Collaborative manipulation of 3D virtual objects in augmented reality scenarios using mobile devices

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1 INTRODUCTION

This project aims to create an application that allows multiple users to connect to a server and experience and manipulate an Augmented Reality Environment at the same time.

2 LITERATURE SURVEY

We primarily follow the work of Grandi, Debarba, et al. [1] They proposed an environment where multiple users can connect to a server and simultaneously manipulate 3D objects, including the same object, provide they are manipulating a different degree of freedom. Users can use touch to select, scale, translate and rotate a 3D object. The users can also group objects together and transform them simultaneously. This enables users to work together and perform tasks such as arranging a living room or scenery.

Algorithm

We use Unity 3D to create the application, and Vuforia to generate the markers. Given a marker which can spawn an object, a user can use touch on the mobile phone to do the following -

(1) Select an item. This is done with raycasting. When the user touches the screen at any position, we do a raycast and try and detect whether the ray hits any collider object. If the ray hits a collider object, we mark the object as currently selected. If the user casts a ray towards the object once again, the object will be deselected.
(2) Rotate an object. An object that has been selected can be rotated by choosing the rotate option at the bottom of the screen. Once an object has been selected and the rotate button pressed, the user can use one finger to change the rotation of the object.
(3) Translate an object. An object that has been selected can be translated by choosing the translate option at the bottom of the screen. The user can use one finger to translate along the x axis and two fingers to translate along the z axis.
(4) Scale an object. An object that has been selected can be scaled by choosing the scale option at the bottom of the screen. The user must use two fingers in a pinching motion to scale the object/
(5) Move along with Camera. An object that has been selected can be set to move along with the camera by choosing the hold option present at the bottom of the screen. Once this has been selected, the user must simply move the camera, and the object will move along with the camera, provided the marker is still in view.
(6) The Synchronisation of the users is achieved via host-client architecture in which one device will be acting as server and others will connect to it. This is achieved via NetworkManager component where player prefab is set to be the object we are interested in.
(7) It is made sure that only the Host(one who selected the object to make transformations) is able to change the transformation of the interested object at that degree of freedom and other clients are able to view the changes.

3 NEXT SET OF MILESTONES

(1) Grouping, which will be achieved by storing all the objects hit by the raycast in an array, and then updating position based on input to all objects in the array.
(2) One user will be able to see a ray from another user's camera to the object that they are manipulating. This is done to allow for ease of collaboration between the users.

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(3) Combining the network and movement components. We've currently implemented these components separately and they work as expected.

Figure 1: An example of how the application would look. There are four buttons at the bottom corresponding to holding, scaling, rotating and translating the object. In this example, the 100 rupee note is the marker.

4 LINKS

Video with original implementation of paper
Github Link

REFERENCES

[1] JerÃťnimo Grandi, Iago Berndt, Henrique Debarba, Luciana Nedel, and Anderson Maciel. Collaborative manipulation of 3d virtual objects in augmented reality scenarios using mobile devices. pages 264–265, 01 2017.