatar called Lesbian GORGEOUS Dryke approached and began removing its virtual clothing.

The group expressed a wish to find a quieter place for the next meeting. In this visit this some communication and collaboration took place, but no collaboration.

3.1.2.2 A Commercial Place
In a shopping mall, the context overrode the intent of the participants.

[19:14] K: thank ya. I just want to buy stuff for myself... another realm in which to spend money..sigh

[19:15] P: I'll consider spending some bucks.

3.1.2.3 A Sacred Place
Participants met in a churchyard; intended as a sacred place, there was no mention of this by participants. Instead it was remarked "this is nice and quiet". However permissions were set so that it was not possible to build, so participants quickly lost interest. Some coordination, but no collaboration occurred.

3.1.2.4 An Inhabited Place
In the fourth interaction we met in the virtual home of one of the members (Figs. 6a, 6b, 7). First when she was present, and later when she was not. This is located in a dedicated sim - a region of virtual space rented by the member in order to obtain exclusive use of some of the CVE vendor's CPU time. The environment has had considerable design effort expended, which was commented on favourably.

Figures 6a, 6b. Visiting an Inhabited Place

Figure 7. Outside an Inhabited Place.

This was the only place in which collaboration occurred, with multiple participants modeling 3D objects in real time to represent projects under way and actively beginning work on designs. The flexibility of the parametric primitives (known as "prims") provided by the Second Life building interface allowed open-ended creative exploration, as predicted by the Theory of Loose Parts [Nicholson 1977].

[19:28] K: ...So this block is the new layout, and the cone shape is...

[19:28] P: I can see it.

Participants commented that they felt able to build more easily in a place belonging to one of the group, but expressed a wish for a place belonging to and built by the group:

[19:32] P: I like the idea of a custom meeting place suited to us, but we'd need to frequent it.

[19:33] K: True. We could create something like a studio that held our works in progress. Images on the wall that showed what we were doing. something like a blackboard.

However, lack of integration between the virtual environment and familiar tools was a problem for creative work:

[19:35] P: I'm not personally a 3D guy.

[19:35] [author]: What kind of tools do you like to work with?

[19:35] P: I'm expert in 2D design and imaging.

[19:36] [author]: What are your favourite tools? Would you like access to them here?

[19:36] P: Photoshop, Illustrator, InDesign...

[19:38] K: I can model... I'm just not sure if my Maya licence has expired... I was given it when they made me one of their so called 'artists' - which I'm really not...I"m an architect

The disconnection between the Second Life system and external tools is a barrier to collaboration and creative work; this is a drawback of all closed immersive systems [Billinghurst & Kato 2002]. Nonetheless this session which included active creative collaboration was by far the best received by the participants.

[19:45] K: I should probably go as well.. but I'm coming back to fool around.

[19:45] T: this is really cool

3.1.3 Results

The central question of whether the design of place effects the nature of creative collaboration in virtual environments was answered in the affirmative for this group. In ethnographic work it can be hard to say how generalisable the results are, but in this case the result accords with theoretical perspectives on the role of place and is likely to be broadly applicable.

It was also shown that some kinds of collaborative support that have been demonstrated in the CSCW literature to be important such as ad-hoc collaboration and integration of familiar tools are lacking in Second Life.

Participants described a number of barriers to effective creative collaboration on real-world tasks. Second Life was perceived as too big and too messy - it was easy for the participants to get lost, and hard for them to find a place to base themselves. In Second Life the owning of "land" – a home – is reserved for advanced users. It was too easy for users outside of the work group to interfere with meetings. The system's walled garden approach precludes linking and transclusion of objects from other online systems such as the web; participants commented that they found it too difficult to bring web documents and images into the shared space. Similarly, the focus on providing a self-contained virtual world separate from the real world militates against the use of familiar tools while "immersed" within Second Life.

Participants expressed a wish for a more open system, connected to their existing real and virtual lives. There was also a strong indication that a dynamic inhabited place, configurable by its inhabitants, may be most conducive to creative collaboration.

