# Virtual Reality Interaction Using Mobile Devices

Sahar A. Aseeri

Computer Science Department, KAUST

Daniel Acevedo-Feliz

Visualization Core Laboratory, KAUST

Jurgen Schulze

Visualization Group, CalIT2, UCSD

**ABSTRACT**

In this work we aim to implement and evaluate alternative approaches for interacting with virtual environments on mobile devices for navigation, object selection and manipulation. Interaction with objects in virtual worlds using traditional input such as current state-of-the-art devices is often difficult and could diminish the immersion and sense of presence when it comes to 3D virtual environment tasks. We have developed new methods to perform different kinds of interactions using a mobile device (e.g. a smartphone) both as input device, performing selection and manipulation of objects, and as output device, utilizing the screen as an extra view (virtual camera or information display). Our hypothesis is that interaction via mobile devices facilitates simple tasks like the ones described within immersive virtual reality systems. We present here our initial implementation and result.

**Keywords**: Mobile devices, Interaction, Virtual reality, Tracking system.

## 1   INTRODUCTION

Nowadays, virtual reality is considered as one of the most important research topics in computer graphic field [1]. Virtual reality technology is using computer graphics to create a realistic world, which responds to user inputs. In other words, we can define virtual reality as an experience in which the user is effectively immersed in a responsive virtual world, which implies user feeling as part of the action. Consequently, interaction is described as one of the virtual reality key features.

Moreover, interaction in virtual reality enables the user to move inside the virtual world as well as to interact with the objects in the virtual world. The level of interactivity of user controls of virtual objects with the current state-of-the-art devices such as mouse, keyboard, and joystick/wand varies from one device to another.

Immersion and presence are two important things that should be considered to measure interactivity within the virtual environment. In this work we use mobile devices as an interaction device and we study and present different approaches for interacting with virtual environments on mobile devices for object selection and camera manipulation.

Our system consists of virtual environment and mobile device. Both are based on OpenSceneGraph: we use CalVR [5] for our virtual environment and OpenSceneGraph running natively on the android. This creates two similar scenes one on the CalVR system and the other on the android device. To move these two scenes simultaneously we need to connect the CalVR system and Android device via TCP/IP protocol. This delivers a single synchronized scene to the user and enables him to interact with a single environment. All this happens by sending and receiving the

tracking system transformation data that moves the virtual camera on the Android device. In addition to that we can send the object transformation to change the object position in the virtual environment.

Our research consists of two interactions; camera manipulation and object selection. In manipulation we can move the mobile device to change the virtual camera position in the virtual environment using tracking system, see Figure 1. To select the object we change the object position in the virtual environment by dragging and dropping it from one place to another using the mobile device, see Figure 2.
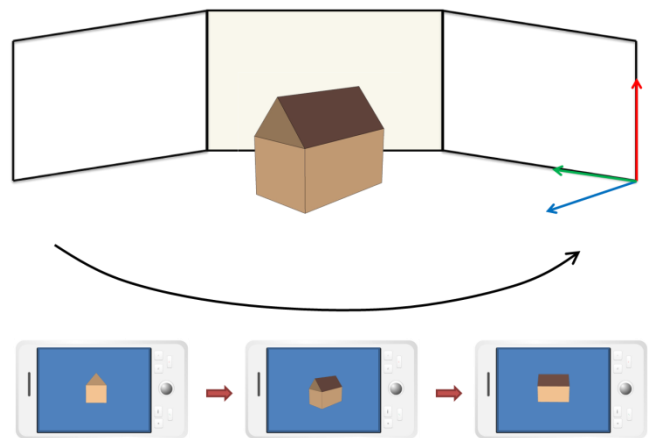


Figure [1]: Camera Manipulation. Viewing the object from different orientations using the mobile device
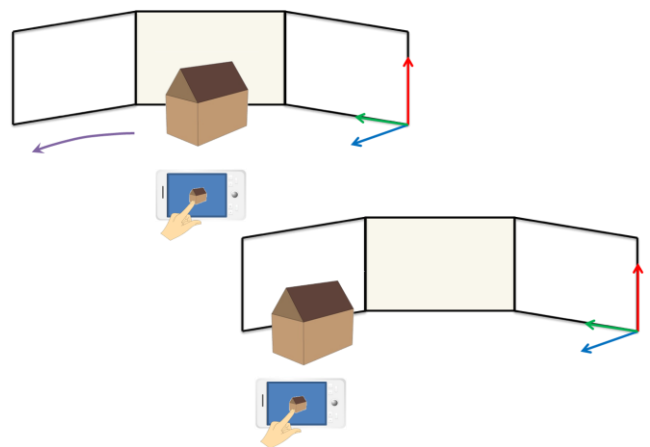


