

LET'S GO - Milestone 1

Team Member: Wayne Lin, Eric Wu, Sheng-Jung Yu
Github Repository: <https://github.com/ericwu13/ee249-letsgo>

I. System Overview

The gloves will collect the data of the gestures and transmit to the laptop (Taiwan) via buckler's BLE. Data will be processed using a gesture recognition algorithm to determine the command from the commander. The command will be sent to the mqtt broker via Wifi to be routed to the laptop (US). With that, Romi robot will receive the command via the buckler's BLE and react according to our finite state machine. Figure 1 illustrates the concept of our system.

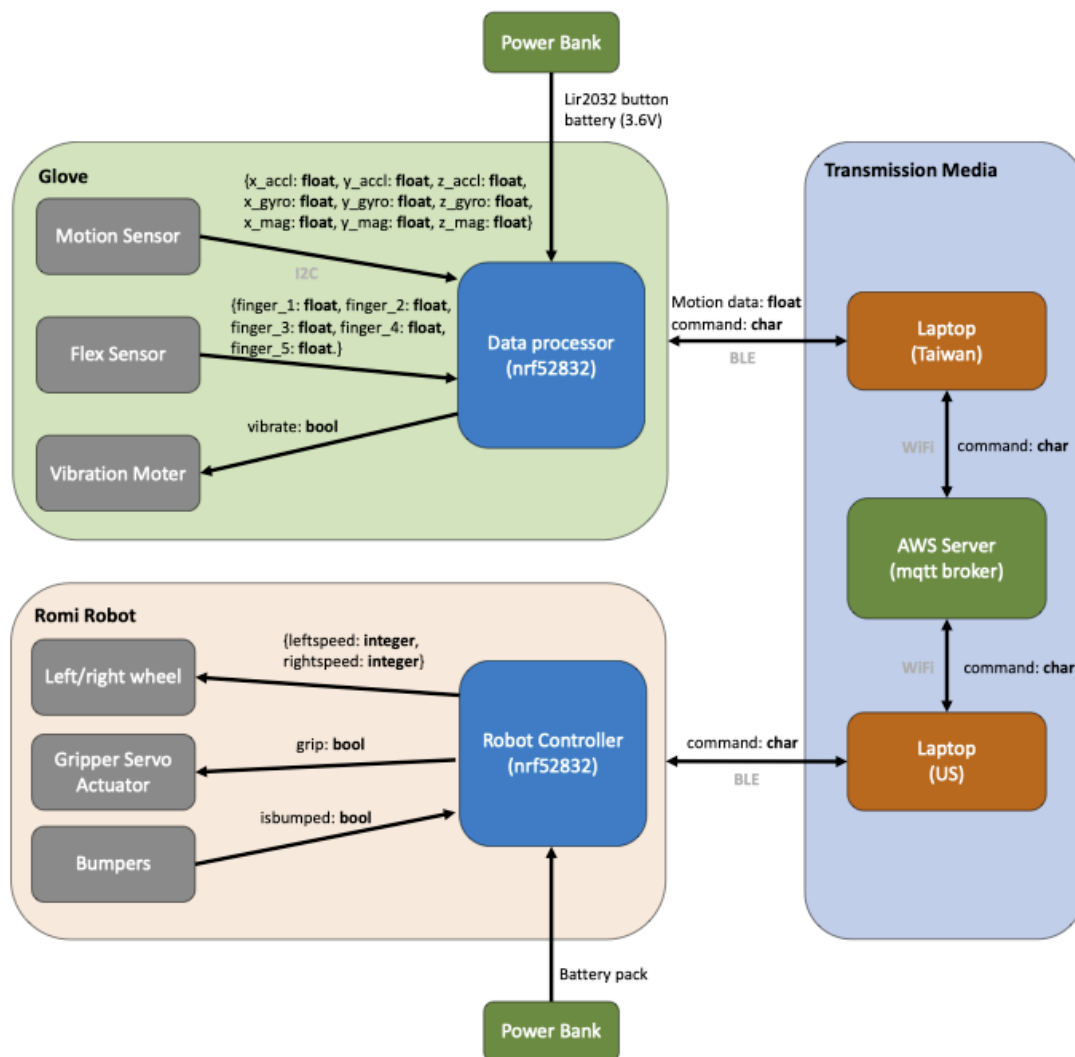


Figure 1: System Overview.

