



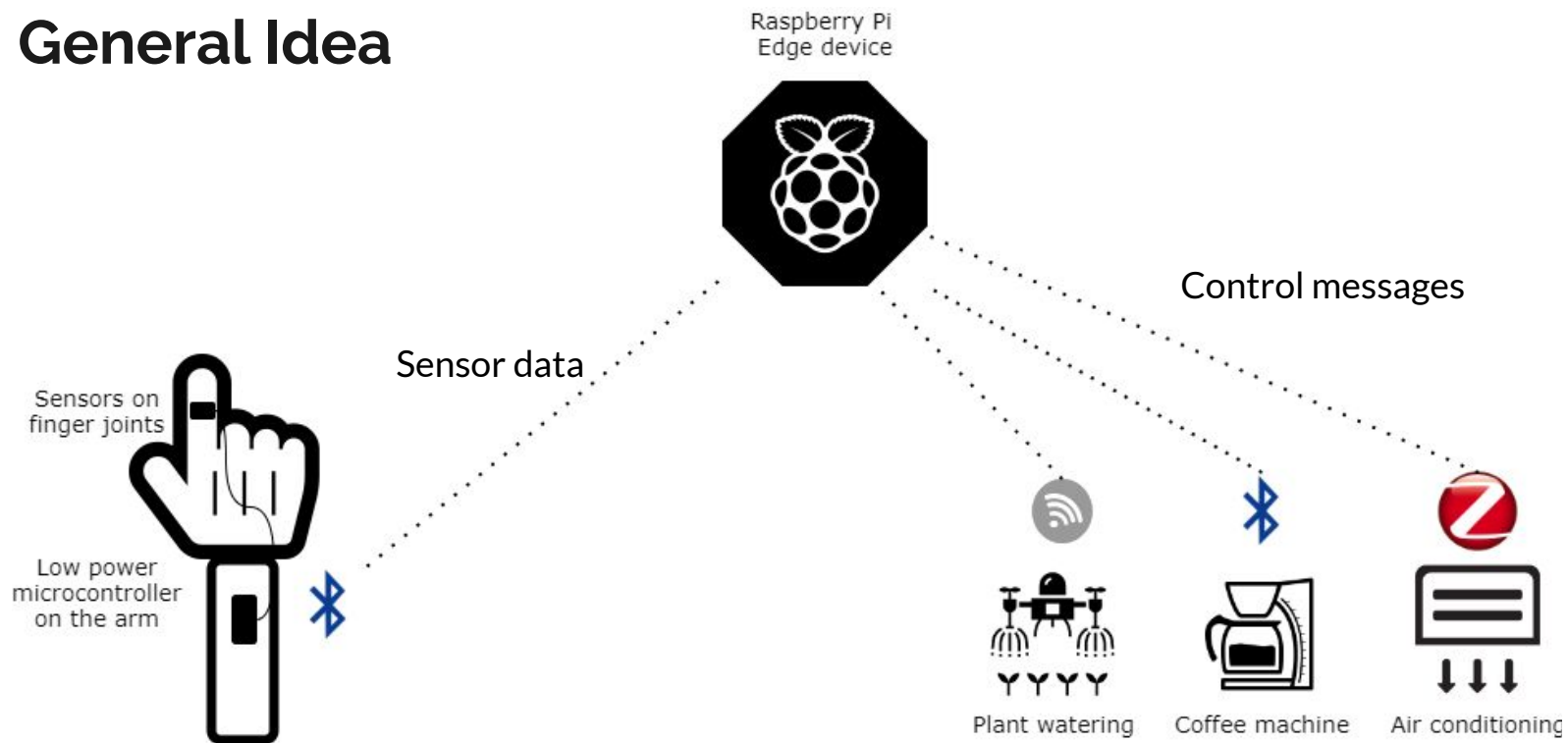
Smart Glove Control System

Final Presentation

