

# SculptAR: An Augmented Reality Interaction System

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## ABSTRACT

In this work, a 3D mobile interface to create sculptures in an augmented reality environment tracked by AR markers is presented. A raycasting technique was used to interact with the objects in the scene, as well as 2D and 3D interfaces to manipulate and modify the objects. The users can move, delete, paint and duplicate virtual objects using 6 DOFs techniques.

**Keywords:** 3D Interaction, Augmented Reality, Mobile

**Index Terms:** [Human computer interaction (HCI)]: Interaction paradigms—Mixed/augmented reality; [Interaction techniques]: Gestural Input; Mobile computing

## 1 INTRODUCTION

SculptAR is a system created for the interaction of users and virtual objects to build art sculptures using augmented reality. It can be used with any device equipped with a camera to display a virtual environment on its screen, where the user can interact by tapping on the display. SculptAR bases itself on AR markers in order to provide a physical reference of the real space where the virtual environment is going to be created. There are three different sets of markers that define which type of sculpture can be created: the Particle System mode, composed of smoke, spark, spray and flare particles, which allows parameter modifications; a Palm Tree mode, with LEGO-like blocks to build a palm tree; and the Fried Sculpture mode to create a Fried sculpture.

The interface is designed to be simple and consistent in a way that there is a general flow of actions: the user selects a tool, aims at an object with a pointer and taps the screen to perform the operation.

The remaining of this paper is organized as follows: in section 2, some related work that somehow contributed to the development of this work is presented; in section 3, each part of the interface is explained; in section 4, each operation is explained in detail; and in section 5 the conclusions and future work are presented.

## 2 RELATED WORK

On Henrysson's et al [2] and [3] works, some techniques about the different implementations for rotation and positioning operations are described. As for positioning, the Tangible technique is described. On the Tangible technique, the object is fixed relative to the device and moves when the user moves the device. When released, the object position is set to the final translated position while its orientation is reset to its original orientation. As for rotation, the Keypad/Joypad and ArcBall techniques are described. On the Keypad/Joypad technique, a keypad is implemented and the object rotates about its own axis according to joypad and keypad input. Left

and right joypad input causes rotation left and right about the vertical axis, etc. On the ArcBall technique, when the device moves, the relative motion of the device is used as input into the ArcBall technique to rotate the currently selected object.

The Tangible technique is more intuitive and faster, since the object is attached to the device and moves with it. However, the user often has to move himself and the phone to achieve the position and orientation he wants, which ends up being more time consuming than using the ArcBall or Keypad/Joypad techniques. By being faster, it also loses precision, since a small movement on the device can move the object away from where the user wanted.

Given that the Keypad/Joypad techniques is not intuitive as the Tangible one, we decided to combine both. The identification of swipe motions on the screen serves as a keypad for the Keypad/Joypad technique. By combining both techniques, the user is allowed to move and rotate the object by a small distance using the Tangible technique and to perform these operations on wide angles by swiping across the screen to rotate the object around its own axes.

## 3 USER INTERFACE

According to Bowman [1], it is a natural technique to embed a 2D UI in a 3D world, which encouraged us to make the tool selection in our user interface as 2D buttons. AR markers are used to create a reference for the objects in the virtual world inside the physical space. These markers are captured by the device's camera and processed by the ARToolkit's SDK [4]. Its location serves as the origin for all the objects and operations.

On the Palm Tree mode (Figure 1), the objects are LEGO-like pieces that can be put together to rebuild a palm tree. To aid the user, this mode was designed with a function that automatically connects the pieces when they are near each other, as LEGO pieces would.

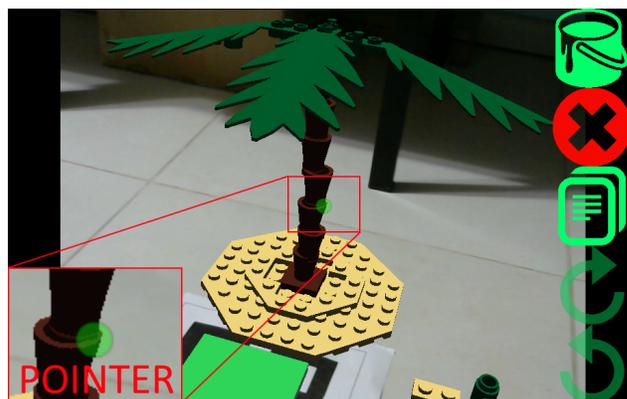


Figure 1: The Palm Tree mode

There is the Particle System mode (Figure 2), which has smoke, spark, spray and flare particles. To create art works, the objects can be modified by rotating, moving, copying and painting the particles as the user pleases. The objects can also have its radius of effect modified, as well as the gravity over each object. These properties

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are able to be modified when two vertical sliders appear when the user grabs a particle.

