Sharing the Magic Circle with Spatially Inclusive Games

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ABSTRACT

This paper will discuss innovative (capstone) projection environments at an IT and Electrical Engineering School. The overarching brief was to develop both more expansive and more immersive viewing and playing environments. Game courses were used as a springboard to extend the students' creative and critical design thinking in relation to wider interaction design issues.

The imaginative combination of game engines and peripherals were also used as initial prompters to encourage students to go beyond current game theory definitions in an effort to explore how to increase the player's sense of embodiment and to transmit the player's experience of the gameplay to a wider audience. The prototypes are being incorporated into future versions of CaveUT to help educators develop more engaging and immersive interactive environments. Hopefully, the next version of CaveUT will also allow the players and the audience to more richly participate in the so-called "magic circle".

Submission Category

Paper. We believe we have too much information and presentation material for a short paper, but do not have enough time to organize a call for papers for a panel and the second author does not currently have funding to present. We will however be happy to consider a short paper if the selection committee prefers.

Anticipated experience level

Novice, intermediate.

1.1.1 Categories and Subject Descriptors

K.3 [**Computers And Education**]: Computer Uses in Education – Collaborative learning.

H5.2 [**Information Interfaces And Presentation**]: User Interfaces - Prototyping, Theory and methods, User-centered design.

General Terms

Performance, Design, Experimentation, Human Factors, Theory.

Keywords

Projection, physical computing, interaction, biofeedback.

1. INTRODUCTION

While computer games were traditionally single-player and single screen focused, this barrier is beginning to break down. Further, recent research on presence in virtual environments suggests that immersion is not a binary phenomenon [Spagnolli and Gamberini 2002], and is highly dependent on the participant and on the local content and content [Wang et al 2006].

Definitions of computer games by such as theorists as Juul [2003], and Salen and Zimmerman [2003] emphasize that computer games are systems, but this is not a necessary and sufficiently condition, and it does not address why users find games enjoyable. Here is a working definition of a computer game (different to Salen and Zimmerman); a game is an engaging challenge that offers up the possibility of temporary or permanent tactical resolution without harmful outcomes to the real world situation of the participant. This definition may not be succinct, but it allows for varied spatial and collaborative configurations of gameplay.

Salen and Zimmerman talked of a magic circle that separates (but not always clearly) the boundaries of a game from the real world, but they focused rather quickly on conflict, leaving aside more generic terms of challenge and competition, and the design possibilities of hybrid play-space shared between audience and active participants in many cultures over thousands of years. For example, a game studies paper on Huizinga by Rodriguez [2006] conflated the ritual with the game, and the magic circle with a sacred place set apart from the general community; yet rituals and sacred places are often set against, above or between non-sacred communal places, and games as played by children do not have to take place in prescribed locations at preset times.

While a colorful and arresting phrase, the metaphor "magic circle" as borrowed from Huizinga, is dangerous. This phrase may suggest to people that immersion in game play is binary (a player is inside the circle or is not), that games do not incorporate real-world events, characters or obstacles, or that in-game consequences do not affect anything outside the "magic circle" of the game. Nor does this spatial metaphor directly address automatic response behavior being incorporated into game play (via biofeedback), and literal translation of the metaphor may lead to the creation of an artificial barrier between the audience and the game participants.

We have attempted to situate the above theory of the magic circle as a research design problem. There is great scope for multi-user interaction. But how can low-cost and accessible display and performance space for VR and games be developed, allowing and thematically affording multiple users enhanced embodiment and more contextually appropriate interaction? To evaluate some potential solutions, we developed the following prototypes. These prototypes were mirrored games (using CaveUT and a semi-circular mirror for surround projection), domes and tents for gaming environments, warping codes to allow for non-expert IT users to customize their own projection surface for OPEN GL-based games, wireless pointing games, graphic tablet driven writing games, and biofeedback that controlled music, shaders, AI, and other elements of games and virtual environments.

These prototypes are cheap, easily customizable, and had some success in involving both audience and player. We believe they are of use to other educators and hence we are amalgamating code and environment with future releases of CaveUT to help educators develop more engaging virtual environments.