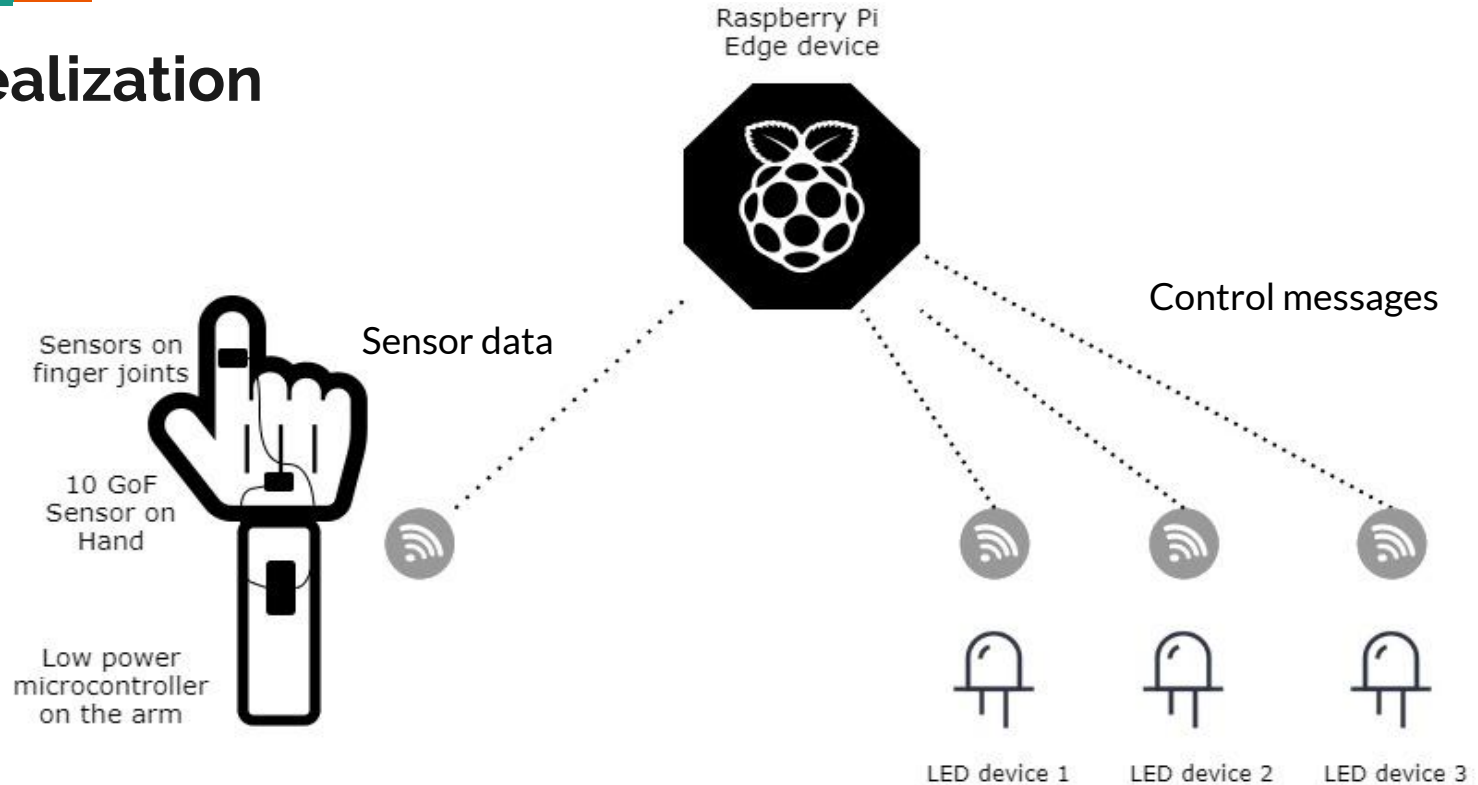
Team 2

- Ata Gün Ögün
- Charles Donven
- Yucong Ma

