Robot Controller through Gestures

Team 41

Eric Zhou(yirui2), Guang Yin(guangy2), Haoduo Yan(haoduoy2)
TA: Hanyin Shao
Spring 2022

Introduction

Introduction

Traditional Robot Controller

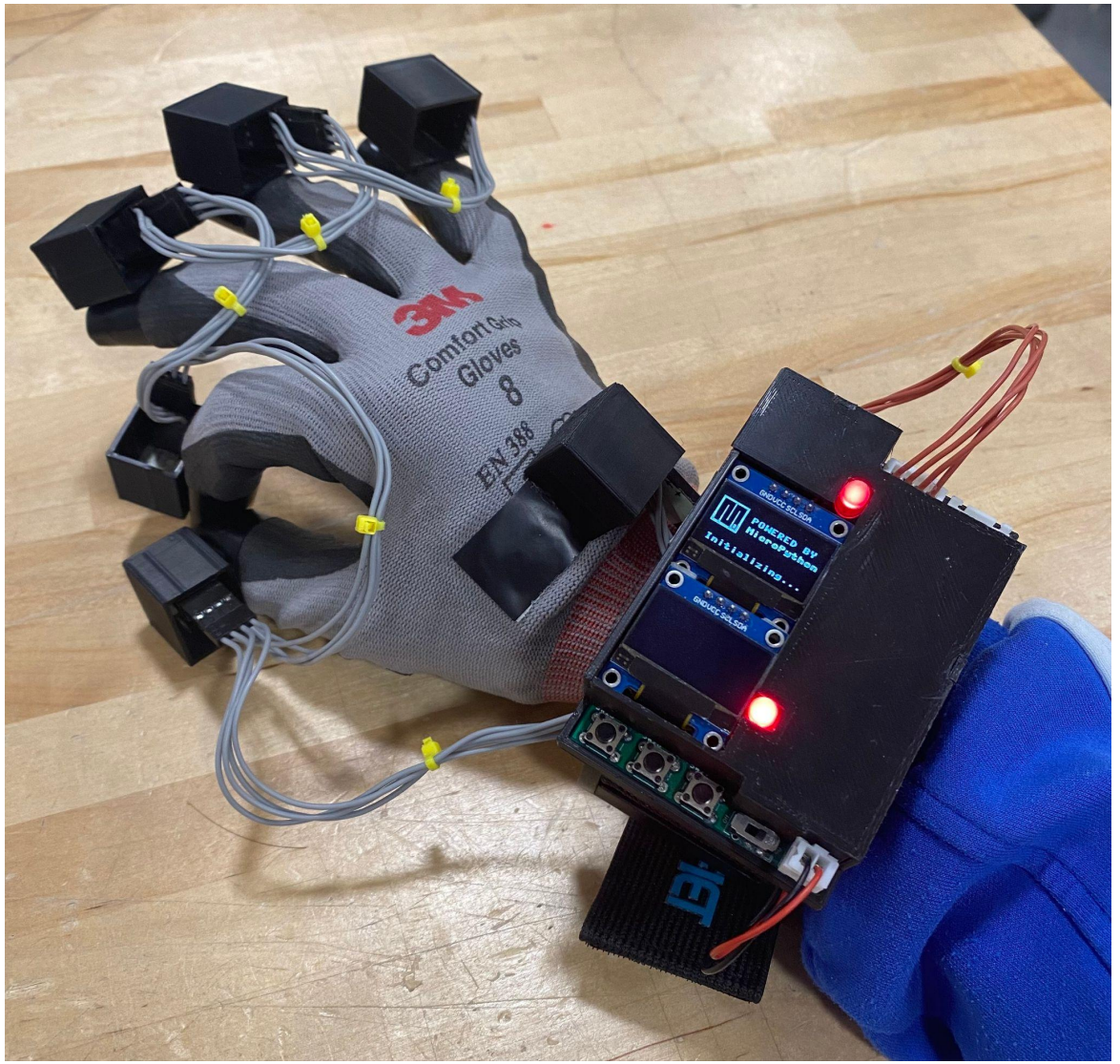
❌ Unresponsive Enough

❌ Not Easy to Use

❌ Unengaging

Can we have a **cool**er and more **intuitive** tool?

