AViRT

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1. Background

We are a group of Purdue undergraduate students in the field of computer graphics technology. We have been tasked by George Takahashi of the Envision Center to use the emerging technology, Project Tango. We plan to use the depth sensing technology on the Project Tango to create an application that composites a real object into a 3D virtual environment in real time.

2. Proposal:

2.1 Problem Statement

***Indie directors are unable to pre-visualize their virtual set without the funds to pay for a high-fidelity 3D visualization system.

2.2 Research Questions

***Would indie filmmakers use an affordable and mobile real-time pre-visualization application to enhance their film production?

How would an affordable and mobile real-time pre-visualization application enhance the film productions of an indie director?

2.3 Vision Statement

AViRT plans to build an Android application that performs real time visualization through the integration of a 3D virtual environment for indie filmmakers.

2.4 Elevator Pitch

The new wave of filmmaking consists of using virtual environments and visual effects. However, these kind of effects are only able to be implemented in high budget production teams due to the high cost of visualizing these virtual environments while on the set. We propose to create a low cost alternative to the previsualization software used in industry today by using Google's Project Tango and its depth sensing hardware. This application we are developing would perform augmented virtuality by placing a real object into a virtual environment and creating this visualization in real time. Our end goal is to make this process usable at the indie filmmaker level of production by creating an android application that utilizes this innovative technology.

3. Significance:

3.1 General

AVIRT would have impact over those producers with a more tight budget. It would allow them to still pre-visualize how the previously modeled 3D environment would fit into scene without having to spend a lot of time or money setting it up.

3.2 Addressing the Knowledge Gap

We hope to be able to determine an aesthetically pleasing polygon and resolution limit usable for this device. There is limited amount of processing power that will be used for high-quality graphics, and we want to find what that limit is without sacrificing functionality of the application.

3.3 Scope

AVIRT has a projection towards the future. We speculate the technology of phone camera’s will incorporate Tango’s infrared sensors, which means that all the cameras in phones will detect depth. Based on that, AVIRT would be able to be downloaded onto any Android device with these sensors.

4. Emerging Technology:

4.1 Technology

AViRT will initially be developed on Google's Project Tango, a tablet with the technology to navigate physical space along with its user through the specialized sensors. With these sensors, the Tango creates a point cloud of the objects and obstacles in front of it. This helps the Tango perceive depth and determine its own physical location in relation to its surroundings. The significance of this technology is that users can now utilize advanced tracking methods with much less external hardware and tracking markers which ultimately saves on setup and teardown time, hardware costs, and allows smaller sets to use parallel technologies.

The specific application of AViRT through the Tango is considered augmented virtuality, which falls on the reality-virtuality spectrum. To better understand augmented virtuality, consider the definitions of two of the most commonly used applications along the reality-virtuality spectrum: augmented reality and virtual reality. Augmented reality is the use of virtual, computer-generated assets in a physical environment usually with the help of a camera. Virtual reality is the simulated and immersive experience of a user putting their own physical presence into a virtual environment usually through hardware tracks certain movements and actions. Augmented virtuality falls in the middle of these common uses and is considered the consolidation of physical objects and beings into a virtual environment; opposite of the use of augmented reality.

4.2 Process

There are two types of informational input for motion tracking: outside-in, where all the physical information is given to the device by physical markers and external sensors, and inside-out, where all of the physical information is measured by the device itself with internal sensors. The Tango utilizes inside-out informational input for motion tracking using internal gyroscopes and infrared and depth processing sensors.

Since the Tango handles all the motion tracking already, bringing a physical object into a virtual space becomes a two step process. First, we load a virtual environment into the Tango through the Unity game engine. The Tango will view the virtual space through a virtual camera, much like a video game. At this phase, the user may walk around in physical space in order to move the virtual camera. While it is common for a virtual camera to be manipulated through a digital or analog controller, being able to do so with 1:1 accuracy with physical movement opens up much more practical uses. The next step in the process of bringing a physical object into the virtual space is by utilizing a green screen. The green screen allows users to take physical objects, chromakey out their physical environment, and automatically place them into the virtual environment as another layer. With the addition of depth perception and motion tracking, the Tango allows users to view physical objects and beings in relation to a virtual environment in real time. This is augmented virtuality in real time.

5. Research Plan:

5.1 Problem Statement

Indie directors are unable to visualize what they are filming as part of their virtual set without paying for a high fidelity 3D visualization software.

5.2 Hypothesis

If the Tango is able to process **augmented virtuality in real time**,
Then this application will be a **valuable asset** and **low-cost alternative** to **pre-visualization** of augmented virtuality for the film industry.

5.3 Research Questions

Is the Tango able the perform the computational processes required for real-time rendering visualization?

Would indie filmmakers use this as a tool to enhance their film productions?

5.4 Methodology

We plan to take qualitative measures in which we will utilize observation in our methods of study. We will record subjects with a video camera and take notes on their interactions with our prototype application in a green screen room environment. In our experiments, our subjects will perform a contextual inquiry of our application. They will all be given the same task of visualizing the subject in the 3D environment. We will provide the subject with one experimenter to be used as the actor and a second experimenter will provide assistance to the subject. The other two experimenters will fill the role of observers.

We will find our participants through the film and video studies department email list service. We plan to have 5-10 subjects perform the experiment.

5.5 Analysis

Our analytical data collection method will be contextual inquiries.We will craft a few simple virtual production tasks, then a small sample of film and video studies students will complete these tasks. During this time we will observe and ask them about their perspectives toward augmented/virtual realities and their opinions of our application. We want to find what directors really find important when it comes to set design, using cameras, and filming actors. We would also like to find out how directors feel about using virtual reality in the recording process, and what they need in an application to perform this process.

In addition to this, we will use our observational findings to find obvious errors within the application and address them as they are determined. Seeing how directors and filmmakers use cameras will be important in finding out how to make our application more usable.

6. Conclusion:

We are developing software for Google’s Project Tango and other depth sensing devices to enable augmented virtuality for the purpose of pre-visualization in the virtual production process. We want to create an application that will be ready to be implemented when these sensors become standard in the next generation of smartphone. In this, we want to enable indie producers to use pre-visualization for virtual production