Smart Glove Control System

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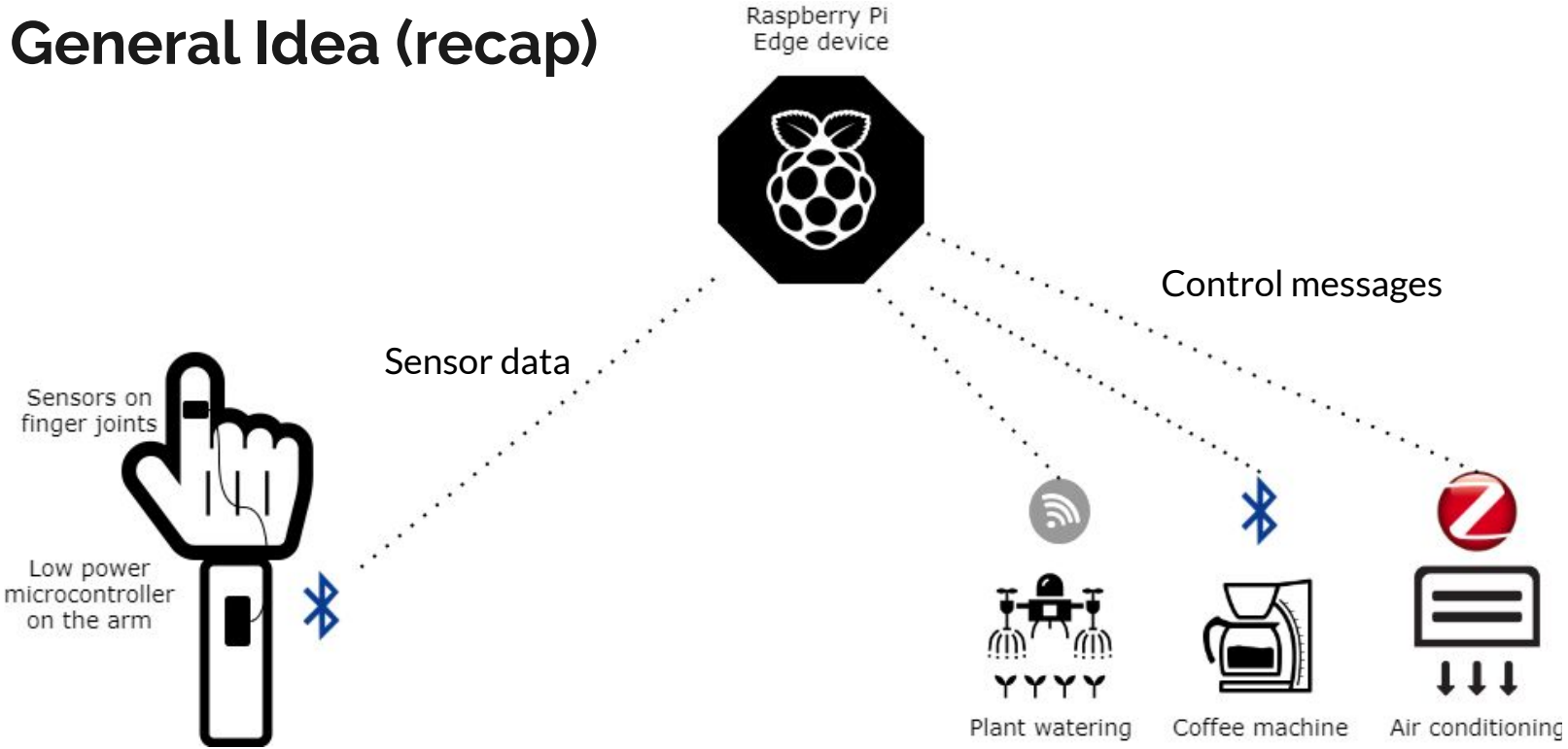
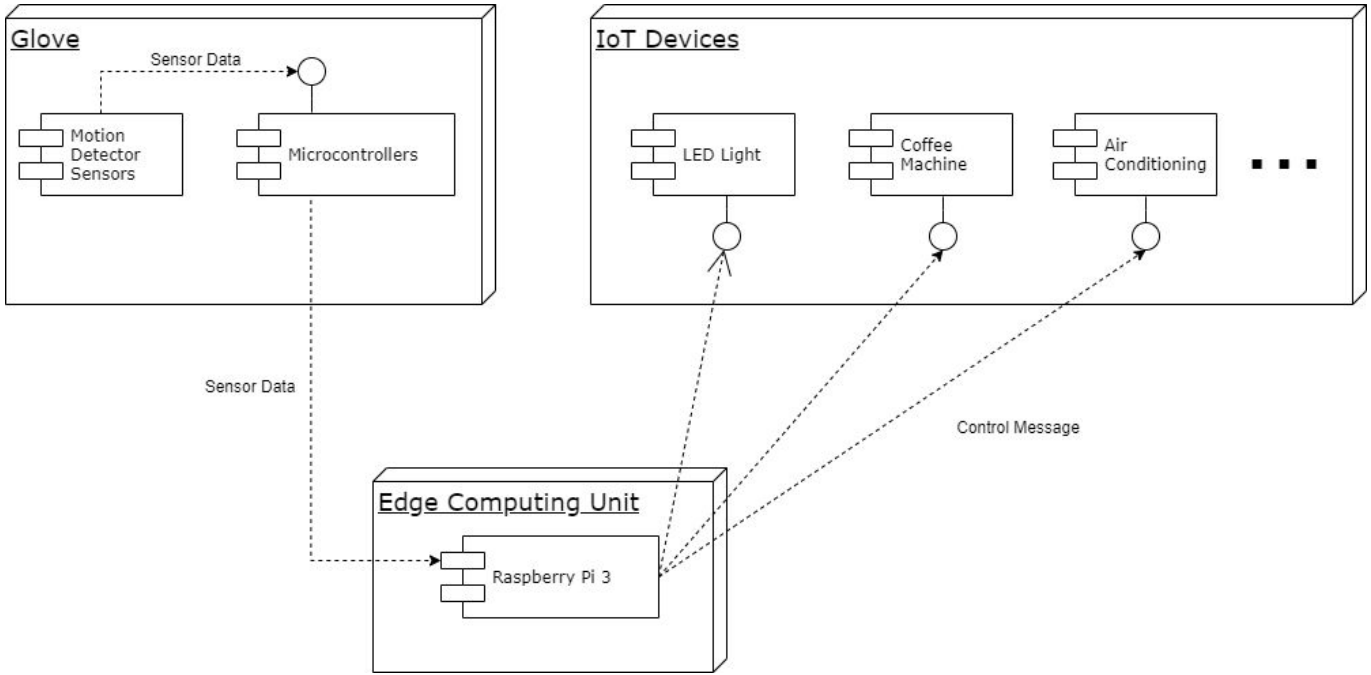
General Idea (recap)