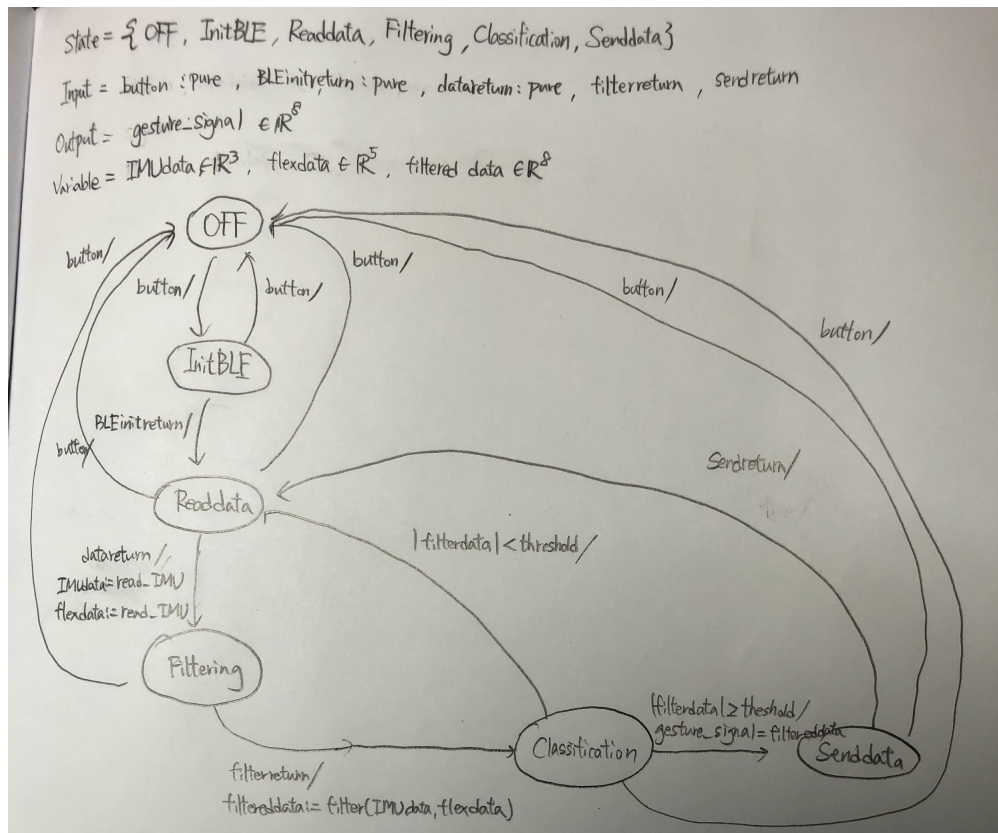
This describes what is the data format from/to the sensors/controller and the primary communication protocols used to transmit the data. Also, it specifies the power supply

II. Transmission Media

- Laptop (Taiwan) - Publisher
 - collect the data from the glove using BLE and do **Gesture Data Processing** (below have details) to obtain the targeted command.
 - Publish the command to the AWS mqtt server through python programming interface.
- AWS server - mqtt broker
 - Construct mqtt broker to forward message for two different devices (laptop (Taiwan) & laptop (US))
- Laptop (US) - Subscriber
 - Subscribe to the mqtt broker to get the command in python programming interface
 - Transmit the data to the Romi via BLE.

