3DColAR: Exploring 3D Color Selection and Surface Painting for Head Worn Augmented Reality using Hand Gestures

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3DColAR: Exploring 3D Color Selection and Surface Painting for Head Worn Augmented Reality using Hand Gestures

Louise M. Lawrence* University of South Australia
Gun Lee† University of South Australia
Mark Billinghurst‡ University of South Australia
Damien Rompapas§ Brewed Engagement Extended Reality Labs

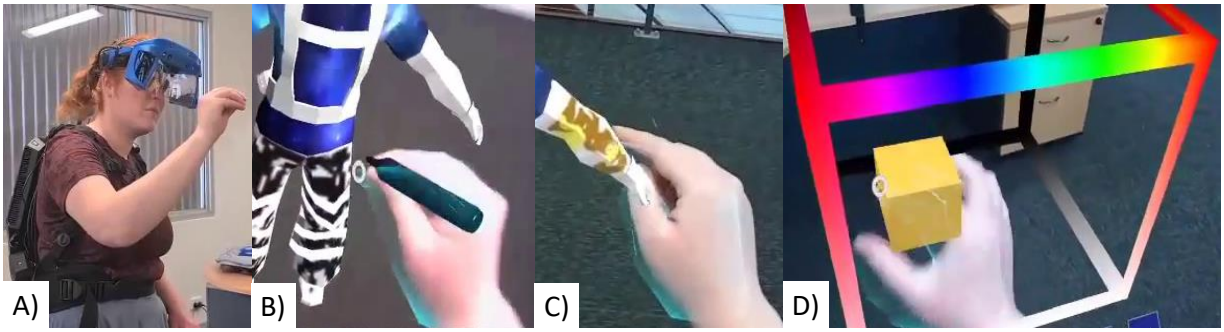

Figure 1: We present 3DColAR, an art application that aims to explore painting 3D models and color selection approaches. A) A user wearing an AR HMD, B) can use either a virtual pen or C) their fingertip. D) We also expand typical 2D color picker interfaces, allowing for 3D space representation of color spaces.

ABSTRACT

Color selection and surface painting has been largely unexplored in head-worn Augmented Reality (AR) using hand gestures. In this demonstration we present 3DColAR: A system that implements several 2D and 3D techniques for color selection. We also implement two key approaches for painting a virtual 3D model using mid-air hand gestures. This includes a virtual pen which the user can grasp using their hand, akin to a real pen and the use of the user's fingertip directly on the virtual 3D model. We hope to explore how these various techniques effect user's efficiency and accuracy when performing surface painting of virtual objects using mid-air hand gestures via. several user studies.

Keywords: Augmented Reality, Human Computer Interaction

1 INTRODUCTION

Currently, the standard practice for developing color selection tools for Augmented Reality (AR) and Virtual Reality (VR) application is to use traditional color menus, such as sets of sliders, gradients, text boxes and presets with color samples. The traditional color selection tools can be described as two dimensional (2D), typically gradients, or one dimensional (1D), such as sliders. However, color is best represented and understood in three dimensions (3D). AR and VR are optimal mediums for 3D interactions. Potentially, 3D color selection tools may prove to be optimal in AR and VR applications, and superior to traditional color selection tools.

3DColAR is a prototype AR art tool (Fig.1), using a head mounted display (HMD), similar to VR applications such as Tilt Brush[1] and Gravity Sketch[2]. In addition to traditional color selection tools, our system includes new 3D color selection tools. It was initially built to be used as a test platform for exploring and evaluating 3D color selection tools in AR. However, it has been modified as a simple AR art tool for coloring 3D models that also demonstrates the 3D color selection tools.

Immersive art applications using 3D color selection tools have been investigated in VR but rarely in AR. An early desktop VR and AR system, VLego [7] and VlegoII [6], featured an opaque 3D color selection tool in the form of a virtual sphere. 3D color menus have been implemented for desktop systems, with the purpose of exploring different color spaces [10], or comparing the mouse keyboard combo and game controllers [8]. Some VR applications contain prototypes of 3D color selection tools, such as an extended pie menu [3], a wireframe bi-cone shaped 3D color selection tool in the early iterations of CavePainting [4], and shaded 3D color selection tools [5].

Unlike VR systems that frequently rely on controllers, AR systems are often dependent on hand gestures for interacting with the system. A rare example of using hand gestures to select color is LeapMotion's demo which included a wireframe cube as a color selection tool [9] as described in a blog post outlining their features. While this was on a desktop VR, our research focuses on exploring using hand gestures to interact with the 3D color selection tools in wearable AR systems.

