Gesture Enabled System Interaction (GESI)

Rakan Fawaz Najeh AlZagha '22
Faculty Advisor: Dr. Maminur Islam
Department of Computer Science, Trinity College, Hartford, CT

Introduction & Significance

- With the exception of gaming, touch and voice have dominated the way we interact with technology over the last decade
- Enabling users to **utilize gestures** to operate and interact with appliances, speakers, lights, machines, and more will allow us to develop more **interactive** and **intuitive technology**
- The purpose of this project is to add another dimension of user interaction with various systems and technologies via **gestures**
- Developing **reliable, robust, and natural interactions** with connected technologies is the ultimate **goal** of this project.

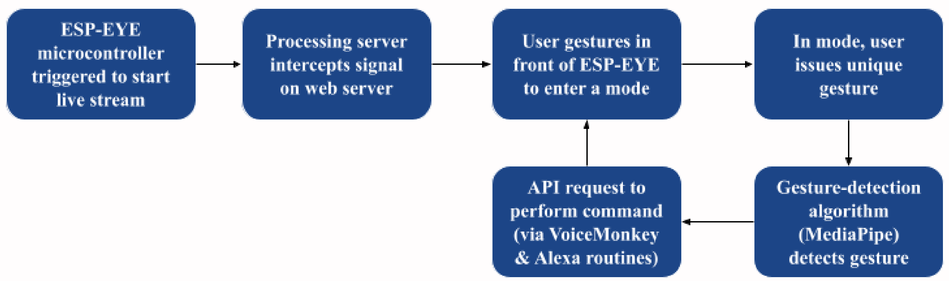
Methodology

ESPRESSIF-EYE AIoT Microcontroller

- **ESP32 -** lightweight and cost-effective, yet powerful processor capable of rapid image processing
- **2-Megapixel camera -** supports live video transmission (mJPEG)
- **Image transmission -** over onboard 2.4 GHz WiFi chip

MediaPipe Hands

- High-fidelity hand and finger tracking solution
- Utilizes a ML algorithm to place 21-3D landmarks across palm and digits which is converted into a graph for data processing



Hardware

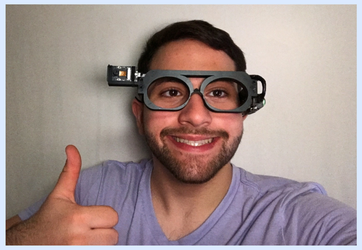


Figure 1: 3D printed glasses with ESP-EYE and battery-shield mounted

Figure 2: ESP-EYE Microcontroller

Figure 3: Battery shield holding lithium-ion battery (16 hours of battery life)

Figure 4: 3D design of glasses

Software

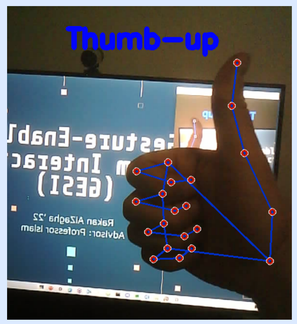


Figure 5: gesture recognition from glasses point-of-view

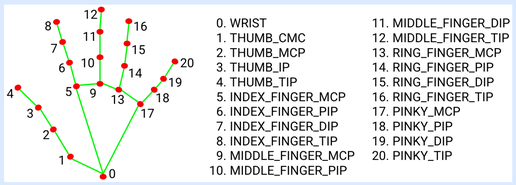


Figure 6: MediaPipe palm and finger detection graph

Outcome

- Developed a **wearable piece of technology** using the ESP-EYE microcontroller that is mounted to a pair of 3D-designed and printed glasses
- Implemented Google's MediaPipe framework on real-time video of a user's gestures which are intercepted by a gesture-detection algorithm running remotely
- Users are able to **interact with any device** connected to their Alexa account or any system that has an interactive API, **by issuing gestures that are unique** to that specific device

Future Directions

- Improve gesture-recognition algorithm in different conditions
- Train on different hand sizes for more accurate predictions
- Develop a user-oriented method of pairing gestures to commands via a web or iOS application
- Expanding to different smart-home interfaces (Google Home & HomePod)
- Improve comfort of glasses and make design sleeker
- Open-Source Code: *https://github.com/Rakan-AlZagha/GESI*

Acknowledgements

- Travelers Insurance, the Trinity College Department of Computer Science, & Dr. Maminur Islam for their support and guidance
- Michael Valdez, Kieran Neath, & Miran Manasrah for their guidance in hardware selection, design, and 3D printing