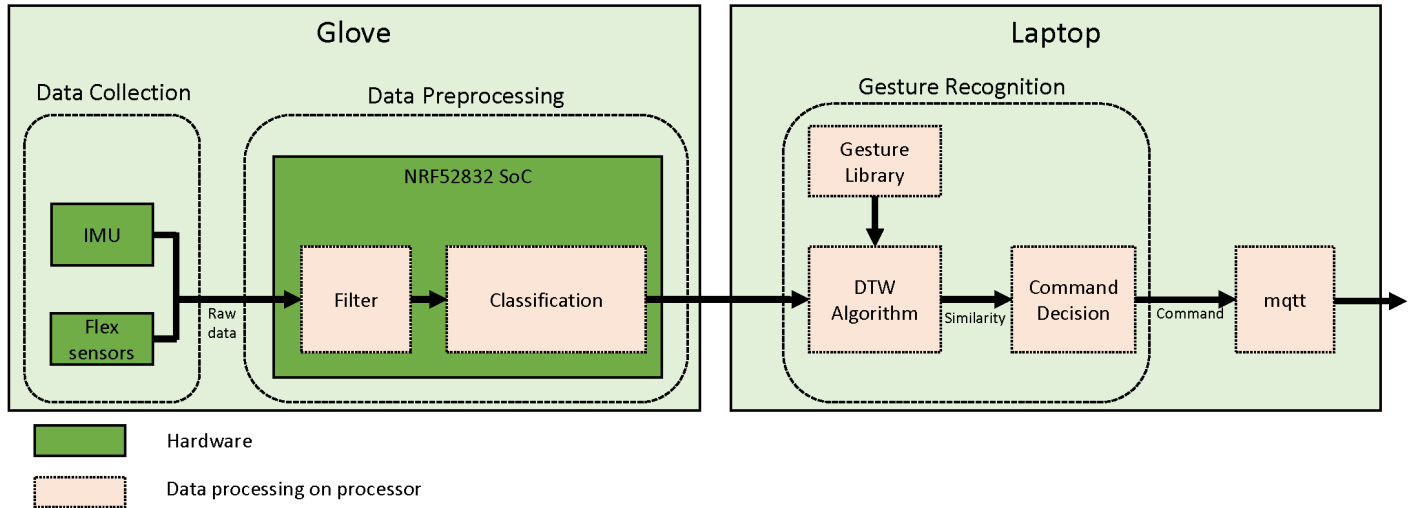
III. Gesture Data Processing

- FSM



- Data Flow

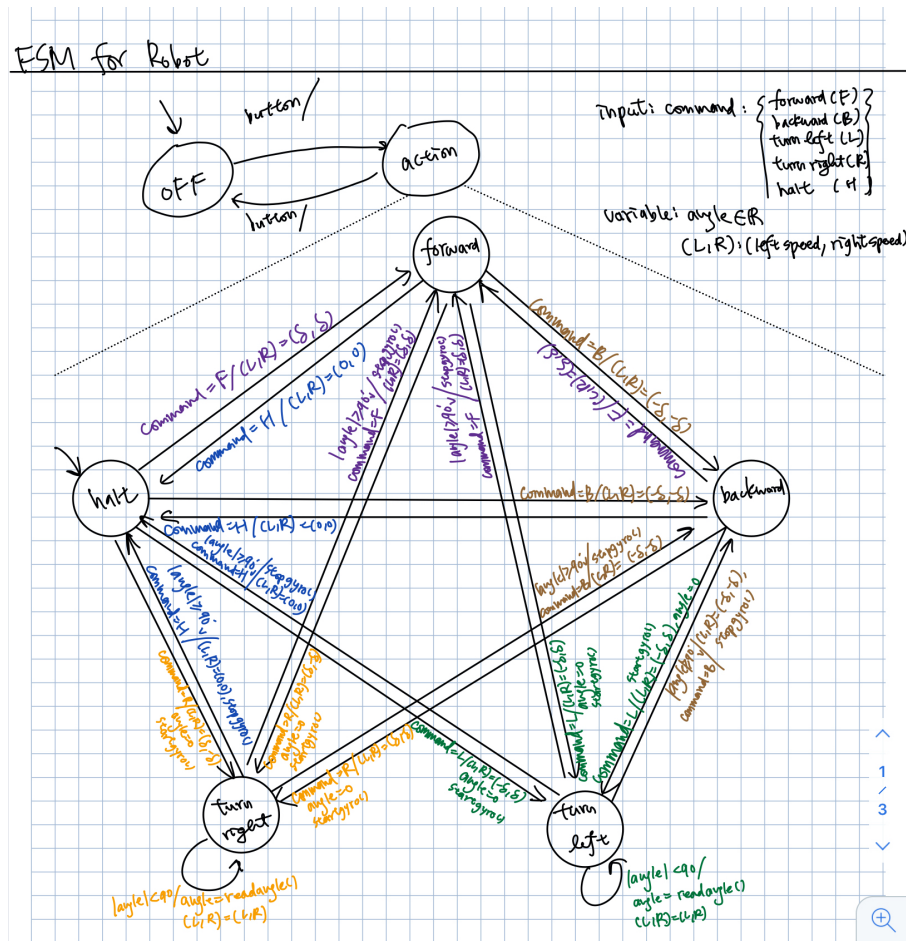
The data flow for gesture recognition, as shown in the figure below, can be divided into three parts: data collection, data preprocessing, and gesture recognition.