1.2 Surround Environment: Mirrored Games

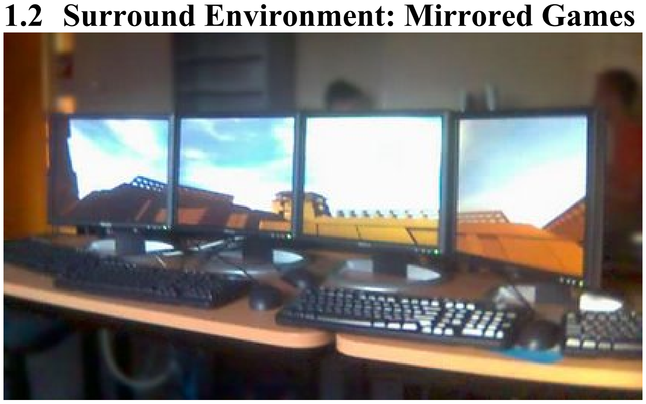


Figure 1: The game level using CaveUT

For an archaeological visualization using Unreal Tournament, we decided to test new low cost peripherals to see if we could increase the feeling of immersion. CaveUT [Jacobson et al. 2005] was used to create a wide-screen display (Figure 1) and it was projected onto a curved mirror. Two final year students built a special environment where the game was projected onto three walls and a ceiling; roughly 2.4 meters square (Figure 2). People could navigate with a 3D joystick while the in-game birds flew above them on the ceiling.

One interesting discovery of this project was the immersive aspect of projection that catered for peripheral vision. When people are surrounded by a large game space in three dimensions that is bigger than they are, and when they interact by standing and moving (we used sensor pads so that they could move by physically raising and lowering their feet rather than using a mouse), the gameplay was discernibly enhanced. The scale of the place and the increased virtual relation to the actual physical embodiment of the visitor enhances the believability of the virtual characters, for the NPCs (non-playing characters) can develop a territorial spatial presence as they could now physically surround the player.

Figure 2: UT2004 convex mirror projection onto corner walls

The above project is based on Bourke's [2005] projection work of panoramas and movies for planetary domes, but applied to interactive real-time rendering engines. Using a spherical mirror, an inexpensive data projector and complex image warping, we can avoid expensive fish eye lens while creating a peripheral and spatially rich experience for one or more viewers. Initially we did not have warping code to pre-distort the image so that when projected via a curved mirror the resulting image appeared slightly distorted, but for games that do not include small peripheral text this did not appear to significantly affect game play.

1.3 Surround Environment: Half-Dome

Last year an honors group, inspired by the above project, built small portable half-domes for the mirror projection (Figure 3). Depending on the type of game, the enhanced peripheral vision creates a more immersive experience. We found car-racing games such as Burnout 3 were particularly suitable, especially when augmented by stereo amplified sound pumped through the player's chair. The below environment also had a steering wheel and pedal set. The dome itself was made from cloth and sewn together; the seams were not considering distracting by the players. The horizontal seams were much less intrusive than vertical seams.

Figure 3: Car- racing in a half-dome with mirror

Both an Xbox and a PC was used with a projector and spherical mirror to project the game onto the inside of the curved surface. With a darkened room it was extremely easy to get willing participants but extremely difficult to stop them. We did not have to create code to warp the game image so that it would project perfectly onto the screen, as for racing games the distortion did not affect gameplay, and the action especially on the periphery was judged by players to be highly engaging.

1.4 Surround Environment: Perforated Tent

A Torque game demo was modified to incorporate feedback from specialist racing pedals and steering wheel (Figure 4). The force feedback was connected to a massage unit inserted into the seat of the chair (which was originally part of a truck), and players found this particularly effective for car racing and collision-based games.

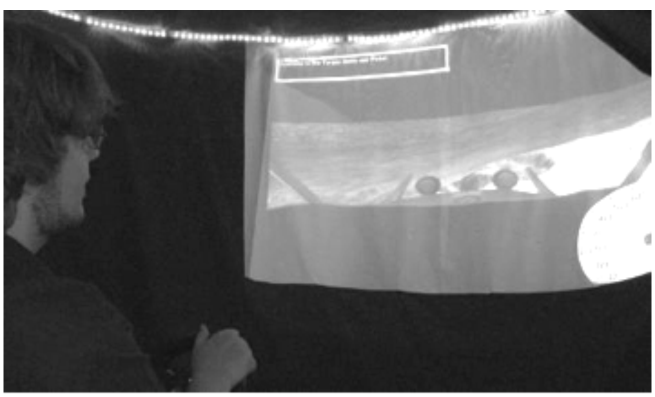


Figure 4: Car Racing Inside a Tent Using Force Feedback

The students also created a more tent-like structure around the game that allows spectators to watch from outside. The spatial size and encompassing field of view engages the player, and hides external distractions. We found mirror projection was not required for this set up, only a data projector was required (which projects from behind and over the seated player).

