A Sketch Interface to Support Storyboarding of Augmented Reality Experiences

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1 Background

AR is a user interaction paradigm where a person's perception of the world around them is directly augmented with graphics and sound, often using see-through/hear-through head-worn displays. AR systems (and their users) are, by definition, situated in the physical world being augmented.

Augmented reality (AR) applications pose unique challenges to the experience designer. The creation of 3D content for AR is time consuming. Working AR experiences are difficult to develop and require technology such as trackers and cameras. Therefore, traditionally, AR designers have been limited in the number of design iterations that can be explored.

To support rapid prototyping, design exploration, and testing of the "participant experience" early and often we have developed the *Designer's Augmented Reality Toolkit* (DART) [MacIntyre et al. 2004]. DART consists of additions to the Macromedia Director environment that support the prototyping of AR applications. DART that addresses the problems associated with *in situ* applications via components that allow for the capture and replay of camera and tracker data. These components allow a designer to easily record synchronized sensor, tracker (e.g. GPS, inertial sensing), and camera data needed for an application at the actual site. This recorded data can then be used in a DART application just as live data would be; allowing the designer to develop working AR applications without having to be located at the site and without all the technology present.

2 The Sketch Interface

Sketched content is commonly used in previsualization to create animatics (animated storyboards, used during film and television previsualization [Katz 1991]). Not only has sketched content been shown to be useful for rapid content creation, the use of sketches can enhance the design process by tacitly freeing people to suggest radical changes [Landay and Myers 2001] and convey more of the designer's intent than quickly created 3D content.

Therefore, as a complement to the capture/playback infrastructure we have created a DART component that allows for the creation and playback of sketch annotations overlaid on the scene. Inspired by Pixar's Review Sketch [Wolff 2004], this interface not only allows the AR designer to draw on top the real-world, but also to generate virtual 3D objects from the 2D sketches; resulting in AR storyboards that can be used for evaluation and collaboration.

In its initial use, a designer simply places an *Annotation* behavior onto any DART application. Then when the application is played the designer can at any time draw on the pre-recorded position-tracked video sequence. The drawings are linked with the video timestamps, such that replaying the application will display the appropriate markings at the correct time. Pausing at a particular frame allows the designer to erase or change the drawing.

The designer may elect to take the process further. At the press of a button, the designer can convert a 2D drawing into a 3D *SketchActor*. This *SketchActor* is a DART component; an animated billboard that lies in the 3D world. Once placed, it will move with the position tracked camera instead of overlaid on top of the video. Since the generation of the overlay drawings and sketch actors modifies the DART score, the resulting sketch actor becomes a persistent part of the application. Once the designer saves the movie, the new objects are saved as well. Currently, positioning the *SketchActor* in the 3D world is accomplished by specifying a distance in front of the camera. The *SketchActor* is created at the camera position + certain distance in the 3D world. Although simple, it can be difficult to estimate the correct distance relative to other objects in the video images.

3 Future Work

While we have implemented a simple approach to the 2D to 3D transform we plan to implement more sophisticated algorithms in the future, based on feedback from designers. For example a more complex approach might require the designer to indicate the desired sketch actor location in two dissimilar video frames. The 3D position is triangulated from the camera position and ray-cast indicated position. The resulting location anchors the *SketchActor* in the 3D world. We would also like to explore the transformation of 2D sketches into true 3D objects, utilizing algorithms such as Igarashi et al.'s Teddy system [1999].

4 References

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