Experiments in interactive panoramic cinema

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ABSTRACT

For most of the past 100 years, cinema has been the premier medium for defining and expressing relations to the visible world. However, cinematic spectacles delivered in darkened theaters are predicated on a denial of both the body and the physical surroundings of the spectators who are watching it. To overcome these deficiencies, filmmakers have historically turned to narrative, seducing audiences with compelling stories and providing realistic characters with whom to identify. This paper describes several research projects in interactive panoramic cinema that attempt to sidestep the narrative preoccupations of conventional cinema and instead are based on notions of space, movement and embodied spectatorship rather than traditional storytelling. Example projects include interactive works developed with the use of a unique 360 degree camera and editing system, and also development of panoramic imagery for a large projection environment with 14 screens on 3 adjacent walls in a 5-4-5 configuration with observations and findings from an experiment projecting panoramic video on 12 of the 14, in a 4-4-4 270 degree configuration.

Keywords: panoramic cinema, interactive cinema, immersive media, immersive environments, interactive entertainment

1. Introduction

This report documents recent experiments in interactive panoramic cinema conducted at the Interactive Media Division (IMD) of the School of Cinema-Television at the University of Southern California, with the support of the Institute for Multimedia Literacy at the Annenberg Center for Communication. Research and experimentation with Immersive Media technologies constitutes a major area of research emphasis at IMD, along with such fields as Game Design and Mobile Media. Generally speaking, this research takes place within three overlapping spheres of interest and potential: Immersive Games; Immersive Environments, and Immersive Cinema, toward a broader goal of innovation across the full spectrum of interactive entertainment. This document focuses on research in Immersive Cinema conducted during the fall and spring of 2004 in two courses at USC: CTIN 532: Interactive Experience Design, taught by Mark Bolas and Michael Naimark, and CTCS 478: The Frenzy of Vision, taught by Steve Anderson and Susana Ruiz. Both courses focused on the possibilities for designing immersive experiences using still and moving images for presentation in a physically immersive environment – a 270 degree (4-4-4) projection environment, and an interactive game console delivery system. The two courses may be thought of as functioning in tandem on a conceptual level, providing divergent platforms for exploring the possibilities of immersion as realized on a psychological/emotional level as well as in a volitional, interactive environment.

2. Historical/Theoretical Context

The theoretical context for this investigation included introducing students to the history and theory of visual culture from the modern era to the present. Drawing parallels with the "new" technologies and art practices that shaped visual culture in the 19th century – especially stereoscopic photography, the panorama, and early cinema – students were invited to understand their work with immersive digital technologies within a context that is deeply historicized.

Students were prepared to conceive their final immersive cinema projects through a combination of theoretical discussions and technical exercises. A foundation for thinking about the concept of immersion was provided by art historian Jonathan Crary, whose book *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, argues that seeing must be understood as an embodied activity and not one that is purely visual.

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Ironically, immersive technology, which at first glance seems to represent another step on the path toward realism, also suggests ways of questioning and subverting our most basic ways of being in the world; our perceptions of space and time, and our fundamental relations to knowledge and visual perception. Part of the goal of presenting students with the opportunity to work with a 360 degree video system was to sidestep the narrative preoccupations of conventional cinema, and to encourage students to think in terms of space, movement and embodied spectatorship. It was considered axiomatic to this project that attention to content was of equal importance with technical mastery of the 360 degree apparatus.

As a step toward realizing these goals, students first created a series of "conceptual prototypes" using projected still images in a 12-screen, 270 degree array [Figure 1]. The limitation of working with static images forced students to begin thinking in terms of space and depth rather than time and movement. An additional exercise involved projecting temporally synchronized but spatially disjunctive moving images on the same 12-screen array. A final exercise was completed using the static but navigable QTVR format, which offered a preview of the game console delivery mechanism of the 360 degree system. [Figure 2].

Interestingly, all three of these exercises yielded projects which frequently departed from the representational conventions of realism, depicting fragmented, disjunctive, or deliberately distorted spaces. In gravitating toward conceptual investigations of space and perception, several of these projects resisted the presumptive ideals of immersive media, namely the approximation of physical and emotional immersion in space.

