Virtual Sets: A Mixed Reality Application for an Old Practice

Antonieta Angulo
Department of Architecture, Ball State University
✉ aangulo@bsu.edu
Michel Mounayar
College of Architecture and Planning, Ball State University
✉ mmounaya@bsu.edu

ABSTRACT

This paper chronicles the implementation of state-of-the-art virtual set technology through the teaching of an independent study course at Ball State University. The paper describes the use of independent study formats as a means to initiate teaching of emergent media that does not fit neatly into specific academic silos. In addition to its learning potential this technology offers a new practice area for architects and designers that have an understanding of communication studies and space design at the crossroads of imagination. The creative realm for new emergent media and markets requires new teaching formats, opportunities and challenges for future implementation.

KEYWORDS: virtual sets, design communications, 3D modeling, design, mixed reality.

The Opportunity for Immersive Learning and Inter-collegiate Collaboration

Mid-summer 2008 the dean of the College of Communications, Information and Media (CCIM) R. Lavery contacted M. Mounayar concerning a new acquisition that CCIM had made in collaboration with the Ball State's vice president for Information Technology in support of the BSU Teleplex. This is a substantial investment for the university, one estimated at 1.4 million dollars.

The university approached CCIM with an offer to pool a portion of the college's annual technology allocation for the next three years in support of this important new software and hardware package produced by ORAD (ORAD, 2010) a company specializing in the production and development of "virtual sets". Ball State had recently identified itself as the leading public research institution in Indiana focused on emerging media. The vision of the university includes the expansion and participation of its faculty and students in this new market. *Emerging media*, as defined by Ball State, is the "evolving use of technology and digital content to enhance work, play, and learning, to broaden access to information, and to enrich personal connection by eliminating the constraints of time and location." Given this framework it was only natural for the College of Architecture and Planning to become an essential pillar of this university focus (Ball State University, 2010).

The invitation included the opportunity to assist in the design of six sets for six different student-produced TV shows. The architecture students are given the opportunity to design and launch six environments focused on varied subjects such as (1) a talk show, (2) a sports program, (3 & 4) two newscasts, (5) a movie review, and (6) a celebrity interview show. The prospect of architecture students working with TV producers and Teleplex staff is perhaps the most essential attraction for embracing this project. What a wonderful opportunity for teamwork and interdisciplinary collaboration in a clear professional setting. The students have a client (the show), a site (the virtual world), and a production program (almost equivalent to that of a building program). All of these three represent new practice conditions that will certainly grow over time. What is described above represents the main characteristics of immersive learning. In such a pedagogical approach, students must: earn academic credit, engage in a student-driven problem-based learning process, involve an interdisciplinary team, make connections to a career path, and engage a service or product (Fig. 1).

Figure 1. The Virtual Set Technology combines live action with virtual worlds

Figure 2. The Newslink Indiana Virtual Set by Tyler Cox, set designer

The Educational Framework

When exciting opportunities land on your desk they never come at the perfect time. The challenge was to draw senior students of the architecture program to take part in this unfamiliar course even though student class schedules had already been established and the semester was set to start . While the administration and faculty were clearly interested, it remained unclear if the students would embrace this new challenge. The implementation plan included a number of simultaneous efforts. First, a small group of specialized faculty working in this research area was contacted. Second, a faculty organizational meeting was held to discuss course format and approach. Third, an email was sent to third and fourth year architecture students announcing the opportunity and communicating the organization of the project. The e-mail invited students to attend an informational meeting scheduled for the first day of classes. The faculty team agreed on the best course format to be employed. The team would use an existing 3-credit independent study course number in which each faculty member worked directly with two students while the whole group acted as a unified team. This format resolved the administrative and scheduling complications while also providing an open and flexible format most conducive to unexpected creative offerings such as this one. Each student would be responsible for one of the six shows. The independent study format would also allow the courses to exist without altering predetermined teaching schedules. The students would use the credit to fulfill elective requirements (Fig. 2).