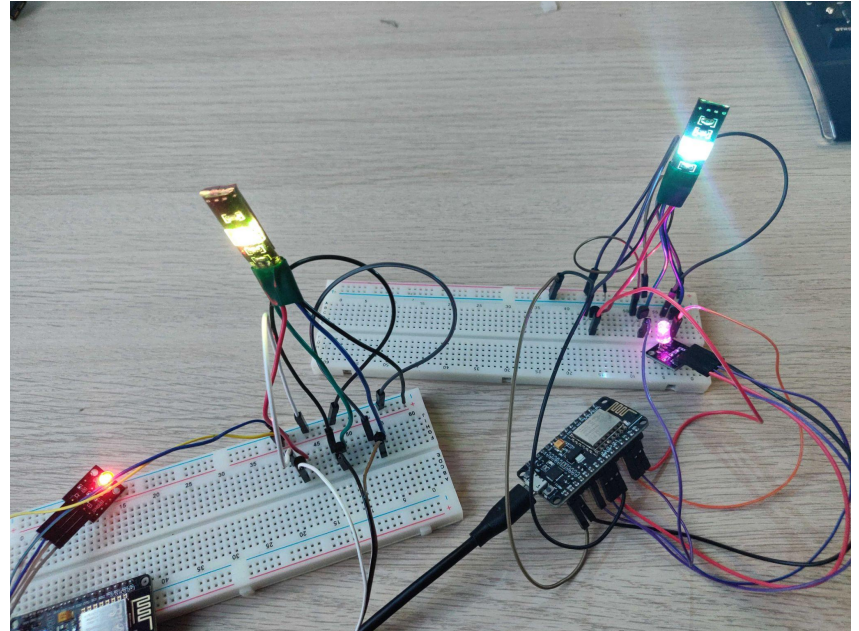
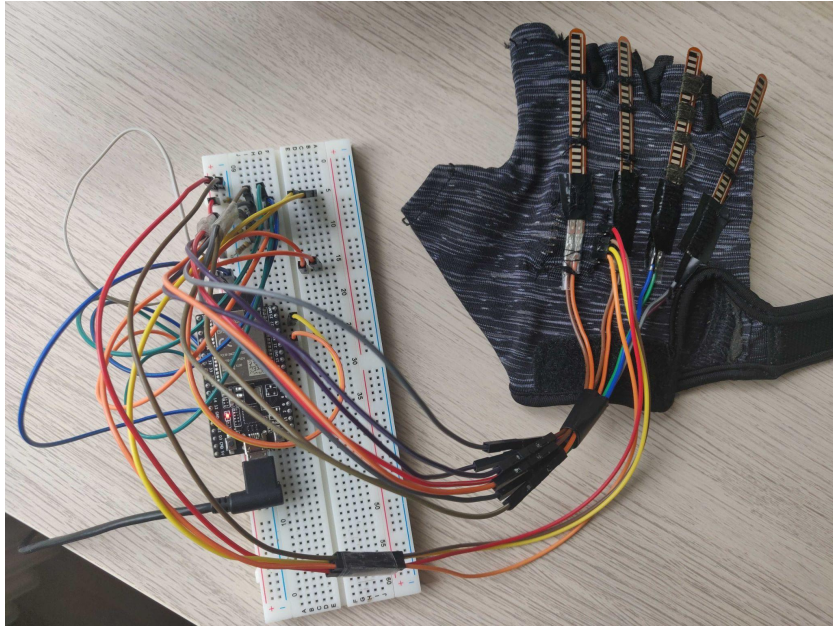
General Idea