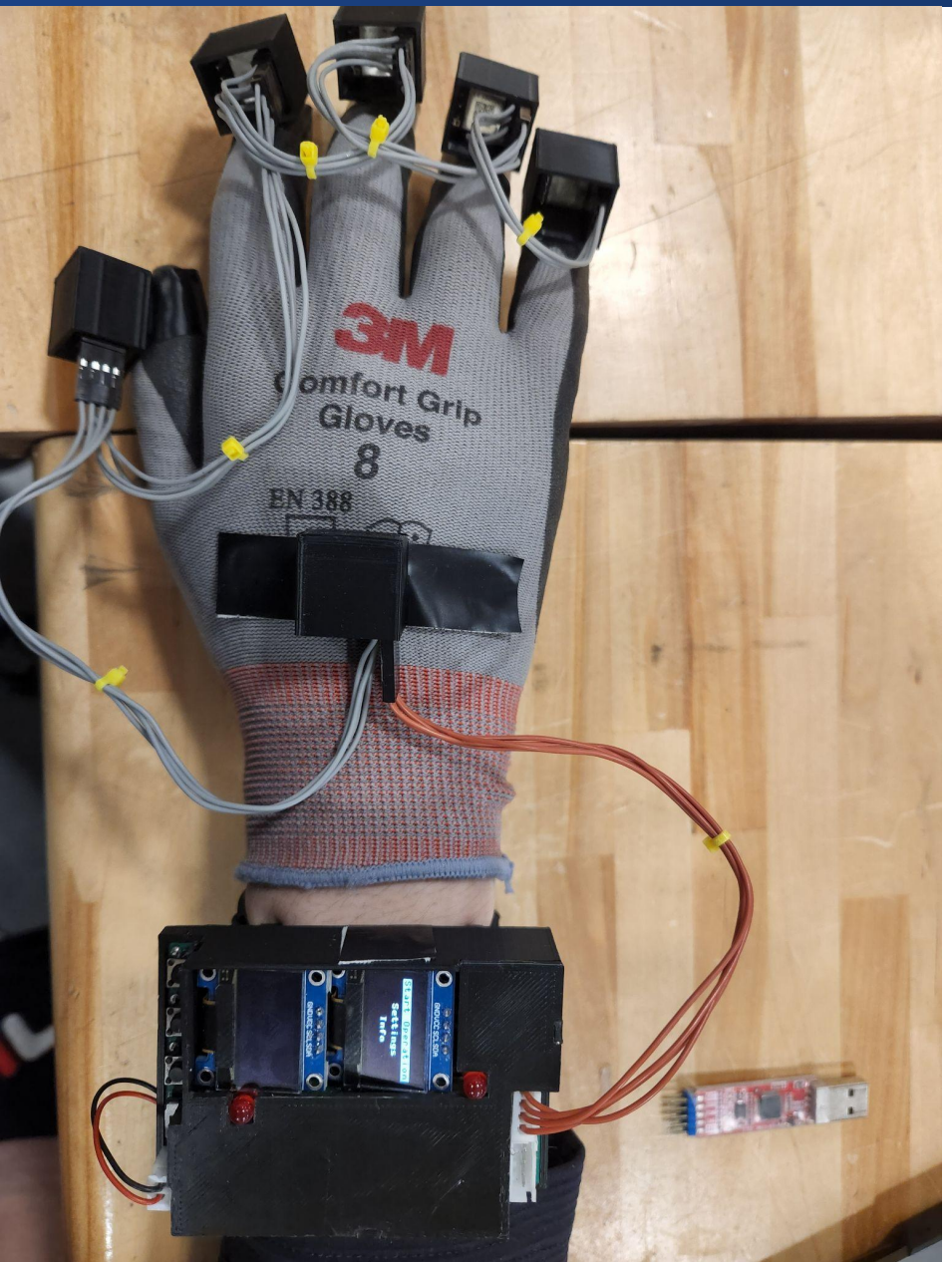
No Problem!


3M
Comfort Grip
Gloves
8
EN 388
POWERED BY
MicroPython
Initializing...

Objective


Feedback
IMU
Microcontroller
Wireless Communication
PC
Wireless Communication
Robot

Objective



- The position and orientation of fingers and palm can be collected through IMUs.
- Hand movements and gestures can be translated to robot control actions respectively.
- Users can get feedback through the glove.