Figure [2]: Object selection. By the mobile touch screen we can drag and drop the object into a new place

* sahar.aseeri@kaust.edu.sa, daniel.acevedo@kaust.edu.sa, jschulze@ucsd.edu

## 2 RELATED WORK

The year of 1993 witnessed the first investigation of interaction possibilities with smart hand-held devices by Fitzmaurice et al. [2]. Subsequently, Watsen et al. [3] used a Palm Pilot for 2D interaction tasks within a 3D virtual environment. These interaction tasks consist of menu items, clicking buttons, and other graphical user interface. They used interfaces that are consistent with these tasks. But, in our case we utilize the mobile device both as a display of the virtual scene and as an interaction device.

This increase in availability of smartphones and variety of mobile interaction enabled vast possibilities of interacting techniques such as multi-touch, sensor-based interactions and camera. Augmented reality systems combine the real and virtual environment using interaction techniques via smartphones. Henrysson et al. [4] considered the implementation of an augmented reality application into smartphones. In this study phones were used to serve augmented reality view from one side and as a selection tool for object manipulation from the other side. Also, the study describes different methods for object manipulation. The most similar method to ours is selecting and manipulating the virtual objects in the virtual environment not in the real environment by using virtual camera.

## 3 METHODOLOGY

The application in this paper was developed using CalVR. CalVR is a virtual reality framework, based on OpenSceneGraph, which was developed in the Immersive Visualization Laboratory at Calit2 [5]. Our main mode of operation is to send and receive data transformations from CalVR to the android devices and vice versa.

Here are the main steps of our system:

- Run the CalVR plug-in on CalVR system as server.
- Run the OpenSceneGraph on the Android device as client by using Android_NDK.
- Using TCP/IP protocol to connect between the server side and client side to send the transformation data between server and client.
- We have two scenes one on the CalVR system and the other on the android device both are based on OpenSceneGraph. Any changes in each of the scenes we can see it in on the screen as single scene.
- Camera manipulation interaction is implemented by moving mobile device in order to change the virtual camera position in the virtual environment using tracking system. When we change the tracking system position the data transformations send over the socket from server to client to change the camera position.
- In object selection interaction we change the object position in virtual environment using the mobile touch screen by dragging and dropping the object from one place to another.

## 4 CONCLUSION

In this research we develop a CalVR plug-in that has been used with many applications to interact with virtual environment. We aim to investigate the use of mobile devices in terms of interaction

within the virtual environment. This provides many possibilities for 3D graphics and virtual world visualizations because it offers independence from traditional inputs while moving and interacting with 3D space objects. Using our idea to describe alternative approaches for interacting with virtual environments on mobile devices for navigation, object selection and manipulation gives us lots of further explorations in the concepts of 3D visualization on mobiles. Figure 3 displays some pictures of the project.

Future research directions include user studies and evaluation to present different approaches for interacting with virtual environment on mobile devices and to compare different kinds of interaction. Moreover, we will add interaction to select objects to receive meta-data about them. And we will add more techniques to navigate, manipulate and select objects in the virtual environments.
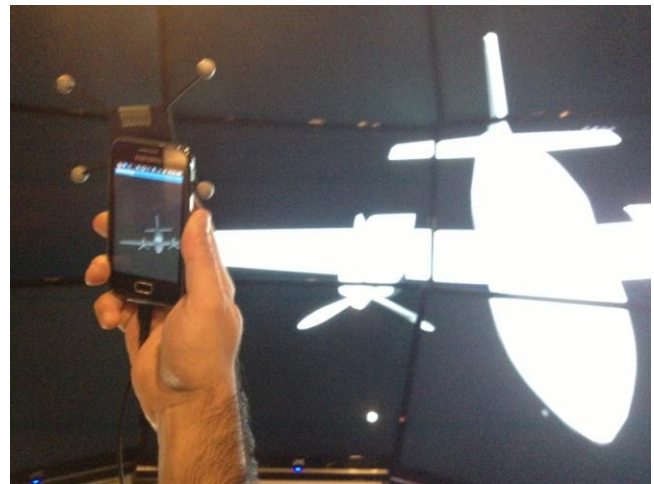


Figure [3]: Scenes from the project

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