

Cave Capture

An Immersive Motion Sketch Pad

1 Objective

We briefly describe past applications of VR technology and provide motivation for real-time content creation through action capture.

Traditionally, the use of virtual reality (VR) technologies have allowed users to experience different environments through an immersion-based experience. For example, in the VR Lab's *Detroit Midfield Terminal* project (a collaboration with Northwest Airlines), a virtual model of the McNamara Terminal demonstrated the ramifications of various architectural designs to users, allowing them to see first-hand how the height of the control tower influences its field of view. This method of immersive experience was most certainly a boon to the architects. We name such uses "content exhibition", as the models and (limited) behaviors are constructed outside of the environment and the VR technology is used simply as a display – albeit both an effective and impressive display.

In contrast, our group describes "content creation" systems as those allowing users to modify the content of their world beyond simple predefined actions (for example, adjusting the height of the control tower). Applications of this sort are few and far between. *CAVE Painting* allows the creation of virtual brush strokes using a variety of tools. *CAVE Sculptor* is simpler yet, allowing for the creation of geometric primitives (cube, cone, sphere, spinning 'Entity' cube – an iconic reference to University of Michigan's media art collective). These applications focus on the creation of simple static geometric objects. Content is created not for the sake of preserving the content itself, but to create interesting exhibits.

We see the future of VR technology as a synthesis of content exhibition with content creation. Virtual environments such as the CAVE can function as canvases for media-rich, creative expressions. Until now, the missing component in this fusion has been motion. Simple head and wand position tracking have become commonplace, but the CAVE's newly acquired motion capture system allows for tracking the location of the entire body. The ability to capture kinesthetic expression with such depth and precision of detail, using this new technology, is yet untapped.

The objective of our project is to develop and explore a method of motion content creation in the CAVE based upon motion capture. An *actor* in the CAVE wearing motion capture equipment will be subject to content exhibition from the CAVE's computers. During this time, the actor will be mapped to an avatar in the virtual environment through the motion capture equipment. The avatar's motions will not only influence the dynamic state of the virtual environment - they will also be recorded for later replay. If desired, a virtual environment with many avatars could be constructed. We envision a human actor recording his motions onto a specific avatar and then repeating the process to record motions for other avatars. In this method, a CG animation can be

constructed to express a narrative, bypassing many of the inherent complexities in constructing 3D animations.

Our collaborative team views the CAVE and motion capture equipment as a technology with the potential for use as a medium for creative expression. Our goal in this project is to study how people can use the technology at hand to create content - not to explicitly create new technology. In this pursuit we hope to design a system which uses existing technology (CAVE projection and motion capture) to create and modify content in a virtual world.

2 Participating students

Don't be fooled by the majors, we are all very different in our interests.

2.1 Jim McCann

Major CS/Math

Focus Graphics, media, art. He favors the immersive and novel over the typical mouse-keyboard-monitor paradigm. Jim is currently writing a metaball modeler for the CAVE (somewhat in the spirit of Cave Sculptor). He also happens to be the current president of Entity (the media art collective noted in the second paragraph). Despite this, he is not drunk with power.

2.2 Michael Samples

Major CS/Math

Focus Michael deeply regrets his decision to double-major in computer science and mathematics, wishing instead that he had double-majored in math and biology or chemistry. He is an active researcher in the field of Artificial Intelligence and Complex Systems, where he studies the development and application of "creative" computer algorithms in problem-solving. His work on solution acquisition diversity has been published in a peer-reviewed journal (IEEE). Currently, Michael is busy writing papers for too-soon publication deadlines. He believes that most of the world can be described mathematically and that computer science can be a tool to explore the world, but he holds that most of the interesting problems are not primarily in the mathematical domain. He also has an artistic side: as an amateur actor and musician he finds deep appreciation for the arts. Michael is inspired by the works of Tolkien and would love to see this project evolve to the point where he can construct animations of mythical proportions.

2.3 Ronit Slyper

Major CS/Math

Focus Ronit is in this group to provide for the gastric needs of the other members. In addition to her culinary superiority, she is also an excellent nuts-and-bolts computer-programmer and is interested in the technical aspects of the cave programming. Ronit was a writer before becoming a geek, and is looking forward to reconnecting with the arts in a whole new medium. She is also a green-belt who will use this new technology to choreograph amazing fight scenes without being injured by Mike like last time.

3 Advisor Bio

A Professor of Music and Dance in the UM School of Music, Christian Matjias is fully invested in furthering both the analysis and understanding of movement and sound. He brings to this collaboration a perspective which is both compositional and choreographic in the generation and execution of movement. A brief outline of his research and creative projects can be found at:
<http://www.music.umich.edu/faculty/matjias.christian.lasso>

4 Project Description

Using the CAVE's existing projection and motion capture equipment we will rapidly develop a system that maps a user's motions in the real world to an avatar's actions in the virtual world. This system will be capable of recording an avatar's actions as a function of time, and then displaying these recorded actions in subsequent exhibitions of the VR world. Our aim is to have a simple system functioning quickly – ideally within a few weeks of starting this project. We'd like to start exploring the creative side of the project as soon as possible.

As our system evolves, collaboration with those in the performing and media arts – theater, film, and dance, among others – will assist in shaping our conception of motion. As careful birth-mothers of a new form, we must allow its identity to emerge without undue presupposition. In striking a careful balance, we shall maintain a vision of the project apart from, yet informed by, present forms of motion expression.

In addition to the benefits we gain from collaboration, our project enables potential applications of the collaborative experience with those in the performing and media arts. We plan to save the environmental state data (including the avatar's actions) in a file which could be transferred to others via email for viewing/editing. Distant performers could enter a similarly-equipped CAVE, add an avatar, interact with the environment (perhaps recording a dance number or acting out a role in a play) and transfer the resulting scenario back to the original creator. He, in turn, could eventually produce a high-resolution version and publicly release an official version.

A portion of our time will be devoted to exploring the utilitarian uses of our system: education (perhaps those in film would benefit from the ability to use virtual cameras and re-shoot a scene repeatedly until they got it right) and preservation (our advisor is very interested in using motion capture to preserve and share choreographic phrases / gestures).

We shall finish the term with an exhibition of freshly created immersive motionworks, some informed by existing styles and others of a wholly original nature. During this exhibition, users will be presented with the opportunity to innovate upon the works presented as well as create their own.

5 Equipment and Resources

Our team would, of course, need access to time in the CAVE. In addition, if we used the old CAVE system, we'd need development time on IRIX. If we use the newer cave system (as we hope) we'll be able to develop on our own computers to a large degree.

We've already been in contact with Professor Beier and other members of the 3D Lab (since the success of our project greatly depends on their cooperation). They have agreed to provide technical support with the new CAVE system as their objectives coincide with ours.

6 Missing Pieces

We're wide open to collaboration in many areas – mostly we'd be interested in making connections with persons involved in theatre, films, dances, and other performance areas to see what sort of features they would like to add.

7 Contact Info

The primary contact will be email: **CaveCap@umich.edu**

Two of our members live at 1223 Hill St. (in Apt 7 and Apt 11 for Ronit and Jim antirespectively). Michael lives at 1224 #16 Washtenaw Ct. Professor Matjias's office is located in Burton Memorial Tower, Room 802.

8 Other Things

We heard about GROCS via the gigantic posters and announcements in ENG477 and (perhaps) EECS494.