3.2 An Exemplary Real Collaborative Place

The second investigation was a practice-based enquiry into a real place of creative collaboration (Jorn Utzon's studio in Hellebaek during the design of the Sydney Opera House) conducted by reconstructing it as a virtual place.

Practice-based research affords practitioners a process for investigation whereby a creative artefact produced as a result of reflective practice can be the foundation of that investigation [Candy 2007].

For this study the virtual reconstruction was shown as a demo at IE2007 [author redacted 2007]. The demo process provided a further opportunity for discussion and reflection on the principles of design embodied in that place.

The experience of visiting this reconstruction is one of historical reflection rather than creative engagement, indicating that it is not the surface æsthetic of a place that makes it work as an environment for collaboration. Rather the æsthetic emerges from the underlying affordances [Gibson 1977] presented to participants by the environment. The key affordance in this case is configurability [author redacted 2007].

Figure 8a, 8b. Virtual reconstruction of Utzon's studio allows users to explore, move objects [redacted 2007]

4. APPLYING DESIGN PRINCIPLES

The crucial role of user-configurability in virtual environments for creativity support is reflected in a number of theoretical approaches to the design of real places [redacted 2007]. Virtual Environments research now indicates that users can usefully inhabit more than one world at a time. A useful perspective for considering the relationship of inhabitants to their environment can be found in Japanese social theory.

Application of these theories points us towards a workable design for virtual places for creative collaboration.

They are: the Theory of Loose Parts [Nicholson 1974], Low Road Architecture [Brand 1994], Pattern Languages [Alexander et al. 1977], Mixed Reality [Benford et al. 1998], Ubiquitous Access, [Berners-Lee 1994] and the 場(ba) Principle [Shimizu 1995].

4.1 User-Configurability

4.1.1 The Theory of Loose Parts

In a paper that has since become greatly influential in the field of early childhood education, Simon Nicholson theorised that "In any environment, both the degree of inventiveness and creativity, and the possibility of discovery, are directly proportional to the number and kinds of variables in it" [Nicholson 1974].

The goal of creating a space for collaborative play and exploration is shared by both early childhood educators and the designers of social creativity support tools; loose parts are an effective way to promote this aim.

4.1.2 Low Road Architecture

The creative possibilities of an easily reconfigurable environment are similarly expressed in Brand's [1994] theory of 'Low Road' architecture, giving MIT's building 20, ' "the only building on campus you can cut with a saw" ' [Brand 1994, p. 24], as an exemplary collaborative place.

4.1.3 Pattern Languages

A technique for describing generalisable design problems and their solutions [Alexander et al. 1977]. A number of existing defined patterns may be applicable to CVEs, but in this case in particular we can see the application of *pattern 73. Adventure Playground* [Alexander et al. 1977] "... a place with raw materials of all kinds..." to promote creative collaboration.

4.2 Mixed Reality & Ubiquitous Access

It is now becoming recognised that users of CVEs are rarely in a completely immersive virtual environment [Fraser et al. 2000]. Instead they are situated in a real environment, with the shared virtual environment embedded within it [Dourish 2006; Benford et al. 1998]. Billinghurst et al. [1997] describe a seamless Augmented Reality (AR) interface, where users can see through the virtual reality to their real environment. A key benefit described is the availability of participants' familiar tools and resources in the mixed reality environment.

Extending this further, Dourish [2006] has presented an argument for a consideration of overlapping spatialities. He gives the exmple of a user in a real space, conscious of network spaces accessible through mobile devices and simultaneously apprehending a CVE as a shared virtual space.

In an isolated Virtual Reality intended as a complete simulacrum [Baudrillard 1994], only in-world tasks are meaningful, and the only tools available are those instantiated in the virtual world. In

order to support work on real-world tasks, consider the virtual environment as just a part of the larger reality inhabited by each user; and acting as a shared space in a distributed mixed reality. To achieve this, the environment should be pervasively connected to both real-world and networked realities, contiguous to and accessible by each member of the distributed team.