Architecture Diagram



Sprint 3 Recap

What has been done:

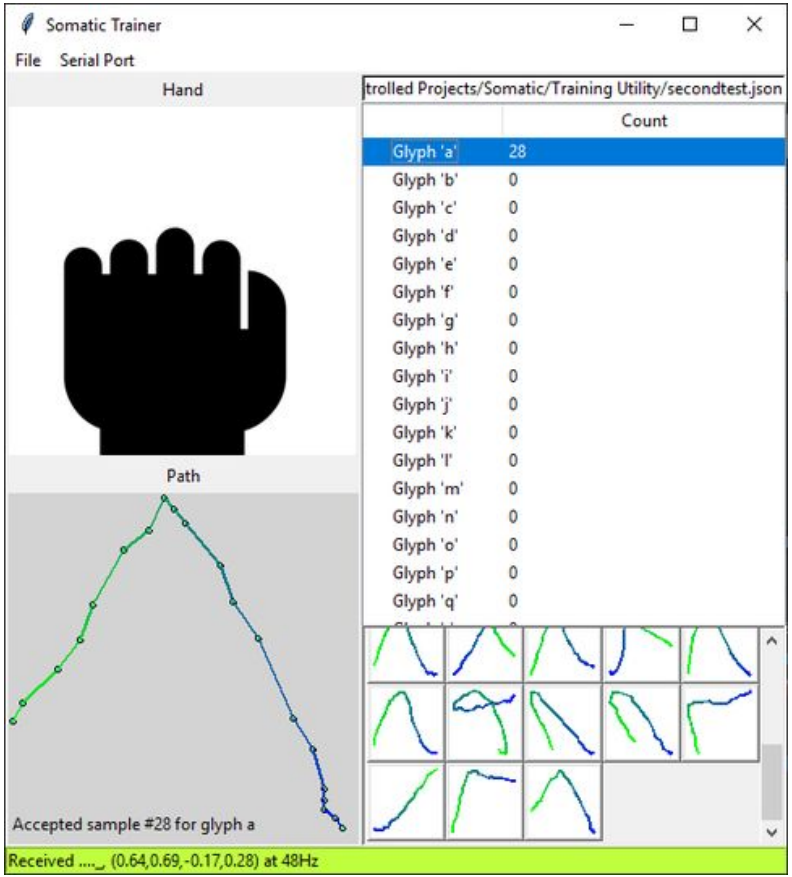
- Started working on several machine learning approaches.
- Implemented data collection to CSV files. Started developing an alternative data collection utility.
- Decided to write a desktop application, analogue to our IoT LED devices, to better show how the devices react to gestures during online presentations.
- Collected data for a single gesture and some noise. Trained a basic svm model to recognize that single gesture given a set of sensor data collected from both of the gesture and the noise.
- Refactored code, made data flow more clear.
- Added 2 more flex sensors to the glove, final version (some cable management/soldering later on, but no major changes expected)

Finished version of the glove: added four flex sensors to track finger angles and an IMU sensor to track wrist movement.

Machine Learning

Found a discontinued, poorly documented, open source project for sensor data collection and model training.

Looks promising but uses defunct APIs, outdated libraries, hard coded for less dimensional sensor data, uses a different communication protocol, hard coded for specific hardware and more...

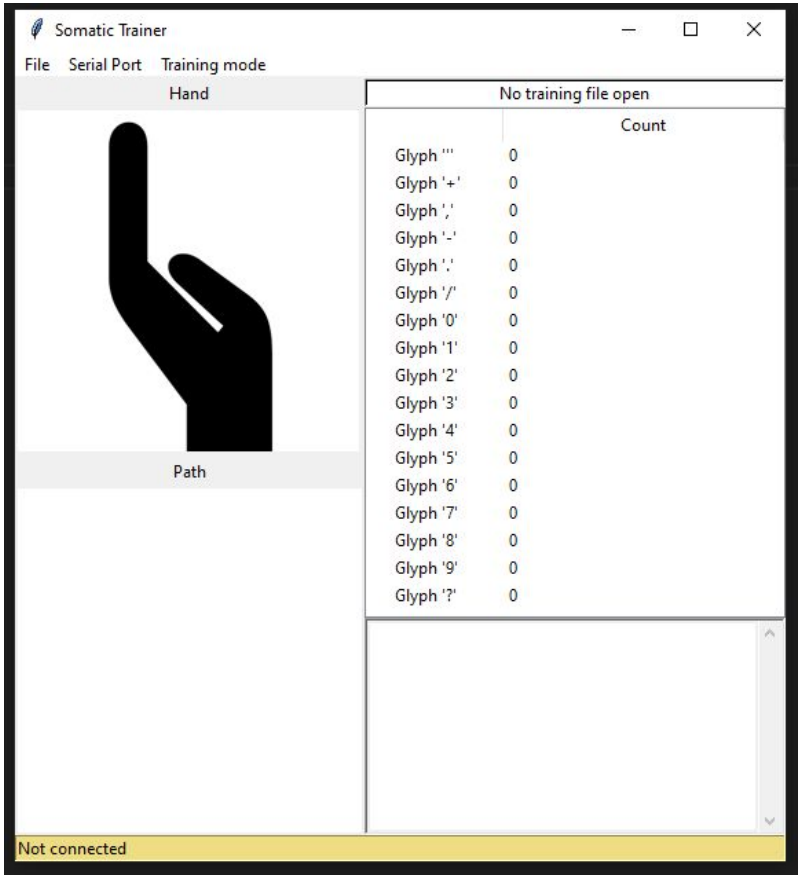


Machine Learning

Fixing and reverse engineering the project to make it work with our glove.