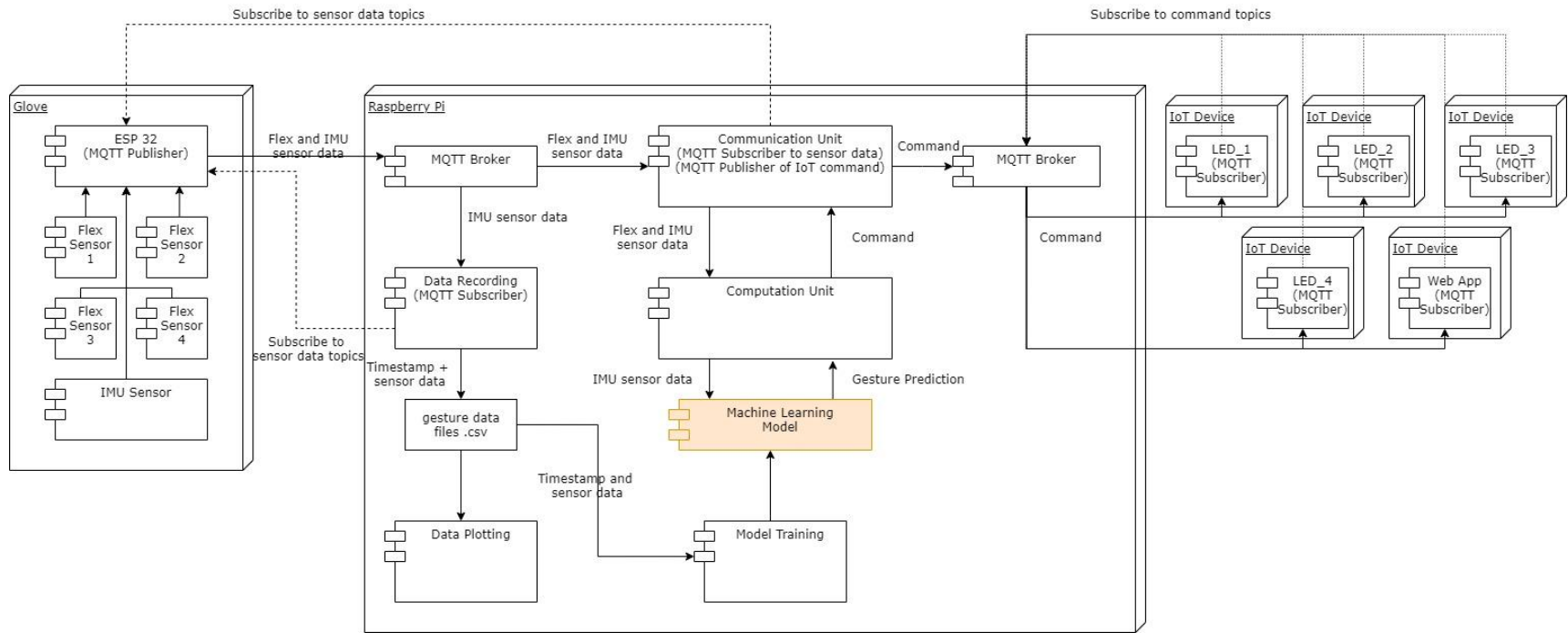
Realization



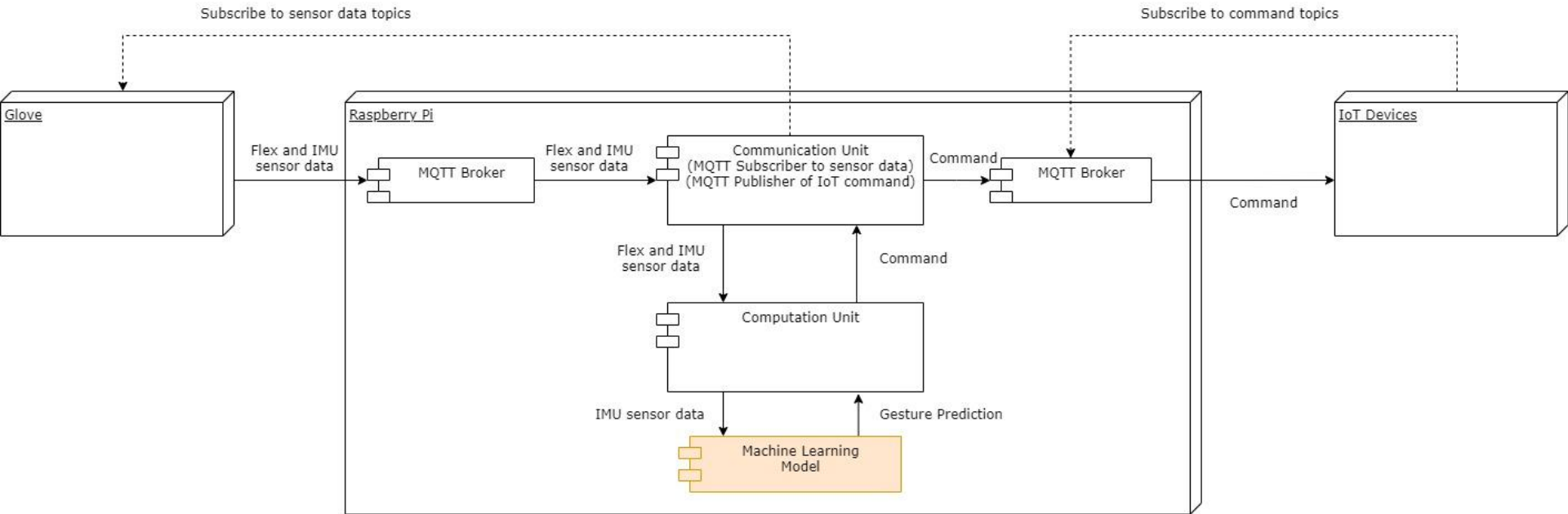
Final Setup



Architecture Diagram



Architecture Diagram: Application





Messaging Protocol: MQTT

- Publisher-Subscriber pattern, subject based
- Reliability
- Scalability

PARAMETER	MQTT (QoS 0)	MQTT (QoS 1)	MQTT (QoS 2)	AMQP	CoAP	HTTP
THROUGHPUT (msg/sec)	75,5	14,3	7,8	67	148,3	11,3
LATENCY (ms)	0	58	56	0	0	18,2

Throughput and latency comparison chart

Source: Reasons and Peculiarities of Choosing MQTT Protocol for Your IoT Devices (2020.09.10),
<https://www.integrasources.com/blog/mqtt-protocol-iot-devices/>



Last Weeks Work

What has been done:

