Exploring the Novel Human-Computer Interaction for Virtual Reality

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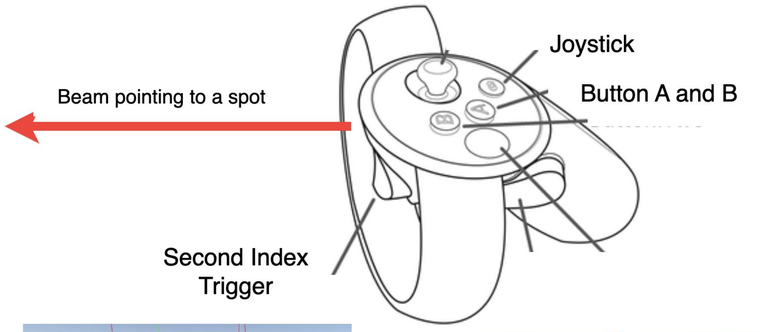
Abstract

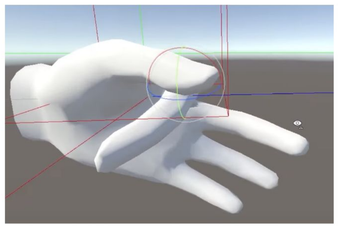
Metaverse or Virtual Reality (VR) stands at the forefront of technological innovation, offering many possibilities for integration into our daily lives. A critical challenge lies in streamlining user interaction within VR environments, minimizing the need for extensive training or additional learning curves. Creating this new interaction requires the integration of many technologies, such as sensors and Bluetooth communication. In this project, we combine flex sensors and an ESP32 microcontroller board to track the movements of every finger, thereby revolutionizing the way users interact with virtual objects. We aim to have a more intuitive interface for controlling VR objects. Through intuitive gestures and natural movements, users can seamlessly manipulate objects, which results in a significant reduction in the cognitive burden or learning efforts on users. In the end, we expect to have more immersive experiences for VR users.

Design

Our goal is to use the VR glove to replace the original Oculus controllers. More importantly, we want to ensure our finger and hand movements can allow users intuitively to manipulate the 3D objects in a VR space.

- Therefore, the glove should provide the following functionalities:
- Each finger's movement can be shown in the VR hand.
- Finger flexion combination can be configured as a certain button click (see Fig. 1).
- The VR glove (see Fig. 2) can be wirelessly connected to the Oculus 2 device.
- Hands' movements will be also shown in the VR hands.
- Hands' movements can be calibrated to show precise control in the VR application.





This hand gesture click the second index trigger button

Palm will point to a spot like a beam

Fig. 1. Finger and Button Clicking Mapping

Development

- **Platform**
  - Oculus 2
    - Unity and C# programming language
  - ESP32 with Flex Sensors
    - C language and Arduino library

We initially tried to use potentiometers and retractable badge reels to measure the finger-bending movements. However, we figured out using flex sensors could be a better solution.

Our biggest challenge is to integrate VR gloves with an Oculus 2. The Oculus 2 does not allow any Bluetooth device to connect it. Even connection is successful, data transmission is also a challenge. We successfully used a personal computer to communicate with the connected VR glove via serial port and Bluetooth. But, it is not working in an Oculus 2 device.

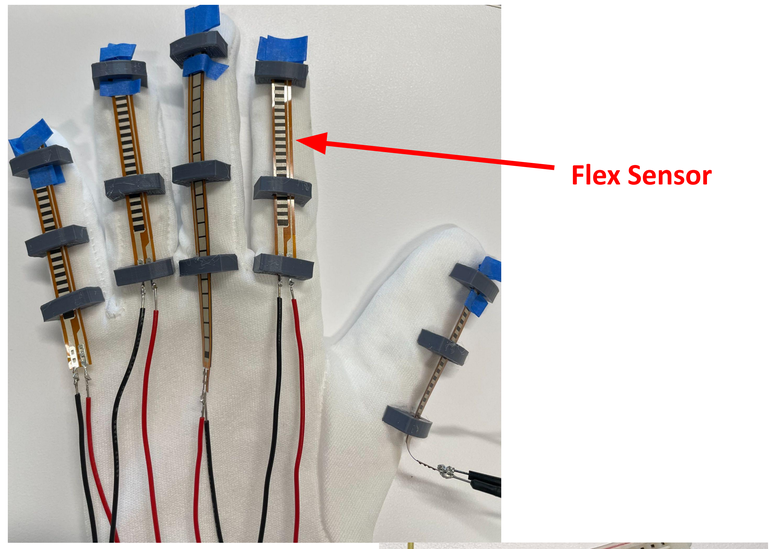


Fig. 2. VR Glove

Conclusion and Future Work

We successfully detect the finger movement in a Unity application running on a personal computer. This means our development on the ESP32 is successful. However, we still have bugs when the application runs on an Oculus 2.

This device still requires a lot of tests that involve human-computer interaction. Until now, we only focused on the functionalities of the VR glove. However, we still do not know how effective or easy for a person to use the VR glove to control hands in a VR space. Particularly, the Oculus controller uses a joystick to move the avatar so we might need to explore more possibilities to deal with body movement.

Acknowledgement

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