The faculty challenged the students to invent new approaches to this design problem. Perhaps the opportunity was to let the virtual nature of the sets show through, but many questions remained. Do these sets have the potential to increase communication levels? What kind of spaces should be provided? These questions were mainly addressed via design sessions by the shows' producers and the architecture students. The producers had a vague idea about the type of sets they wanted to have. In general these discussions happened afterhours and only between students. Perhaps this was the most interesting learning that took place—where architecture students became exposed to a new creative process, that of TV production. However, this learning was out of sight and informal. The producers perhaps kept their expectations low due to the unfamiliarity of the interdisciplinary group with each other's skills and disciplines. After all, the sets had much to contribute to the style and feel of the show. TV producers typically want to control such a central aspect of their show. It was not clear how many critiques took place specifically regarding the design, look, concept relevance, and feel of the sets. In general the class met informally in public spaces and random building lobbies, cafes, computer labs, and TV studios. This was very successful for the students. The mere variety of meeting places kept the course more exciting and closer to the actual professional world; the number of different places seemed to be convenient for all involved. Working with creative collaborators demands a flexible and agile pedagogy that allows dynamic and fluid learning. In effect this course had no classroom, no time schedule, and an army of supervisors and consultants. This loose structure provided a very attractive mode of learning. Difficulties had to do with student grading and establishing guidelines for the intensity of study and quality of work. Two key questions that remained were: How could the instructors demand high levels of involvement when this approach had not been taken prior to this course? What constituted successful completion of the course?

Virtual Set Technology

Digital compositing for visual effects is the process by which elements from any source (analogue or digital) are combined together into a seamless whole. All the elements must appear as if they have been shot together at the same time, under the same lights, with the same camera. Digital compositing

has benefited from the steady increase in the use of computer generated imagery (CGI) and the improvement of compositing software and hardware technologies. Visual effects produced using both CGI and digital compositing technologies are now created faster, and are more cost effective and sophisticated than before (Wright, 2008). The broadcast and film industries that mostly relied on physical sets are now eager to gain a competitive edge and have almost entirely switched into a digital format demanding more complex and creative visual effects. Virtual set technology uses digital compositing to combine actors and a realistic-looking computer generated set in real time. A major difference between a virtual set and the special effects used in movies is that the computer graphics are rendered in real time, removing the need for any post production work, and allowing it to be used in live television broadcasts.

There are many technical solutions for creating virtual sets, and most of them include the following components:

- Blue or green screens,
- Camera tracking that uses either optical or mechanical measurements to create a live stream of data describing the exact perspective and position of the camera,
- Real time rendering software that uses the camera tracking data and generates a synthetic image of a television studio, and
- A video mixer, which combines the video from the camera with the video from the real time rendering software to produce a final video output. One of the most common ways to mix the video is to replace a chroma key background.

A key point in the implementation of a virtual set is that the real camera can be moved in 3D, while the image of the virtual camera is being rendered in real time from the same perspective. To do this the rendering system has to mimic the exact movement of the real world camera & lens. This can only be done if the real time information of that movement is provided. The best and most costly approach is the so called "full freedom of movement virtual set". This is the approach that the Teleplex staff has implemented using the technology of Orad Hi-Tec Systems. This approach builds on the use of advanced camera tracking systems and pattern recognition or grid tracking (mounted to green walls). The data flow from cameras is compressed and passed to the control room and fed into a powerful video graphics rendering platform, where the software processes the tracking data and renders it against the set graphics. The rendering software also provides mapping of live video or video clips to monitors and other objects within the virtual set. This permits the use of large monitor walls and other video features without any investment in set video hardware.

