

Introduction

Currently, virtual reality lacks products which allow users to collaborate with one another effectively. Namely, there is no dominant text input tool for users that would give the user a fully immersed feeling. Mimicking the feeling of writing on a notepad or a white board is impossible, which can make someone in a VR environment uncomfortable and interfere with their work. We were tasked with finding a way to bridge that gap.

Member Roles

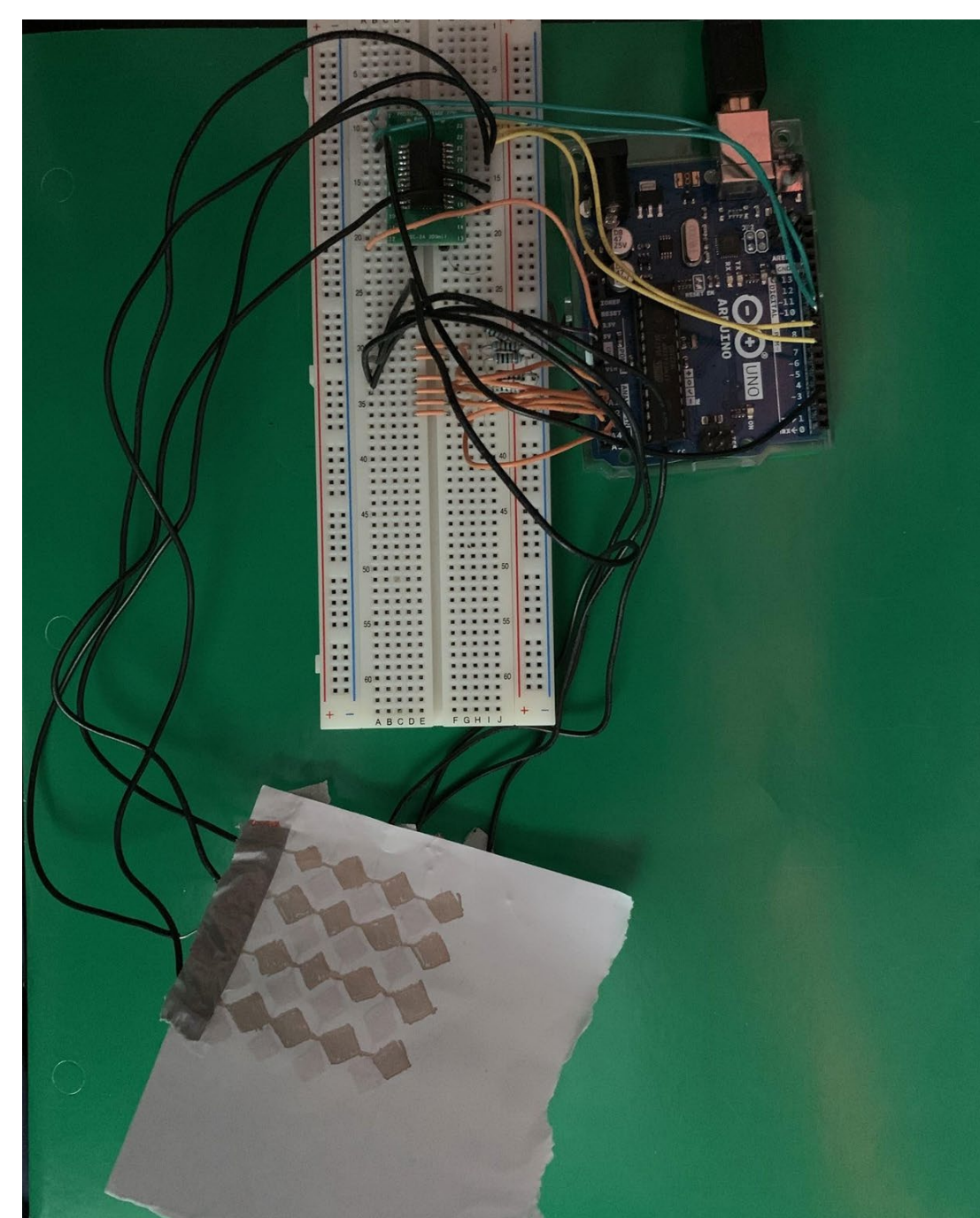
1. **Nahum Tilahun**
 - a. Project Manager, Hardware Engineer
2. **Siddharth Jadav**
 - a. Software Engineer, Faculty Contact
3. **Shih-Hao Yeh**
 - a. Software Engineer, Part Procurer