Design

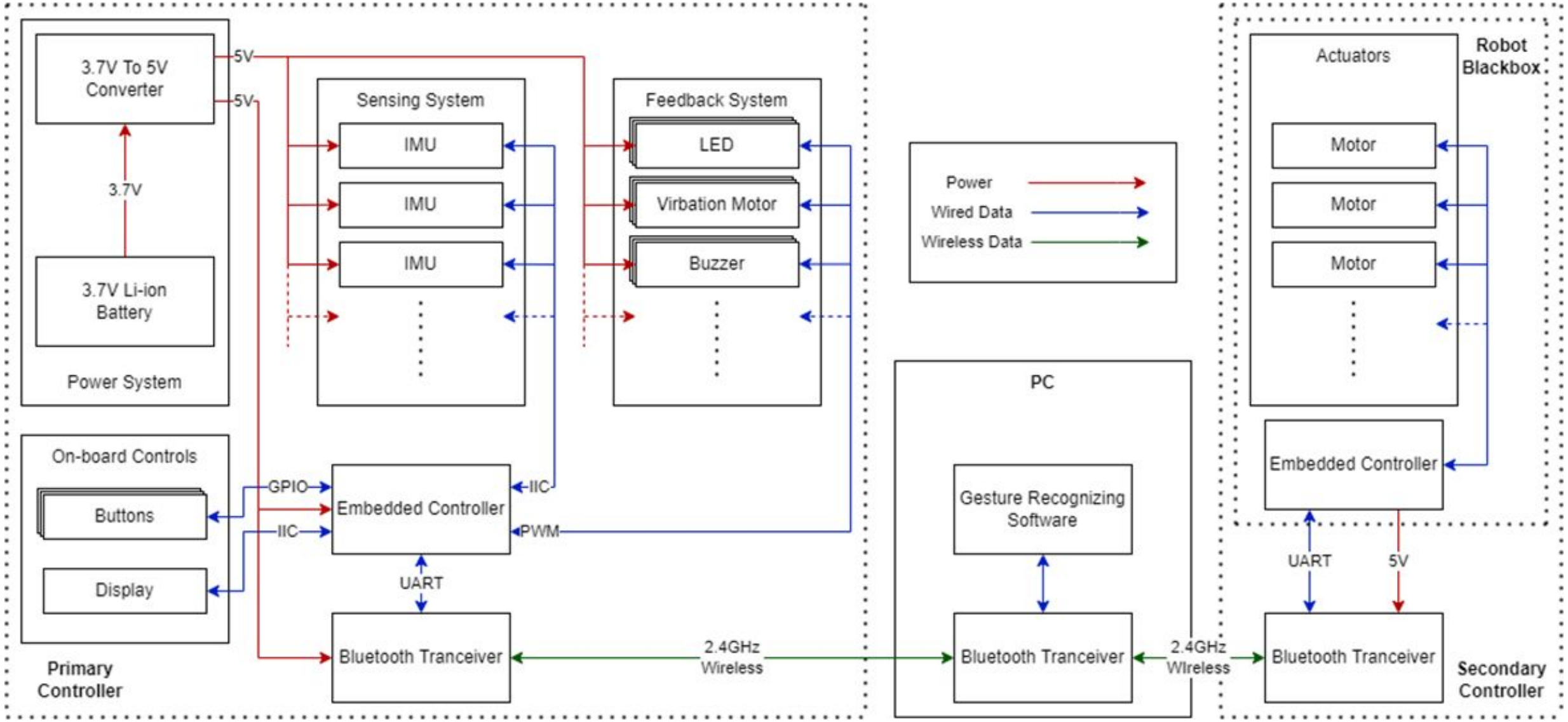
Project Overview

Fig. Hardware Overview

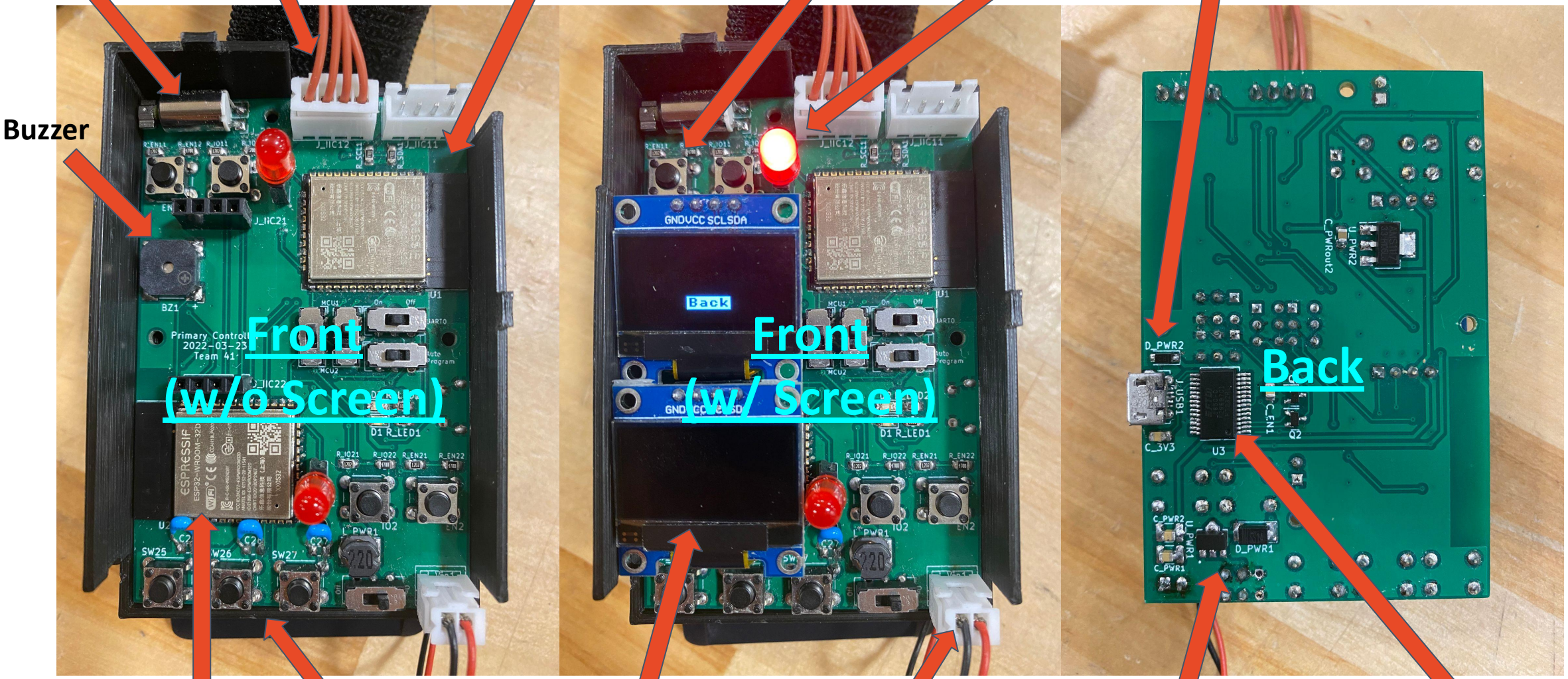
Subsystems

- Human Positioning System
- Gesture Control System
- Robot Feedback System

Block Diagram



PCB Board Overview



Y

Human Positioning System

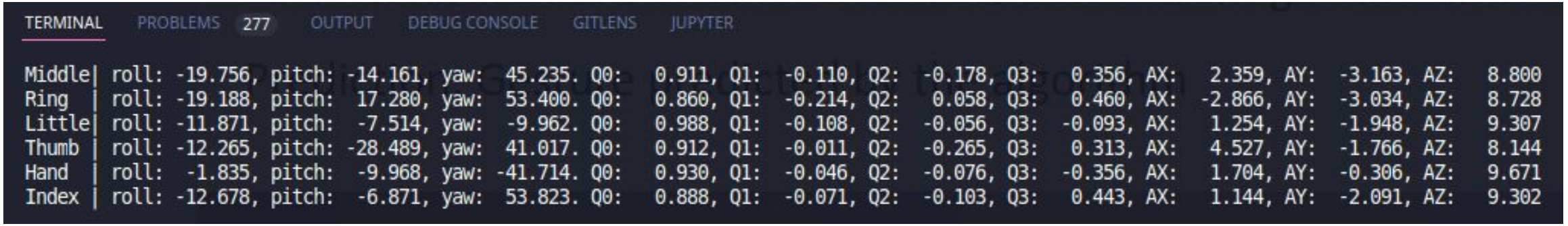


Fig. Gesture data collected from IMUs and sent to PC through Bluetooth