The lights along the structure (Figure 5) could be tied into player biofeedback or in-game health points, if required. The audience could also view from a second monitor, and work was started to create an interactive table where a separate audience could create and place obstacles into the game in order to dynamically challenge the player.

Figure 7: Shooting Arcade Style Games

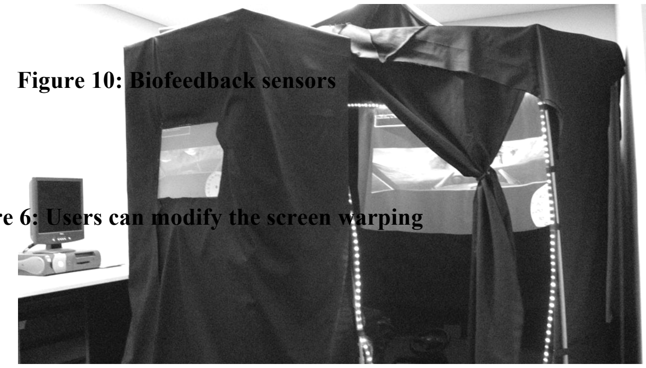


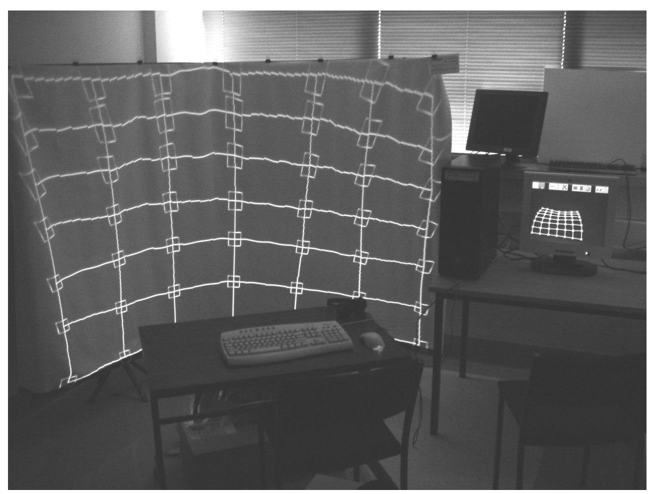
Figure 10: Biofeedback sensors

Figure 6: Users can modify the screen warping

Figure 5: Lights Can Be Linked To the 'Health' of the Player

1.5 Surround Environment: Curved Display

From the above projects we are now developing an Open GL GUI interface (Figure 6) that would allow a non-technical player to creating a warp so that they can use curved mirrors to project an image onto almost any surface. The user takes an image into the application, and moves the red vertex points or adjusts the warping radius to pre-distort the image. Once this pre-distortion is set, it can be used for moving images such as games. We are currently incorporating it into a FPS game but it could be used with other Open GL games.



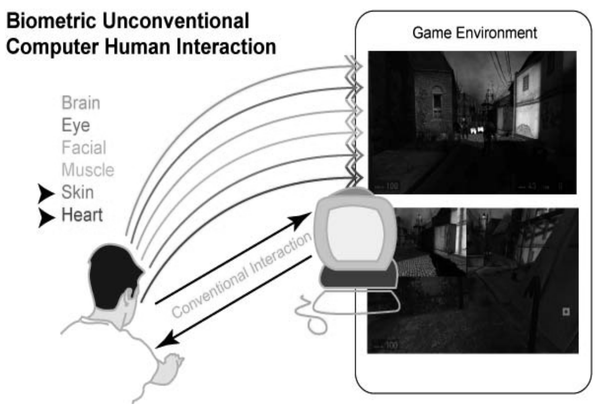
Due to the physical configuration of the games and size of the projected image, people could observe the game from behind or to the side of the player and offer assistance or criticism. As the player can stand or sit, it would also be possible to use camera tracking to record postural change.

Figure 4

Figure 8: A Chinese Writing Game Using a Tablet

The calligraphy game (Figure 8) teaches players how to write Chinese characters by tracing over a shadowy image of a character on the projected screen with a tablet.