The virtual set needs to be designed for the rendering system. This can either be done within the virtual set software itself or done using independent design software. Our CAP students used several software tools (in fact any application that supports the industry standard exporting protocol can be used) for geometric modeling and rendering (3D Studio Max, Maya, and Rhinoceros) and for the creation of material maps and textures (Adobe Photoshop). The Teleplex staff provided some guidelines and a tutorial to ensure that the design/production processes of the set were as efficient as possible so the models would comply with the ORAD software. The procedures that the CAP students followed included these general steps:

- Create the geometry
- Apply materials
- Establish lighting arrangements
- Bake materials and reapply and orient baked materials
- Exporting the design from modeling system into Cortona, a VRML viewer program

Once this procedure was completed, the designs were imported into the rendering software that turned it into a real-time virtual set template. The ORAD system provided a highly efficient rendering engine that handled the most complex virtual sets with ease. It was also able to produce special effects (i.e. such as transparent glass, reflections) for a more realistic depiction of the set. In some cases, when the textures did not look right, the designs were corrected in their native programs in order to attain the desired quality. At that point, the producers of the virtual sets also reviewed the design output and offered feedback for the improvement of the designs. The CAP students modified the sets accordingly.

Conclusions

From a designer's point of view, there are many similarities between the design of an architectural project and the design of a set. Both cases deal with space design. Both types of projects are limited by client requirements and constraints and are guided by aesthetic and functional performance objectives. While the set is not related to a particular site, it might be seen as the expression of a community of people and it represents specific interests and aspects of society; it is a cultural expression. Beyond these similarities, virtual set design has a potentially tremendous impact on viewers' perceptions when it comes to broadcast applications. The talent may communicate the message to his or her audience while being supported by all of the means that the set provides; this impacts the way shapes, colors, surface treatments, furnishings, and others aspects are specified in the set. Moreover, since its inception almost 20 years ago, virtual set technology has sought realism. According to A. Wojdala (Wojdala, 1998) the biggest challenge of virtual set technology is to create the illusion that actors are immersed in the virtual set; this is basically done by proper lighting, camera matching, and proper actors' orientation and interaction with the virtual world. From this point of view, our major contribution in the design of the set has to do with the specifications to improve lighting conditions (illumination and shadow casting) as well as to conveniently locate elements with which the talent was to eventually interact.

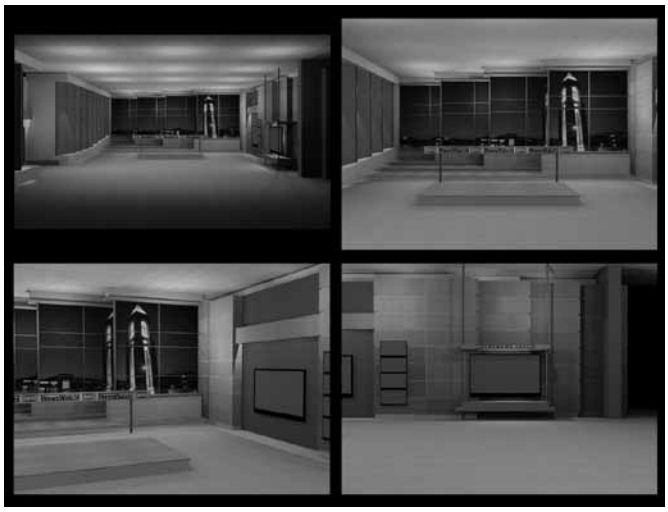

Figure 3. Live campus shots as window backgrounds by Taf Bwititi, set designer

Figure 4. Architecture students working with communication students and camera technicians

From an educational point of view, as we prepare our second cycle of this course we have learned much about our expectations and management of the project and course in such a way as to make the project much more successful. First, the technology will have to be more efficiently and systematically understood as described in this paper. Second, the grouping of CCIM students and architecture students need to be more formal. Third, formal design discussions need to constantly follow the progress of the project. We must explore the exchanges between the TV production process and architectural design more thoroughly. Informal student dynamics of meeting places and professional style meetings must be reinforced and encouraged. More formal methods of reporting and recording the process must be developed (Fig. 4).

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