Euler Angles: Roll, Pitch, Yaw, in degrees

Quaternions: Q0, Q1, Q2, Q3

Acceleration: AX, AY, AZ, in m/s^2

Gesture Control System

- Using L2 algorithm to recognizes gestures

- Translates gestures into robot commands

- Sends commands to robot via Bluetooth

More About L2 Algorithm

0) Prerecord Gestures

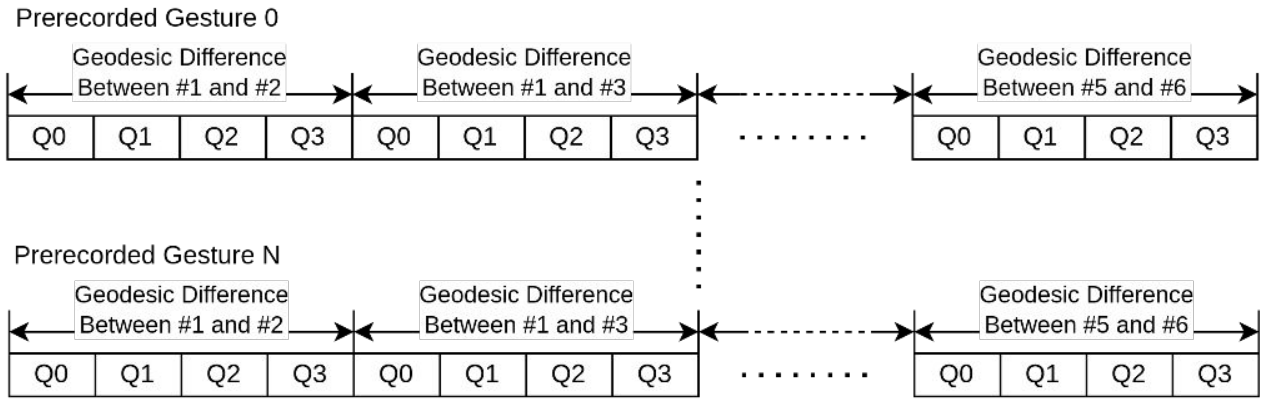