- Integrate IoT simulating web app to the program and display visual demonstrations based on commands.
- Recorded 5 gestures which are more intuitive (swipe left, swipe right, pull, clockwise, counterclockwise).
- Updated program workflow. Machine learning model is integrated into the original program and recognizes specific user gesture on the fly.
- Updated IoT devices so they can change their behavior on upcoming change request from the broker



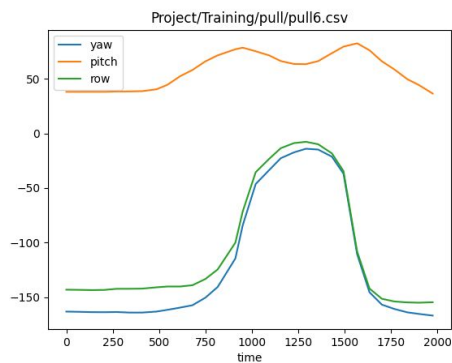
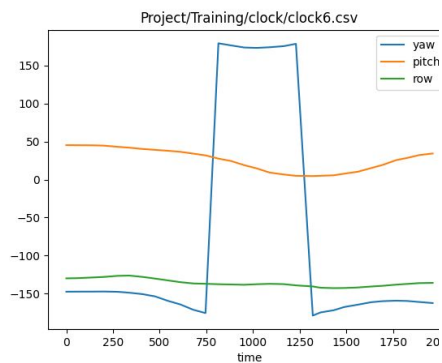
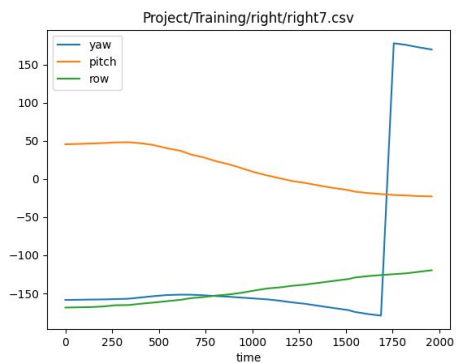
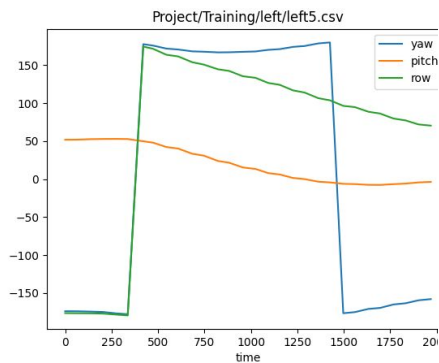
Machine Learning: Data Recording

