Freehand: Unencumbered Drawing in 3D Space

CPSC 490 Proposal
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Project Overview

The appeal of virtual reality (VR) technology is undeniable. The ability to don a headset, “go nowhere, and be transported to anywhere”\(^1\) would seem to be the ultimate form of escapism. However, despite its futuristic allure, in recent years it has been VR’s close relation, augmented reality (AR), that has captured more people’s enthusiasm and attention. One reason for this is the many and diverse applications for augmented reality. From the intensely practical, like augmented reality arrows that help you navigate on Google Maps, to the entertaining, like Apple’s Animoji, to the creative, like Zach Lieberman’s experimentation with AR drawing,\(^2\) the use cases for AR are compelling to individual consumers and corporations alike.

For this project, I am interested in exploring the creative applications of augmented reality. In particular, I am drawing inspiration from Gravity Sketch\(^3\) and Google’s Tilt Brush.\(^4\) Although these tools are designed for virtual reality use, their essential purpose, to foster creativity in real time, aligns with what I would like to achieve this semester. The goal of this project will be to create a system that will allow users to create 3D drawings in space and view them through an augmented reality mobile app. The exact specifications for the system are yet to be determined. Potential ideas could be a “pen” equipped with sensors that track the position of a user’s hand in space, or a multi-camera motion capture system to track freehand drawings.

Project Description

This project will be broken down into two components: an augmented reality mobile app and a motion capture system. One benefit of the increasing interest in augmented reality is the strong

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1. [https://www.theverge.com/a/virtual-reality/intro](https://www.theverge.com/a/virtual-reality/intro)
2. Zach Lieberman, Instagram post on 9/16/19 (https://www.instagram.com/p/B2flW7Wjg4m/)
3. [https://www.gravitysketch.com/](https://www.gravitysketch.com/)
4. [https://www.tiltbrush.com/](https://www.tiltbrush.com/)
developer support across several augmented reality software development kits. The many SDKs available mean that there are many options for the exact configuration of the system, which will need to be finalized in conjunction with my project advisor:

1. Mobile app
   a. Augmented Reality SDKs: Vuforia, Kudan AR, Wikitude (free student SDK), and Google ARCore, Apple ARKit
   b. Operating systems: iOS, Android
   c. Development language(s): React, Swift, Kotlin, Unity

2. Motion capture system
   a. Sensor-equipped “pen”
   b. Multiple camera motion tracking

Goals

1. Primary goal: deliver a novel and usable final product, as specified above
2. Secondary goal: learning, with four specific areas of interest: mobile app development, software engineering best practices, working with Augmented Reality, working with APIs
3. Stretch goals: create a portfolio website on which to host the project details

Deliverables

The following items should be submitted by the CPSC 490 due date (last day of reading period).

1. Wireframes / UI Mockups
2. Hardware specification, for reproducibility
3. Final project code, on Github
4. MVP (minimum viable product) according to project goals negotiated with advisor
5. Detailed documentation of learnings and process
6. Final project report with results, feedback, and next steps

Proposed Implementation Timeline (last day of reading period: December 12)

Week of 9/23:
- Choose operating system and augmented reality SDK for app development
- Finalize specifications for motion capture system
- Create bill of materials and put in order(s) for necessary parts

Week of 9/30:
- Build V1 of motion tracking system
- Create mockup or prototype of mobile app experience
- Learn basics of chosen app development language

Week of 10/7:
- Test V1 of motion tracking system
- Start work on mobile app that can be used for existing augmented reality objects

Week of 10/14 (Fall Break):
- Iterate on motion tracking system
- Continue mobile app work

Week of 10/21:
- Create V2 of motion capture system, test
- Continue mobile app work

Week of 10/28:
- Start work on code to connect motion capture system to mobile app
- Iterate on motion capture system
- Continue mobile app work

Weeks 11/4-11/18:
- Repeat work above

Week of 11/25 (Thanksgiving Break):
- Goal at this point: all core app functionality built out
- Reevaluate and set timeline for last two weeks

Week of 12/2:
- Start on project report
- Start on documentation: code comments and diagrams for future reproducibility
- Attempt stretch goal if possible

Week of 12/9:
- Finalize project report and documentation

Additional References & Resources:

- AR Basics
- 3D Drawing with Augmented Reality
- Bare-Handed 3D Drawing in Augmented Reality
- SLAM: Simultaneous Localization and Mapping