Fig. Principles of L2 Algorithm

More About L2 Algorithm

1) Get quaternions

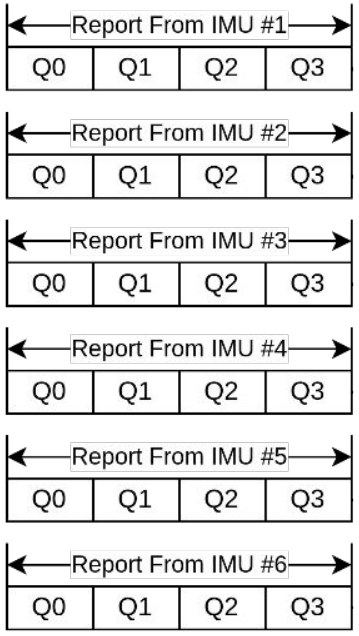


Fig. Principles of L2 Algorithm

More About L2 Algorithm

2) Calculate geodesic distance

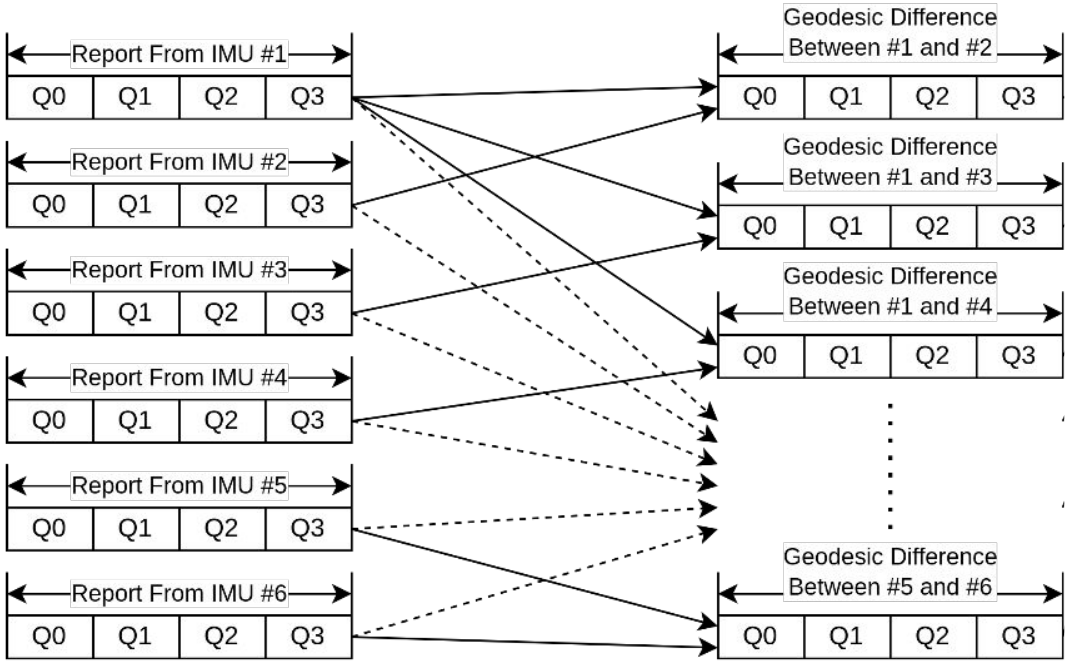


Fig. Principles of L2 Algorithm

More About L2 Algorithm

3) Concatenate into one vector

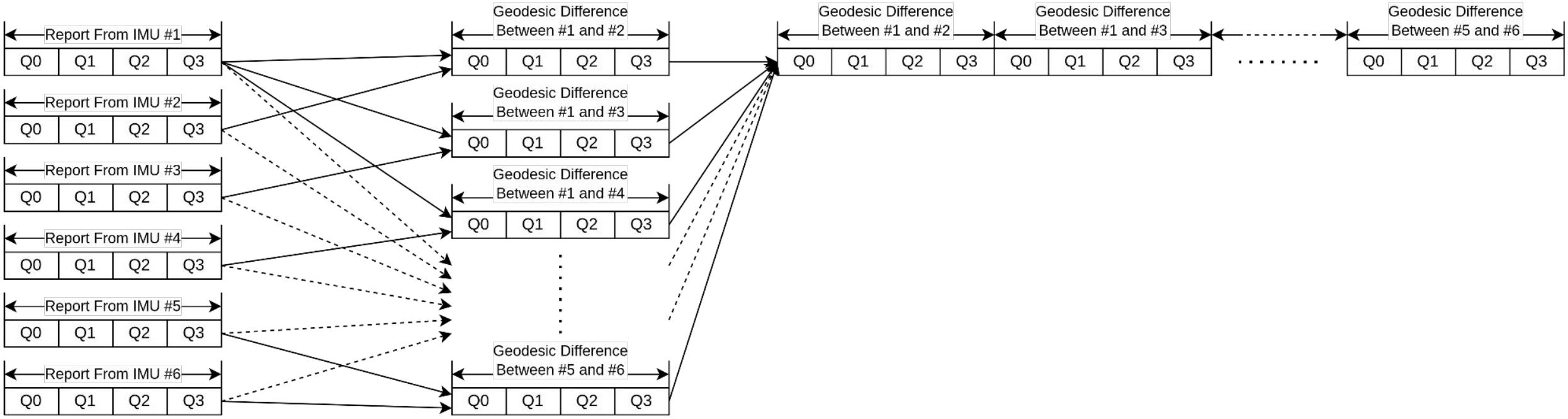