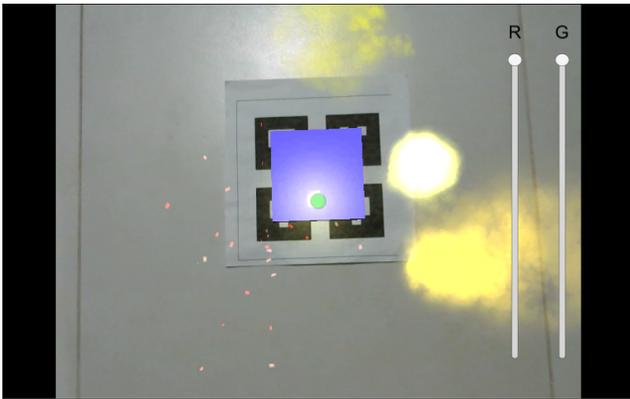


Figure 2: The Particle System mode. The R and G sliders referring to the radius and gravity of the particle, respectively

There is also the Fried Sculpture mode (Figure 3), where the user should stack and resize round structures to create a Fried sculpture.

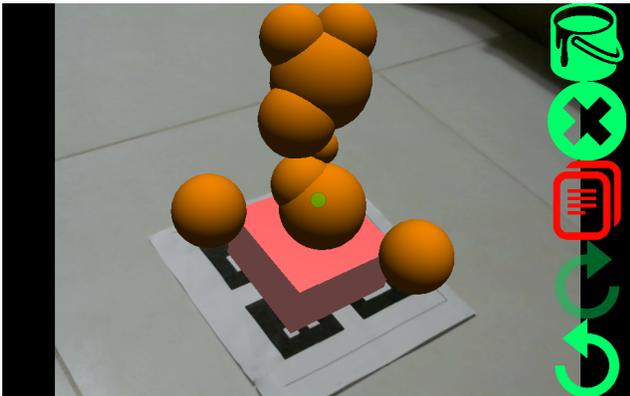


Figure 3: The Fried Sculpture mode

#### 4 APPLYING THE OPERATIONS

The interface has tools, from which the user can perform operations. The tool activation is based on button-driven interactions, informing the user about which tools are activated at each time and allowing the deactivation of them. There are 8 major operations that can be performed by the user: painting, removing, copying, undoing redoing, rotating, scaling and moving.

The user utilizes a circle in the middle of the screen as a pointer to select an object and target an operation. It changes its color from red to green when an object is interactable and can also change its color when painting.

To move an object, the user must aim the pointer to an interactable object and hold his finger on the display. When moving, the spatial motion of the device is used to change the position of the virtual object. To scale an object, the user must hold an object and perform pinch gestures to change its size. To rotate an object, the user can do it while moving or by performing swipe gestures on the screen while holding an object. These operations are always active, allowing the user to perform them at any time, even when another operation is active.

As for painting, copying, removing, undoing and redoing, there are buttons on the interface to activate these operations. The button

turns red when a tool is selected.

When painting, a color palette composed of seven buckets with different colors appears in the environment as soon as the tool is activated (Figure 4).

In order to paint an object, the user can immerse it in a bucket to paint it or fill the crosshair with a color by touching the display when pointing at bucket. This second method allows the user to sequentially paint multiple objects by aiming and tapping the screen.

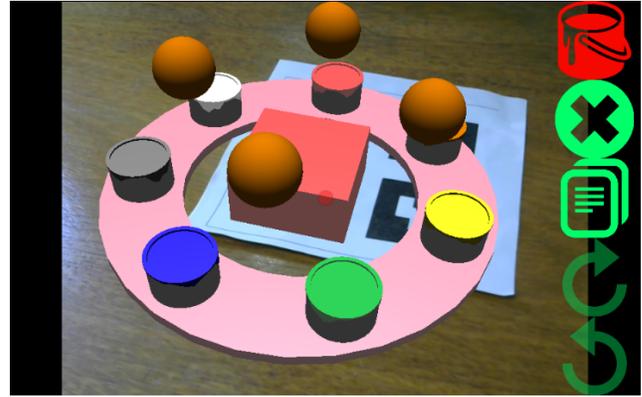


Figure 4: The color palette

Copying and removing work by the same ways, i.e., the user activates the tool, aims at an object and touches the screen to copy or remove an object. As for undoing and redoing operations, the mere activation of the tool already performs the action.

#### 5 CONCLUSION AND FUTURE WORK

In this paper we presented an augmented reality environment where users can interact with different type of objects to complete different art-related tasks, such as building a Fried sculpture or a palm tree made of LEGO-like structures. We focused on making its interface as clear and intuitive as possible by performing predictable results from every tool.

Besides a single user interaction, the system can be extended by implementing a multiplayer system.

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