- Data collection: we will use IMU to obtain accelerations of different axes and flex sensors to obtain information about stretch of the fingers.
- Data preprocessing: the processor on the nrf52840 will use a filter to reduce noise of the data and then recognizes the start of a gesture by a threshold value. After identifying the start of a gesture, the nrf52840 starts transmitting data to the laptop via BLE.
- Gesture recognition: we will implement the dynamic time warping algorithm on the laptop to recognize the gesture. The algorithm returns the similarity of the gesture and all candidate gestures from a pre-constructed gesture library. Each command is mapped to a gesture in the library. We recognize the command by finding the command whose corresponding gesture has the largest similarity. The command is then transmitted via the WIFI to the server.

IV. Robot Control Mechanism

- FSM:
 - Romi is ready to receive commands as the button is pressed.
 - There are five possible actions for Romi to take.
 - Halt (H): Romi stays stationary until another command tells otherwise.
 - Forward (F): Romi goes forward until another command tells otherwise.
 - Backward (B): Romi goes backward until another command tells otherwise.
 - Turn Right (R): Romi spins right for 90 degrees and resumes the previous action.
 - Turn Left (L): Romi spins left for 90 degrees and resumes the previous action.



- Data receive:
 - Romi receives interrupt commands from Laptop(US). The commands are received in the format of one single character. For example, 'F' corresponds to the command "forward", 'B' corresponds to the command "backward", etc.

V. Future Work

- **Additional Tasks** - Modify and add actions that Romi takes, such as grabbing colored styrofoam and more flexible movements.
- **Identification of Major Risks** - It may be difficult to separate two gestures that are made too close together?? IDK

VI. Logistics

◦ Schedule

- November 11: Discuss and finalize the entire framework and FSM
- November 18: Implementation of the data collection, data preprocessing, BLE. Preparation of the gesture library.
- November 25: Implementation of the gesture recognition, mqtt server, and additional tasks.
- December 2: Debugging
- December 9: Debugging
- December 16: Final presentation and demo

- **Hardware Materials (each person)**
 - Glove
 1. (v) nrf52832 board * 1
 2. (x) [Flex sensor](#) * 15
 3. (x) LSM9DS1 * 3
 - a. <https://www.sparkfun.com/products/13944>
 - b. <https://www.sparkfun.com/products/13284>
 4. (x) B1034.FL45-00-015 * 3 ([Vibration Motor](#))
 5. (*) Glove * 1 (buy at grocery store)
 - Battery
 1. (x) lir2032 * 1 ([rechargeable lithium battery](#))
 - BLE
 1. (x) [Dongle](#) * 3
 - Romi
 1. (v) nrf52832 board * 1
 2. (v) Romi robot * 1
 - Additional Material
 1. (x) [Gripper](#) * 1