Fig. Principles of L2 Algorithm

More About L2 Algorithm

4) Compute the L2 distance

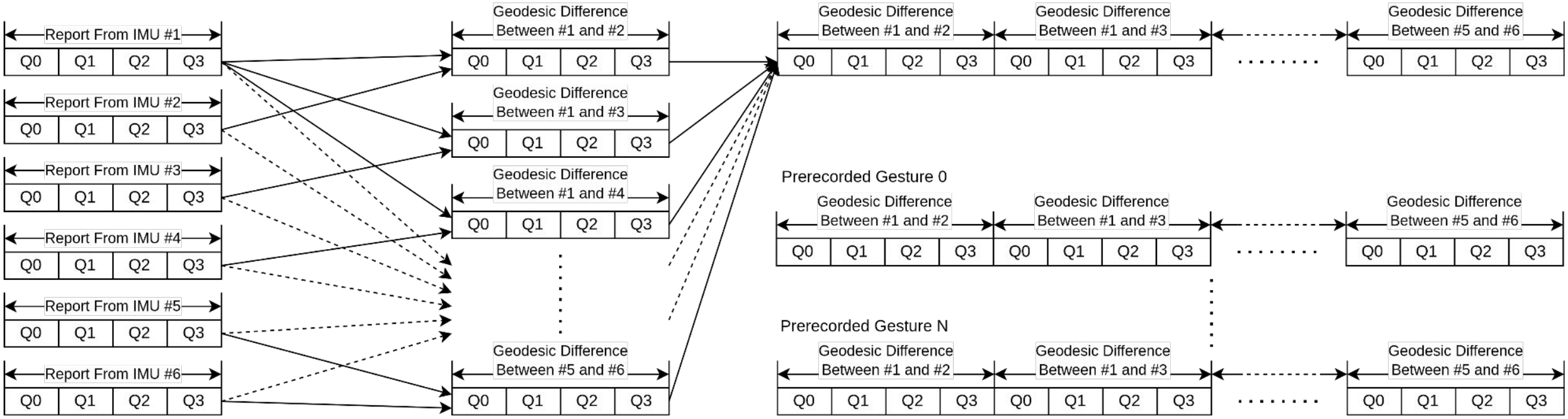
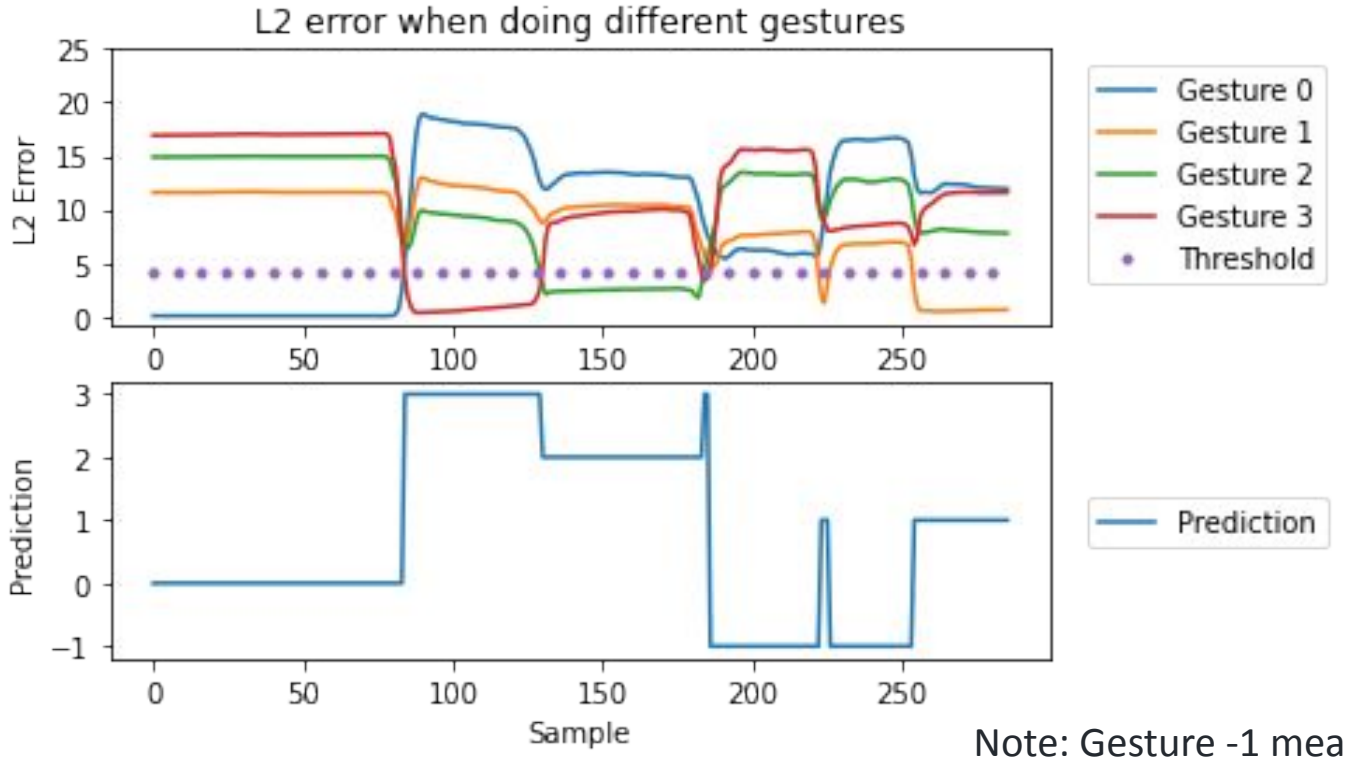


Fig. Principles of L2 Algorithm

More About L2 Algorithm

5) Predict the gesture



Note: Gesture -1 means no prediction

Fig. Example of L2 Algorithm in Operation

Example of Saved Gestures

Hold
(Gesture 0)

