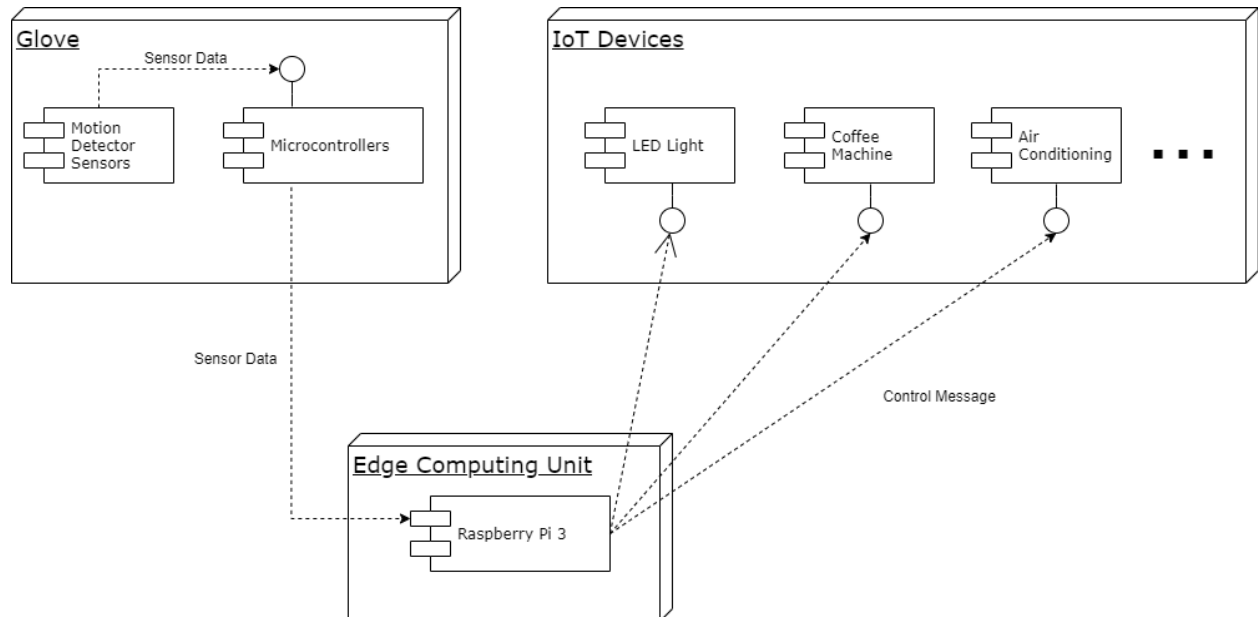


Project Plan - Smart Glove Control System

Team 2: Ata Gün Öğün, Charles Donven, Yucong Ma

Project Idea

There are various methods of controlling IoT objects, for example, using a single point of control portal on a smartphone to control home appliances, or relying on sensors detecting natural humidity to turn on an agricultural watering system. We hope to explore different ways of controlling IoT objects systems in this practical class. Inspired by some existing data glove projects, in which the glove user makes gestures in the air to specify numbers and letters on a typeboard, we come up with the idea to use the glove equipped with motion detector sensors to make gestures in order to control IoT objects.



Above is the architecture diagram of the project. The user will wear a glove, which is equipped with motion detector sensors on the finger part. These sensors are connected with a low power microcontroller on the user's arm. When the user moves the fingers, sensor data will be captured and sent to the microcontroller where the raw data will be preliminarily processed. The sensor data will be further transferred to a remote edge computing unit through bluetooth. The edge computing unit will then analyze the data, and recognize specific gestures when the user intends to make one. Once a predefined gesture is interpreted at the edge computing unit, the corresponding controlling command will be immediately sent to the specific IoT device, which would respond to it by making actions based on the command.

List of Required Equipment

Item	Amount	References and Notes
Bend sensor	5	https://shop.flexpoint.com/products/the-bend-sensor%C2%AE
IMU sensor	1-3	adafruit bno085, bno055 or any other IMU available
Hall Effect Sensors	5	A3144 or alternatives.
Mini magnets	5	https://www.amazon.de/-/en/Oblique-Unique-Mini-Magnets-Ultra-Strong/dp/B01JCKOYRI

Components which we already have access to, such as ESP32/ESP8266 and Raspberry PI are omitted from this list for simplicity. Further additions such as li-po batteries or 3d printed parts might be required later on.

Use of Equipment

- **Bend sensors:** Will be installed on the finger part of the glove, so that whenever the user tries to make a gesture, the finger movement would be caught by the bend sensors and signals would be transferred forward to the microcontroller.
- **IMU sensor:** Will be used for providing more degrees of freedom to improve gesture recognition. There is varying library support for different IMUs, so having access to several different models will give us more flexibility.
- **Hall effect sensors + Mini magnets:** Can be used as an alternative to bend sensors for finger tracking. Puts less stress on the fingers compared to bend sensors. Physical positioning of these sensors and magnets require more precision compared to bend sensors.
- **ESP32 development board:** Will be used in the glove. Preferred over other microcontrollers because of the built in WiFi and Bluetooth connectivity and low power requirements.
- **Raspberry Pi:** Will be used as the edge computing unit, allowing our smart glove device to offload computationally heavy gesture recognition computations and device control logic to a device with no power or weight constraints.

Implementation Plan

For the implementation of this project we will focus on the construction of the glove and the reading and transmission of the gesture data. Therefore we will first focus on establishing basic functionality and then optimize the glove for everyday use such as energy efficiency.

For controlling the devices we will create a framework that can be extended with gestures and devices at the end of the project. The amount of gestures and devices we support will depend on our progress in the other areas.

With this background, we have divided our goals into the 4 sprints as follows

Sprint 1 (8 May - 21 May):

- The first prototype of the glove
- Configure movement sensors
- Establish connection to the edge device

Sprint 2 (22 May - 4 June):

- Recognize and interpret hand movement patterns on the edge device
- Optimize w.r.t. Energy efficiency

Sprint 3 (5 June - 25 June):

- Establish object selection scheme
- Control simple IoT devices using commands from finger movements

Sprint 4 (26 June - 9 July):

- Provide framework add new devices
- Recognize more gestures, and control more advanced IoT devices

GitLab Repo

<https://gitlab.lrz.de/edge-iot-team-2/smart-glove-control-system>