1.7 Bodily-Aware Games



Is it possible to add to gameplay through subconscious and automatic player reaction (Figure 9)? After all, the mouse and keyboard are very constrained and mechanical forms of human input. If a game could automatically and dynamically react to the instinctive reactions and physiological state of the player, it could increase the frequency or intensity of elements that most excite (or calm) us. Yet despite much research into Virtual Reality VR) to control phobias, research on biometrics as it affects the user-reactive aesthetics of gameplay is a recent development [Sykes and Brown 2002; Zagalo, Barker and Branco 2004; Gilleade and Dix 2004; Gilleade and Allanson 2005].

In order to see if low cost biofeedback can be introduced into a virtual environment for aesthetic reasons, another student, Andrew Dekker [Dekker and Champion 2007] developed sockets for Half-life 2: Source game engine that allows a low cost biofeedback device or around $180 US dollars to input dynamic data of the player. He also created shaders (and other effects such as camera shake) that are automatically triggered when the player's heartbeat and galvanic skin response reach certain levels

The biosensor (Figure 10) signals changes in biofeedback and triggers the shaders in the game to change both dynamically and dramatically (shaders can control the color, reflectivity, and translucency of a rendered surface). Further, the bio-input data causes the hostile zombies to respawn in response to increased agitation of the player. The hostile zombie response was done by creating invisible entities in the game editor as spawning points.

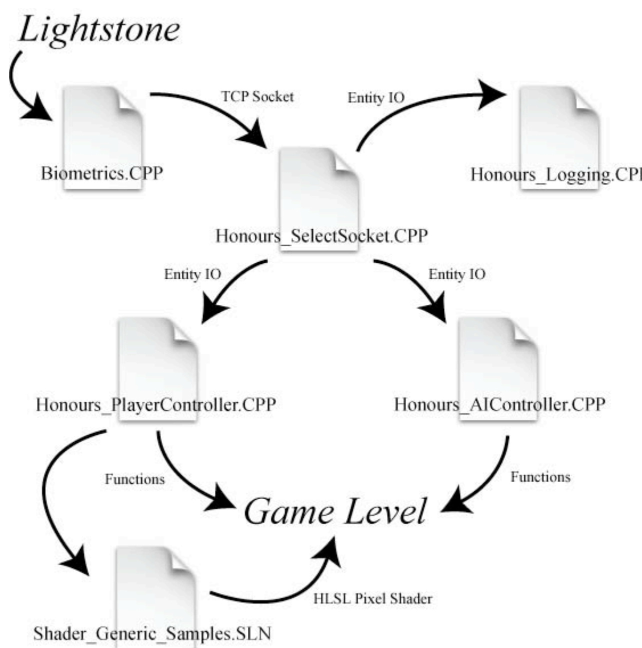


Figure 11: Socket Diagram for Shaders

The overall setup (Figure 11) allowed for a Playercontroller which affected the avatar's jumping height, the special effects (when the player was too excited the screen changed color or shook), the music, running fast, and dynamic Field of View. Dynamic FOV was put into the prototype, but it wasn't successful as it was triggered rather than linked to gradual changes in heartbeat.

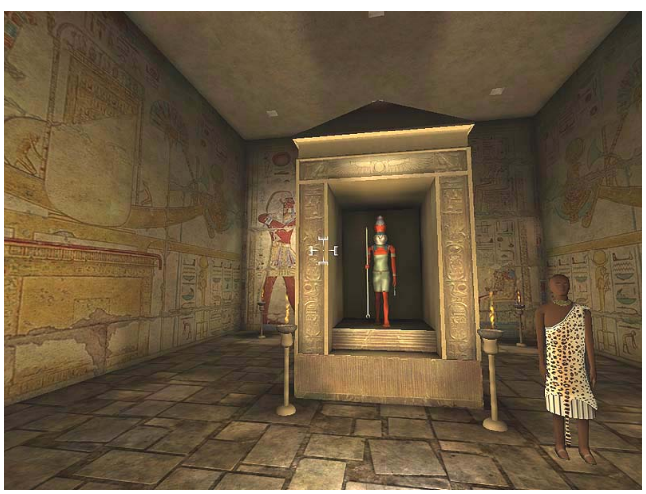
If the heartbeat was very high the Field of View would become narrow (focused), and if heartbeat well below average the Field of View would become wider than normal (more perceptive and aware). The aicontroller controlled sounds in the environment and the artificial intelligence of the NPCs.