- Left, right, clock, pull
- 150 individual sets of data for each gesture recorded for plotting model training

left0.csv 1.03 KB

1	,timestamp,yaw,pitch,row
2	0,0.034,-137.15,59.67,-133.96
3	1,67.978,-136.98,60.13,-133.50
4	2,135.51,-136.78,60.49,-133.17
5	3,207.657,-136.37,61.10,-132.54
6	4,272.54,-135.59,61.73,-131.21
7	5,341.07,-135.08,62.68,-129.94
8	6,406.565,-136.92,63.02,-132.08
9	7,476.637,-143.26,61.67,-139.22
10	8,543.646999999999,-149.20,59.77,-146.39
11	9,616.904,-159.67,56.94,-159.36
12	10,679.487999999999,-168.08,54.32,-169.68

Machine Learning: Data Plotting





Machine Learning: Training

Classification algorithms

Logistic Regression accuracy is 98.8889 %

Logistic Regression prediction takes 0.001 seconds

Decision Tree Classifier accuracy is 98.3333 %

Decision Tree Classifier prediction takes 0.0015 seconds

KNeighbors Classifier accuracy is 98.8889 %

KNeighbors Classifier prediction takes 0.0134 seconds

Linear Discriminant Analysis accuracy is 97.7778 %

Linear Discriminant Analysis prediction takes 0.0005 seconds

SVM linear kernel accuracy is 96.6667 %

SVM linear kernel prediction takes 0.0025 seconds

SVM non-linear (rbf) kernel accuracy is 97.2222 %

SVM non-linear (rbf) kernel prediction takes 0.0069 seconds

Regression algorithms

Linear Regression accuracy is 83.6112 %

Linear Regression prediction takes 0.0069 seconds

Decision Tree Regressor accuracy is 93.1355 %

Decision Tree Regressor prediction takes 0.0045 seconds

Random forest small tree accuracy is 98.4472 %

Random forest small tree prediction takes 0.005 seconds

Machine Learning: Live Testing

1	expected command	program output	expected gesture	program prediction	time (seconds)						
2	next device		1	1	0,005942						
3	next device		1	1	0,005644						
4	previous device		2	2	0,005655						
5	next color		1	1	0,006266						
6	previous color		2	2	0,006321						
7	higher brightness		4	4	0,011972						
8	lower brightness		3	3	0,005674						
9	next color		1	1	0,00581						
10	lower brightness		3	3	0,005905						
11	next device		1	1	0,006115						
12	previous device		2	2	0,009242						
13	previous color		2	4	0,011165						
14	lower brightness		3	3	0,005758						
15	lower brightness		3	3	0,007757						
16	next device		1	1	0,005856						
17	next color		1	1	0,007841						
18	lower brightness		3	3	0,005537						
19	higher brightness		4	4	0,005414						
20	previous color		2	2	0,005951						
21	lower brightness		3	3	0,012954						
22	higher brightness		4	4	0,006446						
23	previous color		2	4	0,006806						

Expected	Count	Actual	Count	Accuracy
1	31	1	31	100%
2	26	2	24	92.31%
3	24	3	24	100%
4	19	4	19	100%



Live Demo



Future Improvement

- Flex-sensors did not work very well
 - Sewing positions on the glove
 - Hall effect sensors might work better
- More training data for machine learning model training
- Perform analysis and further data augmentation on the collected data
- Connect more IoT devices to the system
- Provide management portal for easy access to configuration



Thank you!

Questions?