Figure 1. Static image studies for panoramic display developed by IMD graduate students Jenova Chen (top), Ashley York (middle), and Andrew Sacher (bottom).

Figure 2. QTVR prototype for panoramic cinema experience.

3. Project Guidelines

Overarching goals for the project included exploring the formative possibilities of multiple 360-degree takes in order to shape the experience of narrative time; to produce a story that could only be conveyed effectively through the use of a 360-degree viewing field; and to incorporate a sense of technological reflexivity, creating an environment that uses the 360 degree apparatus while simultaneously analyzing its significance in an increasingly self-conscious, surveillance-oriented society. In formulating their final 360 degree projects, students were encouraged to consider the following conceptual issues.

3.1 Space, depth, dimension, immersion

How does a 360 degree environment allow us to experience space in different ways? Is there a connection between the fascination of a 360 degree video apparatus and 19th century desires for immersion by means of panoramas and stereoscopy?

3.2 Time, movement, interval, duration, speed

What is the relationship between time and movement? With its apparent emphasis on new ways of experiencing space, a 360 degree system might seem to downplay issues of time – however, might it also invite us to think differently about things like movement, duration and speed as we move through these spaces? Are there interesting ways to work with temporal discontinuities, non-linearity or temporal manipulation?

3.3 Bodies, physicality, interiority/exteriority

Our experience of space and time is intimately connected to our physical presence in the world. How is our sense of embodiment affected by a 360 degree authoring environment?

3.4 Fragmentation and multiplication of screens and surfaces

Just because this system allows for creation of 360 degree screen spaces, doesn't mean that you should feel constrained to creating a single, physically contiguous world. Is it possible to embed a 360 degree world inside another 360 degree world? Are there interesting ways to insert other viewing perspectives or points of view as an alternative to the radial logic of the centered, 19th century viewing subject?

3.5 Narrative, navigation, exploration

What kind of navigational structures are uniquely possible when working in an interactive 360 degree format? How do narrative and navigational goals and possibilities change? Is this system best suited to working with elements of story, mood, ambience, exploration, etc.?

4. Project Selection and Genres

To select the two final 360 degree projects that would be produced, each student presented a project idea, and then the class and instructors voted for their top two project choices. This process resulted in two clear favorites – a narrative project called "The Recalcitrant Panopticon" [Figure 4] about a human and computer who struggle for control of the visual field, and a conceptual project based on the idea of a life-size Zoetrope that gets out of control [Figure 5]. Interestingly, both of the projects that were selected are based on pre-cinematic technologies of vision which were introduced in the historical component of the course. Both also resemble the radial structure of the camera apparatus itself – i.e., both the Zoetrope and Panopticon present a circular field of vision which privileges a single, centered viewing position.

The other project ideas that were presented could be roughly described as falling into one of two basic genres:

4.1 The action-immersion genre:

Several students proposed projects which located the camera apparatus in the center of some extraordinarily dynamic field of action – a college football game, a medieval jousting match, a gymnastics event, etc. Each of these projects promised to make strong use of the 360 degree system's unique capacity for capturing a sense of immersion in a highly stimulating visual environment. Several of these students described their goal as creating a sense of frustration in the viewer at not being able to see in all directions at once, thereby revealing both the seductive power of immersive media and the limitations of the viewer's perceptual abilities.

4.2 The perception-challenging genre:

Several other students proposed projects which were devoted to experimenting with the capabilities of the technical apparatus of the camera system and exploring the boundaries of viewers' perceptual abilities. These projects tended to rely on an experiential or game-like structure, in which viewers would attempt to discern the puzzle of how the images were created and the limitations of what could be seen. Many of these projects required elaborate post-production effects, often involving shooting images against green screen backdrops to facilitate image compositing and creating the possibility of additional spatial dislocation. Others involved spinning the camera apparatus in circles or pivoting it so that the axis of view was perpendicular to the horizon; still another called for superimposing image masks to restrict perception so that viewers would be forced to navigate the project to maximize their field of view, etc.