Overall we found incorporating the biometric data back into the level did affect gameplay, but sometimes adversely, the effects inside the game have to be very carefully related to changes in the biofeedback data. What was very surprising to us was the amount of not only facial expressiveness, but also postural change that was captured on the video camera of the participants (Figure 12).

Figure 12: Biofeedback showing emotional change

In future research we would like to use camera tracking to record not only facial expressions but also postural change and perhaps even player gaze direction. We envisage sending this information to NPCS with a form of spatial intelligence, so that they can approach the player directly or on the periphery of their vision, depending on their level of hostility or friendliness. We would also like to readjust the Field of View control so that it changes depending on gaze movement or whether one is moving through rooms or crowded landscapes.

2. CaveUT



We have in the past used the Unreal Tournament game engine to create a CAVE-like environment that can surround and thus more succcessfully immerse the viewer (or player) in a contextual, thematic, and more highly interactive experience. We are adding Hendon's warping code (discussed above) to the current version of CaveUT, and it will be available to the public as open source code.

3. CONCLUSION

The study of games as a subset of screen studies risks ignoring particular cognitive activities of the player, but it may also prevent academics and designers from seeing the theatrical potential of games as spatial performances. As spatial performance, digital games may also more richly and dynamically incorporate the expressive and empathic abilities of audience and participants as embodied and embedded social beings.

All of the games mentioned in this paper were exhibited, and the second year game projects were definitely more advanced than when offered to final year students the year before. The evaluation methods, interface and interaction design demonstrated by the final year undergraduate and first year postgraduate students have been considered a success by other staff, and projects have been published and publicized at national and international levels.

The students and exhibition audience appreciated all of the above projects, possibly the dome was the most effective, and yet the simplest to construct. The biofeedback prototype offers the most interesting aesthetic effects, and people enjoyed watching player reactions, but the need for dark conditions weakens its usefulness for audience inclusivity, unless we are able to create multiplayer player versus player games based on triggering each other's phobic triggers and do away with the single player horror genre. Finally, the Open GL warping code seems highly useful for large-scale game level evaluation, as we can now use large screens or even corner walls to project on and conduct group play testing.

We also intend to further develop the code for the next version of the Unreal game engine. As the second author has secured a non disclosure agreement with EPIC GAMES, the creators of the next version of the game (UT3), and its game editor, we hope to collaborate with other education specialists in creating more immersive, authentic and successful learning environments that enhance current levels of player-audience-content interactions. The new version will allow teachers and students to create customised surround projection, and there is plenty of research scope to create collaborative and thematic peripherals and interfaces for these new projection environments.

2. ACKNOWLEDGMENTS

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Author Bios

Erik Champion, (speaker and primary contact), is (from June 23) Associate Professor, Research and Postgraduate Director at the School of Design, Massey University, New Zealand. Erik graduated in architecture, philosophy, and engineering (Geomatics).

His doctoral thesis was on evaluating cultural learning in virtual heritage environments, and the industry partner was Lonely Planet. He has supervised or collaborated on various games and virtual environment projects, mostly based on cultural learning and virtual heritage, spatial projection, or physical computing. He has taught game design courses at the University of Queensland and the University of New South Wales, Australia. He is on the editorial board of *Games & Culture: A Journal of Interactive Media, Gaming and Virtual Worlds, Loading.., Journal of Gaming and Virtual Worlds*, as well as Book Review Co-Editor for *the International Journal of Gaming and Computer-Mediated Simulations*.

Jeffrey Jacobson, Ph.D., [not attending] is Director of PublicVR (http://publicvr.org) a non-profit corporation dedicated to free software for virtual reality in research and education. Dr. Jacobson has led research and development efforts for VR applications in low-cost VR, cultural heritage, medicine, human factors, and education. He led the team, which developed CaveUT and related tools, freeware which adapts Epic Games' Unreal Engine (v2.5 in the game UT2004) for low-cost visually immersive displays. Recently, he led a successful research study, where students played a game based on a virtual Egyptian temple. Students who employed a visually immersive interface learned measurably more than those with only a standard computer monitor. (For more information, see http://planetjeff.net/Dissertation.pdf)…

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