Especially useful for data collection and visualisation.

Machine learning needs to be reimplemented from scratch.



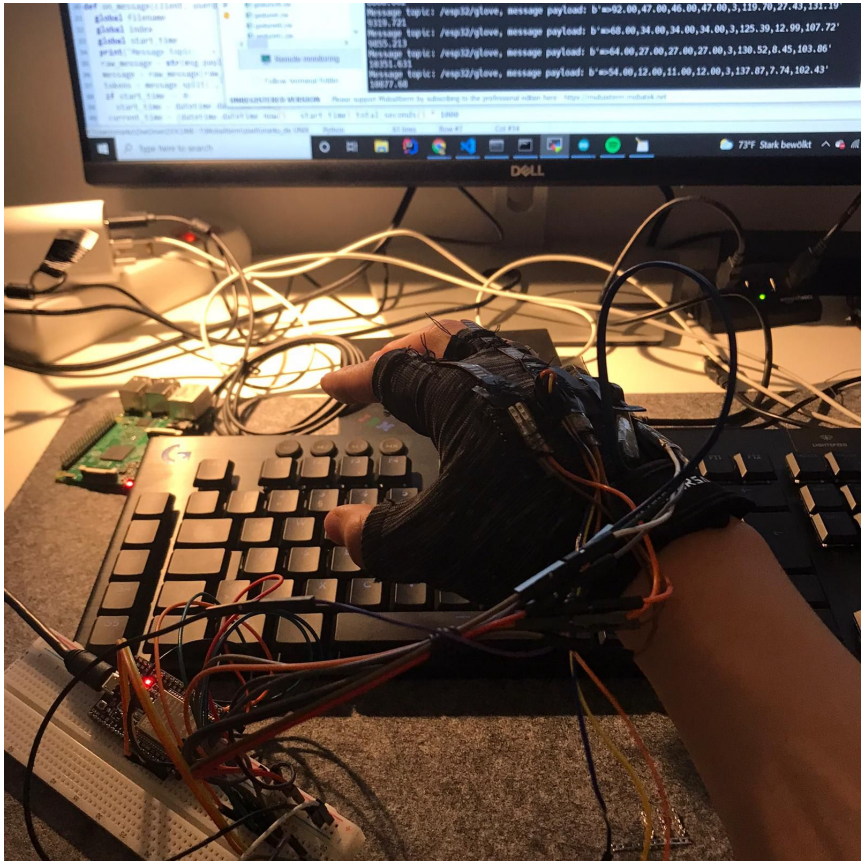
Machine Learning

Separately, implemented a simple data collection program which records sensor data to CSV files.

Collected data (1x50 gesture, 50 noise samples).

gesture0.csv 1.51 KB

```
,timestamp,flex_1,flex_2,flex_3,flex_4,IMU_status,yaw,pitch,row
0,0.028,22.00,10.00,10.00,9.00,3,94.79,4.07,-158.00
1,496.419,120.00,86.00,84.00,84.00,3,90.88,3.86,-156.16
2,1005.8940000000001,39.00,69.00,68.00,69.00,3,91.21,10.19,-158.14
3,1563.642,28.00,69.00,67.00,67.00,3,120.13,9.72,-163.53
4,2041.131,73.00,64.00,64.00,64.00,3,121.70,8.52,-163.14
5,2570.08,46.00,28.00,28.00,28.00,3,122.15,7.98,-162.70
6,3076.354,44.00,6.00,6.00,6.00,3,123.96,6.51,-162.84
7,3620.2830000000004,44.00,1.00,2.00,0.00,3,125.38,9.08,-161.13
8,4110.852000000001,39.00,-1.00,-2.00,-1.00,3,125.01,9.64,-160.92
9,4639.196,35.00,-6.00,-5.00,-6.00,3,124.68,9.29,-161.30
10,5147.34,28.00,-6.00,-7.00,-6.00,3,125.46,10.03,-161.11
```



Machine Learning

Tried using a basic SVM model for training.