Deliverables

- A text input device that...
 - Gives the user the same tactile sensation as writing in a room
 - Gives the user the ability to place writing up on a whiteboard
 - Eases the input of text
 - Allows for multiple users to see the text output

Touch Surface Prototype

- Utilized an Arduino, 100 kΩ Resistors, and a multiplexer
- Touch surface was designed using a silver conductive ink pen which was used to draw transmitting and receiving lines on paper
- Initial findings showed that the touch sensor did work based on the output of the serial plotter
- Further analysis showed that, though the sensor could sense, it struggled with pinpointing the location of the touch or the pressure
- Finally, we decided that with our time frame and needs, this was not feasible



Our Solution

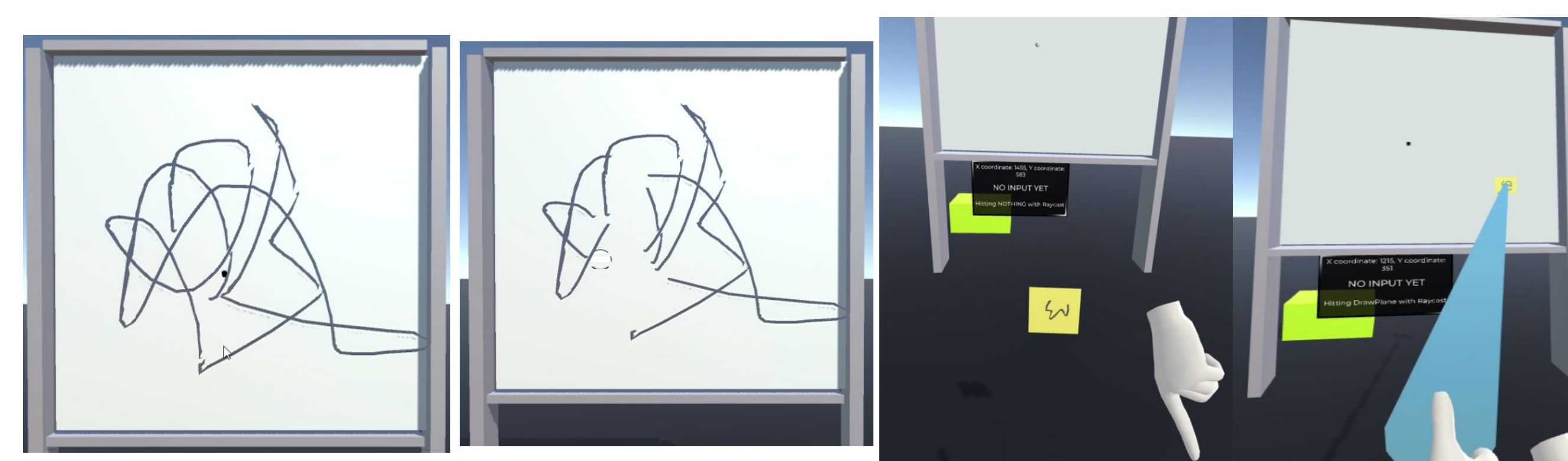
Project writing pad to VR environment

- In order to utilize a physical writing pad, we need to be able to see the pad even when we are in the VR environment.
- By attaching ArUco markers on the pad, we can use an external camera mounted on the Oculus to detect the 3D position and orientation of the physical writing pad.
- Since Oculus Quest do not support external camera input, we used a portable embedded board (Raspberry Pi) for the camera and run C++ detection code on it.
- The detected pad position and orientation are then transmitted to Oculus Quest. The communication between Raspberry Pi and Oculus Quest are done by TCP connection.
- The received position and orientation value will be set to a writing pad unity model inside the VR environment, mapping the physical writing pad motion.