4.3 The 場(ba) Principle

In architectural theory it is said that a place is a space with a history. This distinction between space and place in virtual environments [Harrison & Dourish 1996] has been described above. However there is a further distinction; the quality of a dynamic, inhabited place which is imbued with not only history but also ongoing collaboration and emerging relationships. Shimizu [1995] expounds on the concept of 場(ba) from Japanese

cultural theory as descriptive of that idea. Ba describes a collaborative place from the perspective of a participant who is a part of that place. The wish expressed by participants for their own space, where the group could meet and place objects with meaning to that group is in effect a wish for the establishment of a virtual ba.

5. FUTURE RESEARCH

The application of these principles requires an interaction design process, which must be informed by ongoing user testing. The action research process described above is therefore an appropriate way to proceed; building and testing prototypes to reveal and refine the design approach.

One design approach that has been effective in embodied virtual interaction is AVIE from the iCinema Centre for Interactive Cinema Research [McGinity et al. 2007] ; a cylinder 10 meters in diamater and 3.6 meters high.
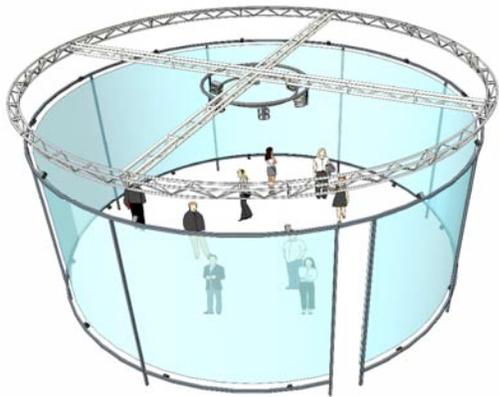

Figure 9. The AVIE design [McGinity et al. 2007]

A number of virtual environment experiments with different forms have been developed for this system, such as TVisionarium (figure 9) [ibid].

Figure 10. TVisionarium running in AVIE

This design is just one potential approach; its main benefit is that it has a minimum of embedded cultural meaning, thereby facilitating place-making by end-user participants.

Nonetheless the cylindrical form factor has particular affordances and constraints: for example it facilitates the placing of a panoramic image as a backdrop. Indeed it affords the integration of 2D images and text in general, but providing a surface on which to place them. Conversely it compels users to keep their shared objects within the cylinder's diameter, constraining the size of a project that can be contained within any one place.

Adopting the AVIE form factor for a virtual environment privileges users who are accessing the environment through an actual AVIE; however the cylinder also lends itself to being unwrapped onto a large flat display, such as those used in Access Grid conferencing rooms [Suarez 2007], or to navigation through a window on a computer monitor or mobile/augmented reality device display.

To facilitate multiple layers of 2D images, the virtual cylinder can be augmented with extra concentric cylinders, as shown in the following prototype, built in X3D.
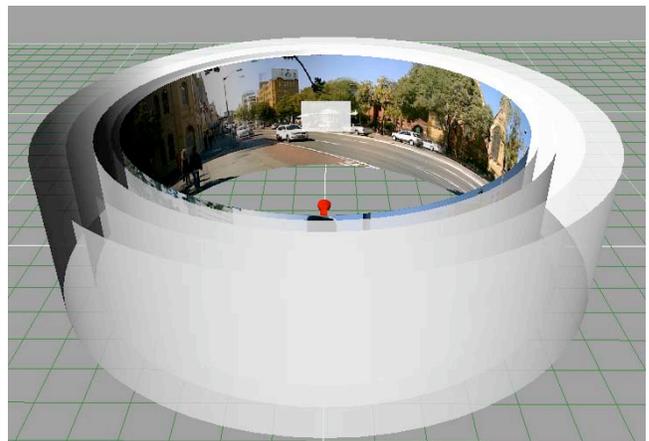

Figure 11. Prototype Place for Creative Collaboration, based on the AVIE form factor

6. CONCLUSIONS

Theories for the design of place to support creative collaboration in the real world have been shown to be applicable in virtual worlds as well. To effectively support creative collaboration, virtual environments should be user-configurable, owned by their inhabitants, pervasively connected, and situated in mixed reality. Various interaction design solutions may provide the required affordances, and can be discovered through iterative design performed using a participative action research methodology.

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