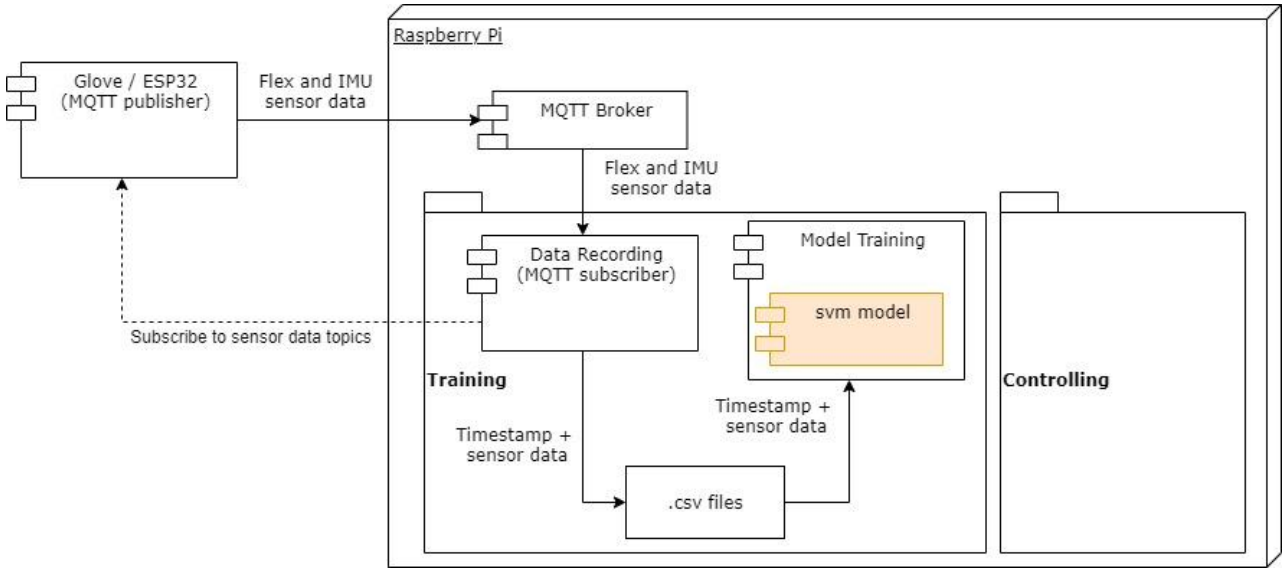
```
(184,)
99
MQTT/Broker/CSV_testing/noise\noise9.csv
Accuracy is  0.9666666666666667
PS C:\Users\marku\OneDrive\Documents\TUM\smart-glove-control-syst
```

Our research suggests using Random Forest/XGBoost might be better for this kind of data.

(https://github.com/lwoiceshyn/Time-Series-Gesture-Detection)

Machine Learning

Machine Learning data recording and model training:



Sprint 3 Recap

What was missed out:

Implement controlling part to process live gesture sensor data, and test out the model by interpreting live message sent from the glove and control the LEDs (integration test). Only training part is implemented using saved csv files.

Sprint 4 Plan

- Improve data collection process.
- Data preprocessing to capture the most important features in the raw sensor data, and use those for model training instead.
- Write a desktop application, analogue to our IoT LED devices, to better show how the devices react to gestures during online presentations.
- Train using the most suitable machine learning framework/model.
- Integration test, which involves using the glove to send out sensor data - machine learning model interpret most likely gesture - send out command to IoT devices

Thank you!

Questions?