# PRISMS
Princeton International School of Mathematics and Science

# The implementation of an augmented reality display and a virtual reality controller on glasses

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## Introduction

Augmented Reality (AR) is a technology that enhances a user's perception of the real world by overlaying digital information on top of it. Most AR sets cannot utilize Virtual Reality (VR) for interactive control, however, there are different methods, such as controllers and body tracking. Current AR technology grants freedom of movement, but cannot generate a completely virtual world. Conversely, people can act as what they want in VR, but they are restricted in a closed virtual area. Therefore, the goal of this project is to allow users to control the scene projected on AR glasses by combining AR's and VR's advantages together by using offline position tracking on a near-eye projection.

**Fig. 1: Mr. Heim is using the prototype to confirm whether the frame design works.**

## Materials and Design Draft

Materials: ESP, Accelerometer, Projector, lens, plastic board, computer, 3D printer.

Design Draft:

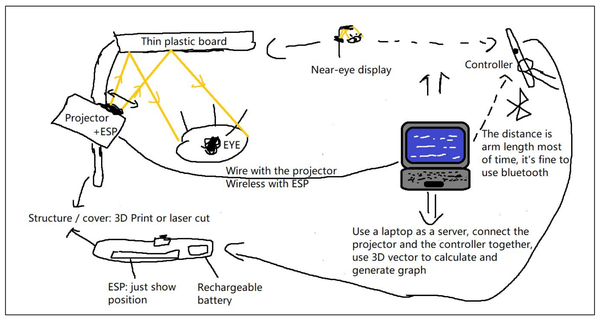
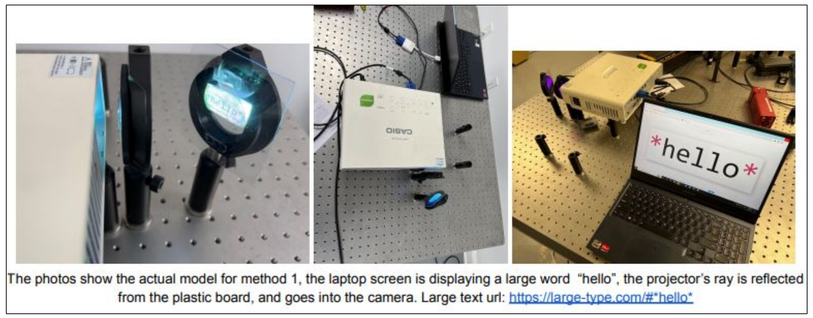



**Fig. 2: The draft of the design.**

## Goals and Approach

1. Display the laptop screen to human eye.
   My method: Use a plastic board to reflect light from a projector.




The photos show the actual model for method 1, the laptop screen is displaying a large word "hello", the projector's ray is reflected from the plastic board, and goes into the camera. Large text url: https://large-type.com/#*hello*

**Fig. 3: The projector and plastic board work together.**

2. The product can track rotation and simple movement.
   My method: Use an accelerometer to record acceleration and angular velocity, integrate them to get motion and rotation.

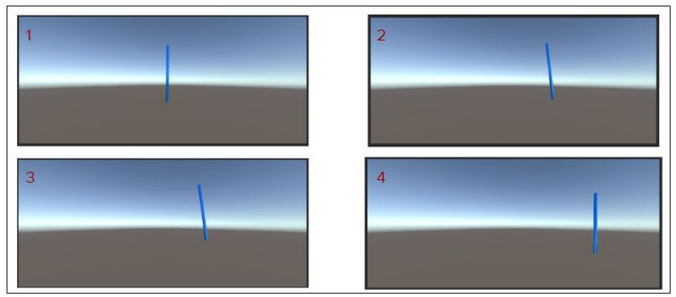



**Fig. 4: The screenshot showing how the motion and rotation of the accelerometer is recorded.**

3. A projector holder that can hold everything firmly on head.
   My method: Design and 3D print it.

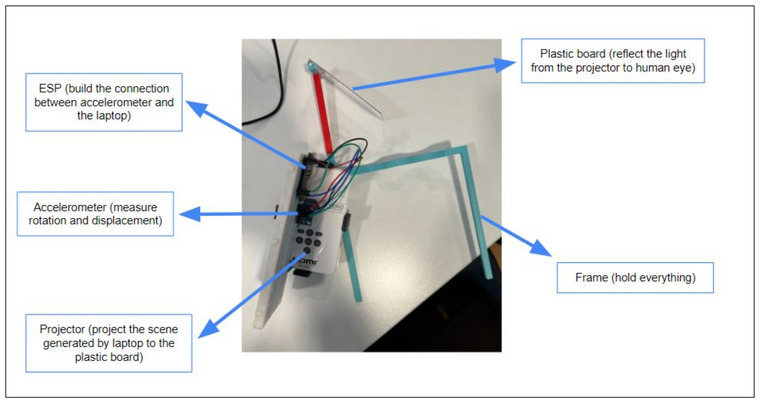



**Fig. 5: The photo of the first prototype.**

## Problems

1. Need more adjustment on position tracking.
   Sometimes the accelerometer loses position because of the low accuracy and the influence of gravitational acceleration is not included.

2. Need something to hold the frame firmly.
   The projector consists most of the weight, which causes the frame to fall to the projector's side.

## Future Plans

1. Better position tracking.
   Hardest part, could add more factors in the formula for displacement.

2. Build a controller.
   Design it and print it out.

3. Less weight. (Reduce to less than 100g)
   Could remove the battery of the projector.

4. Change to a wireless connection.
   Could use a wireless HDMI transmitter and receiver.

## Timeline

| Time | | Goal |
|---|---|---|
| Sept - Oct | —> | Refine position tracking |
| Nov - Dec | —> | Build controller |
| Jan - Feb | —> | Refine frame |
| Mar - Jun | —> | Wireless & Test |

## References

1. Seokil Moon, Chang-Kun Lee, Seung-Woo Nam, Changwon Jang, Gun-Yeal Lee , Wontaek Seo, Geeyoung Sung, Hong-Seok Lee & Byoungho Lee. (2019). *Augmented reality near-eye display using Pancharatnam-Berry phase lenses*. Nature, 9:6616.
2. *ESP8266 NodeMCU with MPU-6050 Accelerometer, Gyroscope and Temperature Sensor (Arduino)*. Random Nerd Tutorials, Feb. 09, 2021, randomnerdtutorials.com/esp8266-nodemcu-mpu-6050-accelerometer-gyroscope-arduino/. Accessed Mar. 08, 2023.

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