Figure. 4. “The Recalcitrant Panopticon” panorama

Figure 5. “Zoetrope” panorama

4. Technical Challenges and Execution

The 360-degree camera system included eight facets, each capturing a 45 degree arc of the surrounding space, with an approximately equal vertical angle of view. [Figure 6, Figure 7]. The recording medium was DVCAM tape captured on a nine-deck array – one deck for each video stream, plus a composite recording of all eight simultaneous camera views to assist with editing. In spite of the labor intensiveness of the post-production process, both the "Panopticon" and "Zoetrope" projects featured extensive visual effects and/or asynchronous editing. This process was exceptionally time-consuming and the editors were somewhat impaired by not having access to a "preview" mode that would allow simulation of the navigable output until the project was fully edited, exported and composited.

Dedicated, proprietary stitching software was used to create the final composite images that were exported for playback on the video game console. Seams between camera views are largely unnoticeable, owing in part to careful lighting and color correction in post-production. Overall, the system functioned with minimal technical problems, except for a single video stream on the "Zoetrope" project, which lost timecode synchronization and therefore drifts out of synch upon playback, creating an interesting but unintentional disruption of spatial contiguity.

Figure 6. Class design session with panoramic camera

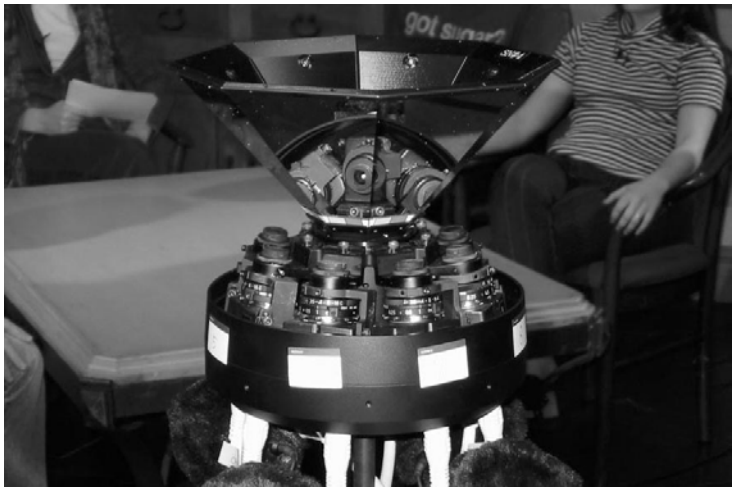

Figure 7. 360-degree camera system with eight facets, each capturing a 45 degree arc of the surrounding space.

5. Summary analysis

Unlike the static prototypes created in preparation for these final projects, both the “Zoetrope” and “Panopticon” projects invested their primary efforts in utilizing the system’s capacity for reproducing a contiguous, realistic visual field. Presumably, this resulted in part from the shift from a static to time-based medium and with it a move from the conventions of photography and graphic design to those of cinema and video art. The further introduction of story content seems to have carried with it the desire for psychological immersion and narrative closure that is not disrupted by spatial or temporal discontinuities.

Except for the single technical problem noted above, the effect of a compelling, time-based 360 degree viewing experience was essentially achieved. Ultimately, some doubts were raised by viewers about the advisability of delivery of these projects via the game console. While this mechanism has the obvious advantage of tapping into a massive, pre-existing user base, the mechanized panning action of the console joystick works against the desired perceptual immersion of the viewer – i.e., horizontal pans and zooms poorly approximate the fluidity of real-world head movements and attention shifts – thereby disrupting the sense of psychological immersion.

Numerous users of the system expressed the desire to see the images projected, rather than being constrained to the roughly 120 degree angle of view offered by the monitor. Other users lamented the fact that the system did not provide surround sound, which would seem to be a natural complement to the 360 degree environment. Finally, after compression and exporting of the final video files, the resolution of the screen was visibly degraded from the DVCAM original, thus compromising the otherwise useful zoom function on the game controller.

Overall, these experiences confirmed several of the operating hypotheses of the IMD’s ongoing research in immersive media. As technological developments continue to bring immersive technologies within the grasp (both economically and practically) of a growing user base, the need for understanding the properties and limitations of immersive experiences will increase proportionally. As these experiments in immersive cinema also demonstrate, numerous technical challenges – including resolution, synchronization, and development of an ideal delivery mechanism – remain to be solved.

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