2 SYSTEM SETUP

We built our system using the Project Esky framework [2]. The software framework includes Microsoft's Mixed Reality Toolkit (MRTK)[3], as well as software connectors for the Ultraleap hand tracking hardware. We use a Project NorthStar AR HMD[4], and alternatively have also deployed on a Project Ariel [1] AR HMD, to

*e-mail: louise.lawrence@mymail.unisa.edu.au
†e-mail: gun.lee@unisa.edu.au
‡e-mail: mark.billinghurst@unisa.edu.au
§e-mail: dr-damo@beer-labs.net

[1] https://www.tiltbrush.com/

[2] https://www.gravitysketch.com/

[3] https://docs.microsoft.com/en-us/windows/mixed-reality/mrtk-unity/

[4] https://developer.leapmotion.com/northstar

show the versatility of the software.

We intend to demonstrate 3DColAR using the Project Ariel HMD. These HMDs have a diagonal field-of-view of ∼100 degrees. They use the Intel RealSense T261[5] module to allow six-degrees-of-freedom tracking. For input, we use the UltraLeap[6] hand tracking sensors. We develop using a HP VR Z G2 backpack PC with the following specifications: Intel Core i7-8850H 32Gb RAM and an NVIDIA 2080RTX graphics chipset.

3 The 3DColAR system

The prototype system is a simple AR art application. It has 3D models that can be painted, along with the virtual color selection tools. The system has six color selection tools, each accessible by different buttons. A seventh button closes all the menus. The six color menus are a Red-Green-Blue (RGB) slider set, a Hue-Saturation-Value (HSV) slider set, a greyscale gradient with a Hue slider, a color gradient with a Value slider, an RGB cube and an HSV cube (Fig.2). The first four color selection tools are traditional 1D or 2D, while the last two are our new novel 3D color selection tools.

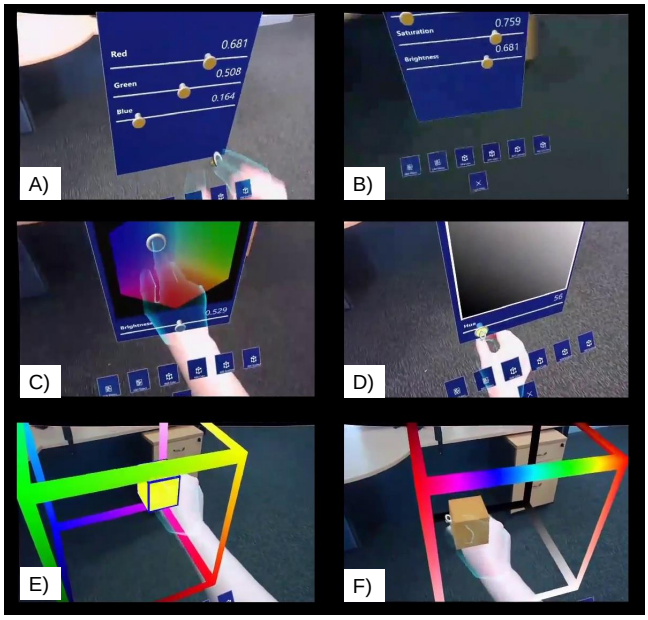

Figure 2: We represent color selection interfaces as A) RGB Sliders, B) HSV sliders, C) RGB Gradients, D) HSV Gradients (Hue as slider), E) RGB Cube wireframe and F) HSV Cube wireframe.

The traditional menus in our system are adapted from color selection tools from an experimental branch of the MRTK. The menus, modified from the MRTK, are the RGB slider set, the HSV slider set, and the greyscale gradient combined with a Hue slider. These are three of the four traditional color selection tools. Our fourth traditional color selection tool is a color gradient combined with a Value slider. It was adapted from the greyscale gradient color selection tool. The original greyscale selection tool in the MRTK did not have a slider. Our 3D color selection tools are based on the LeapMotion demo, which was a wireframe cube. We have two wireframe cubic color selection tools, an RGB cube and an HSV cube. In addition to our color selection tools, we have two options for painting our 3D models. First, holding a virtual pen or marker which can be used to color the 3D models. The other option is to use the finger tip to paint the 3D models.

[5] https://www.intelrealsense.com/tracking-camera-t261/
[6] https://www.ultraleap.com/tracking/

4 Demonstration

We will demonstrate our system by loading and coloring a simple AR scene. The scene has a selection of 3D models, a virtual pen, and the menu to load the color selection tools. Since the conference will be held virtually, we will live stream a combined view to remote viewers. The first view will show a first person mixed reality perspective, where virtual content is combined with an RGB camera stream (like the teaser video). A second view will show a third person perspective focused on the demonstrator. Viewers can ask questions of the live demonstrator, make suggestions, and enjoy the artistic presentation of the live painting.

5 Conclusions and Future Work

Our system presents interesting combinations of 2D and 3D user interfaces for color selection tools, as well as approaches for 3D model surface painting in AR using mid-air hand gestures. Future work will include user studies to evaluate the impact on user efficiency and accuracy using the the 3D color selection tools and surface painting interactions. Part of this exploration includes the use of 3D color selection tools which encompass different 3D shapes (cones, bi-cones), various visual renditions (wireframe, shaded planes) and presentation modes (discrete, continuous). User studies will also evaluate the mid-air interactions for painting 3D models.

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