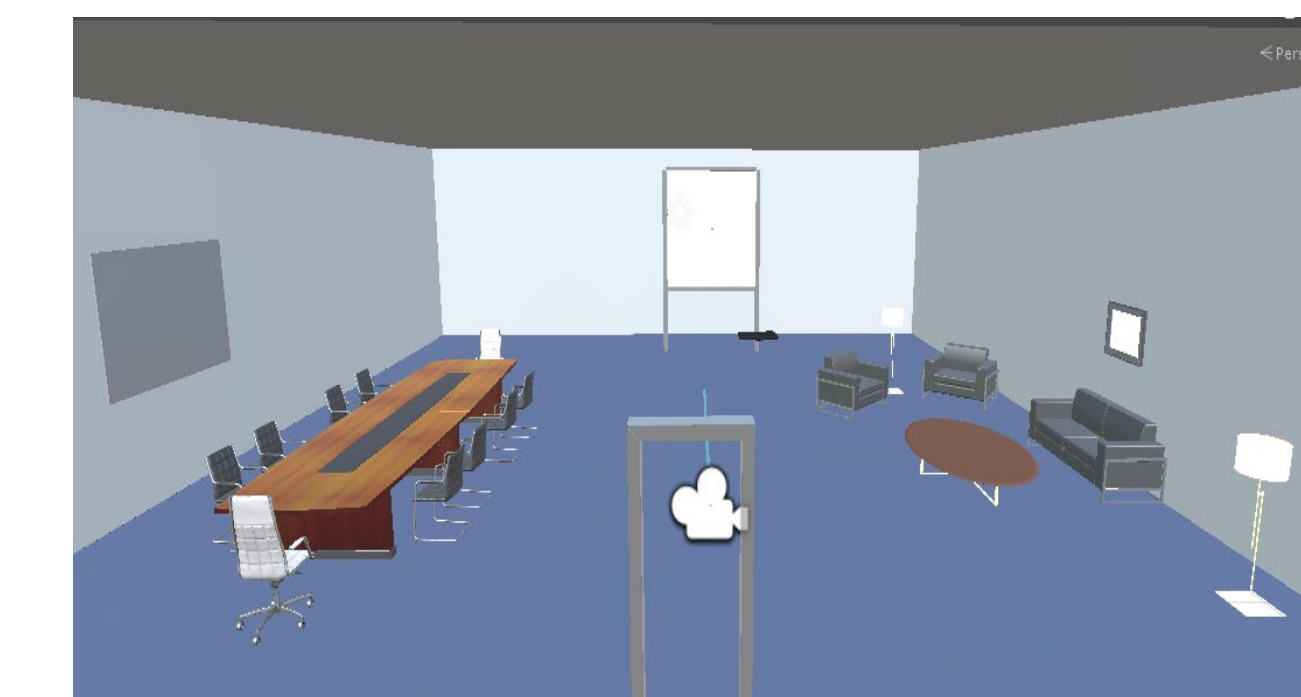
Building the Unity Note-Taking Application and Creating a VR environment

- To get a tactile feel and surface to write on, we chose the Wacom Tablet. The Wacom tablet allows us to read user input through a cartesian coordinate format. These coordinates are transmitted over a networked UDP connection to the oculus quest.
- The Unity application takes the position of the user on the tablet, and renders a stroke as per the coordinates received, thereby creating a note-taking functionality. This was displayed onto a whiteboard. We added extra features such as an Undo function, Eraser Features, and Sticky Notes that can be attached onto the board.



Our Solution (con.)

- We also created a VR environment using Moonbeam's 3D assets that helped create an office environment. Our final application allows us to view the 3D render of the Wacom tablet and draw on it so we can adjust accordingly.



Future Work

Based on our results and final product, we believe that we were able to accomplish the task we were given. That being said, for our future work we will be focusing on making improvements to the current solution we have, in both the software and hardware elements. A few examples are listed below.

- Our own version of a touch surface implementation, potentially utilizing the same method as our initial first prototype, so that we create the full solution.
- Features that can be activated using multi finger touch. For example, increase/decrease text size by pinching two fingers on the pad.
- Different colored markers to the whiteboard and additional sizes of the eraser.
- Voice chat support for user interaction within the VR environment.
- Show stroke input on the Wacom tablet render inside VR environment so users get a natural feel when looking down at the tablet and seeing the output.

Conclusion

The goal of our project was to design some type of interface that helped make collaborative work much easier. Our final solution was able to solve that issue by allowing the user to write directly on to a writing tablet that would be mirrored in the Virtual Reality environment to give the user the most realistic feeling possible. We hope that this system we designed will be a good starting point for our Industry Mentors to use in their continued work.