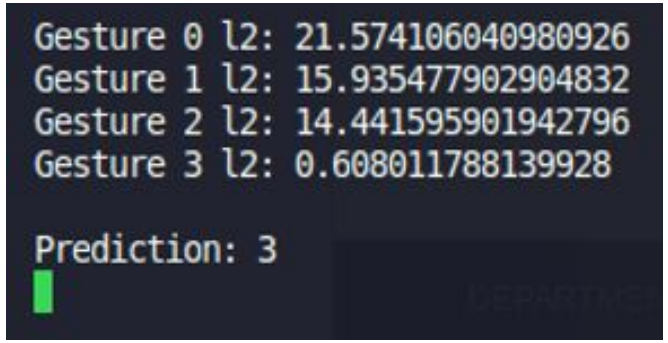
Chassis
(Gesture 1)

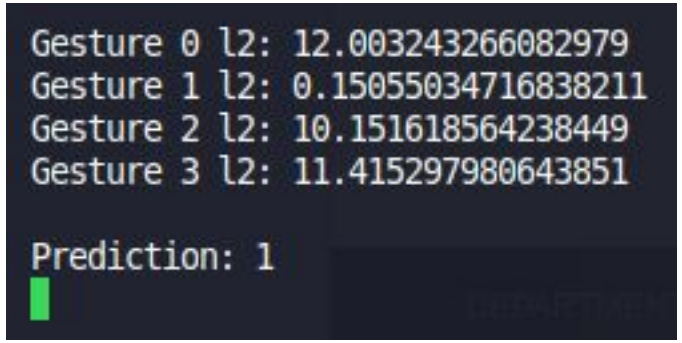
Gimbal
(Gesture 2)

Shoot
(Gesture 3)

More About L2 Algorithm

Example output of software running on the PC





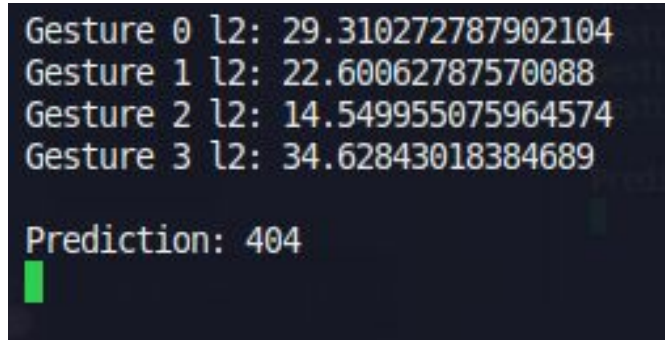


Fig. Examples of L2 Algorithm in Operation

Note: Threshold: 4, Prediction 404 means no prediction

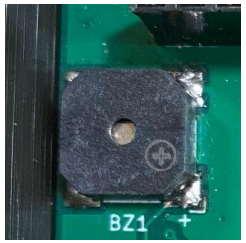
Robot Feedback System

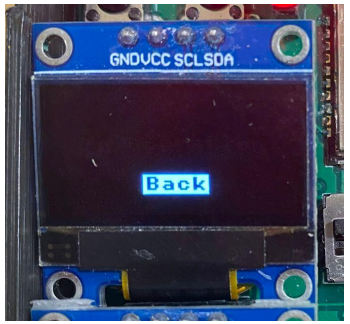
Feedbacks include:

- Controller operating status
- Bluetooth connection status
- Messages from robot
- Possible warnings and errors

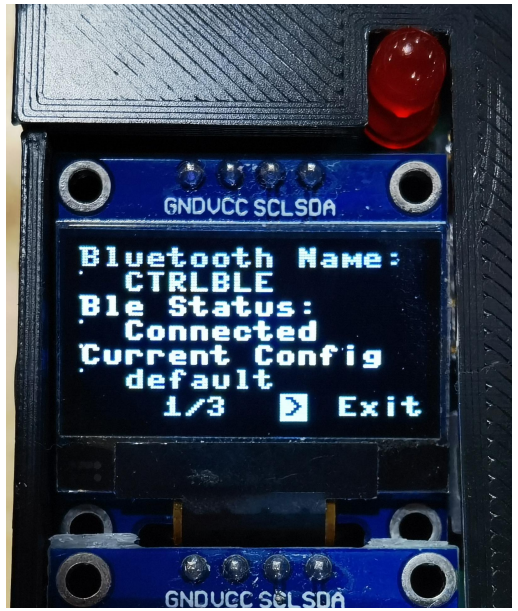
Feedback will be displayed through:

- LED
- Vibration motor
- Buzzer
- Display



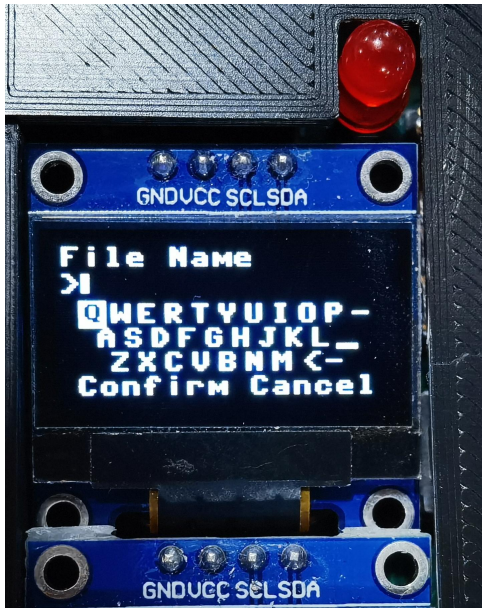


More About Display



Showing System Information

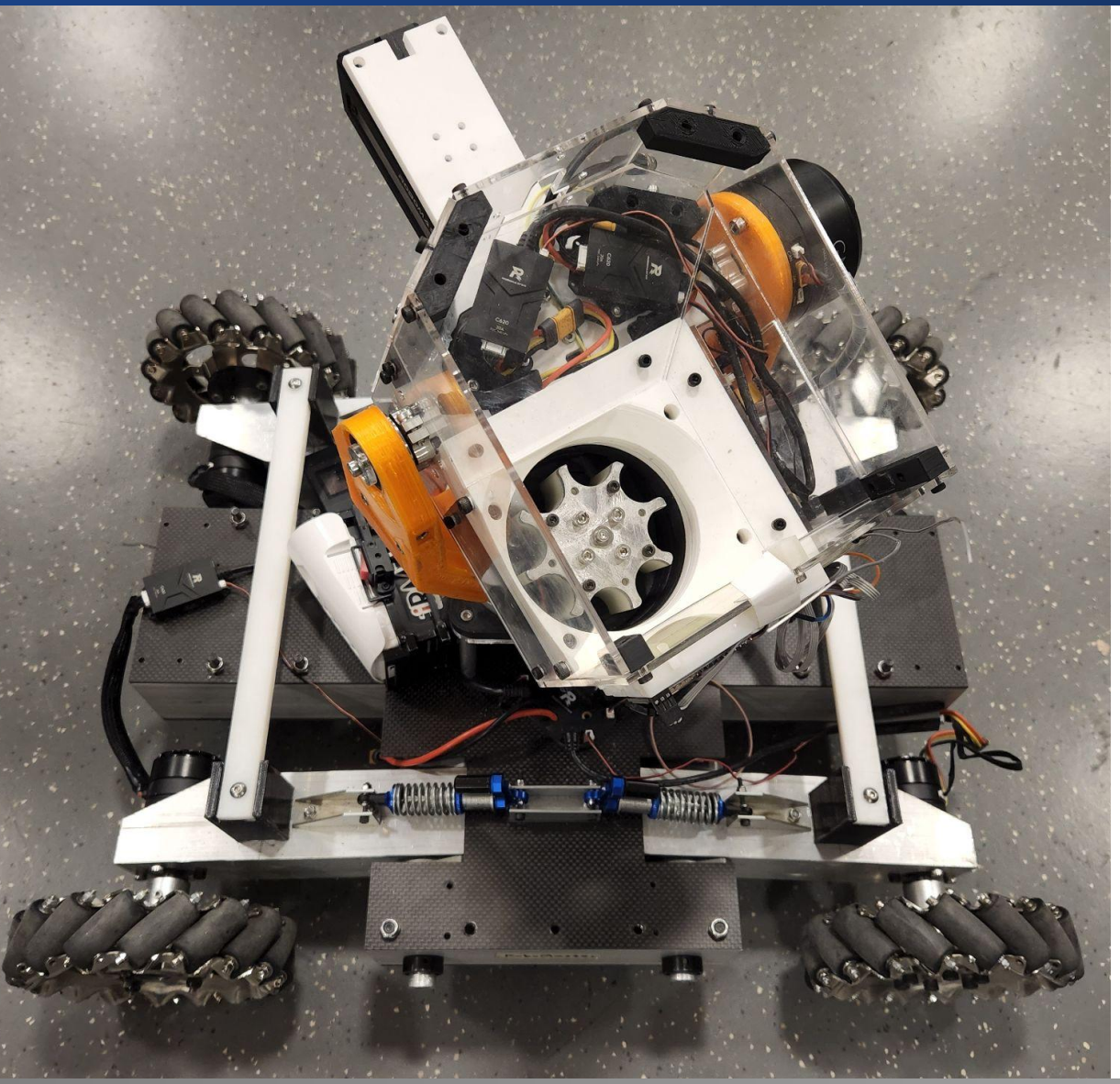
Create Config Files Onboard



Manage Config Files Onboard

Showing Operation Status

Functionality & Instruction Set



Hold	Stop all action
Chassis	Move forward or back
	Turn left or right
	Rotate clockwise or counter clockwise
Gimbal	Move up or down
	Move left or right
Shooter	Shoot

Video Presentation

Conclusion

Successes & Challenges

Successes

- Controller is fully functional.
- Also universal and customizable.
- We make use of the IMUs and identify gestures with high accuracy.

Challenges

- Bluetooth connection is unstable.
- Readings from IMUs are greatly influenced by the magnetic field of surrounding environment.
- Drawing the PCB board according to our needs.

Future Work

1. Remove intermediate PC
2. Build a UI for recording more gestures
3. Revise the gesture recognition algorithm
4. Reduce magnetic interference
5. Extend battery life
6. Tidier exterior design

The End