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MY VOICE

Department of Electrical and Computer Engineering

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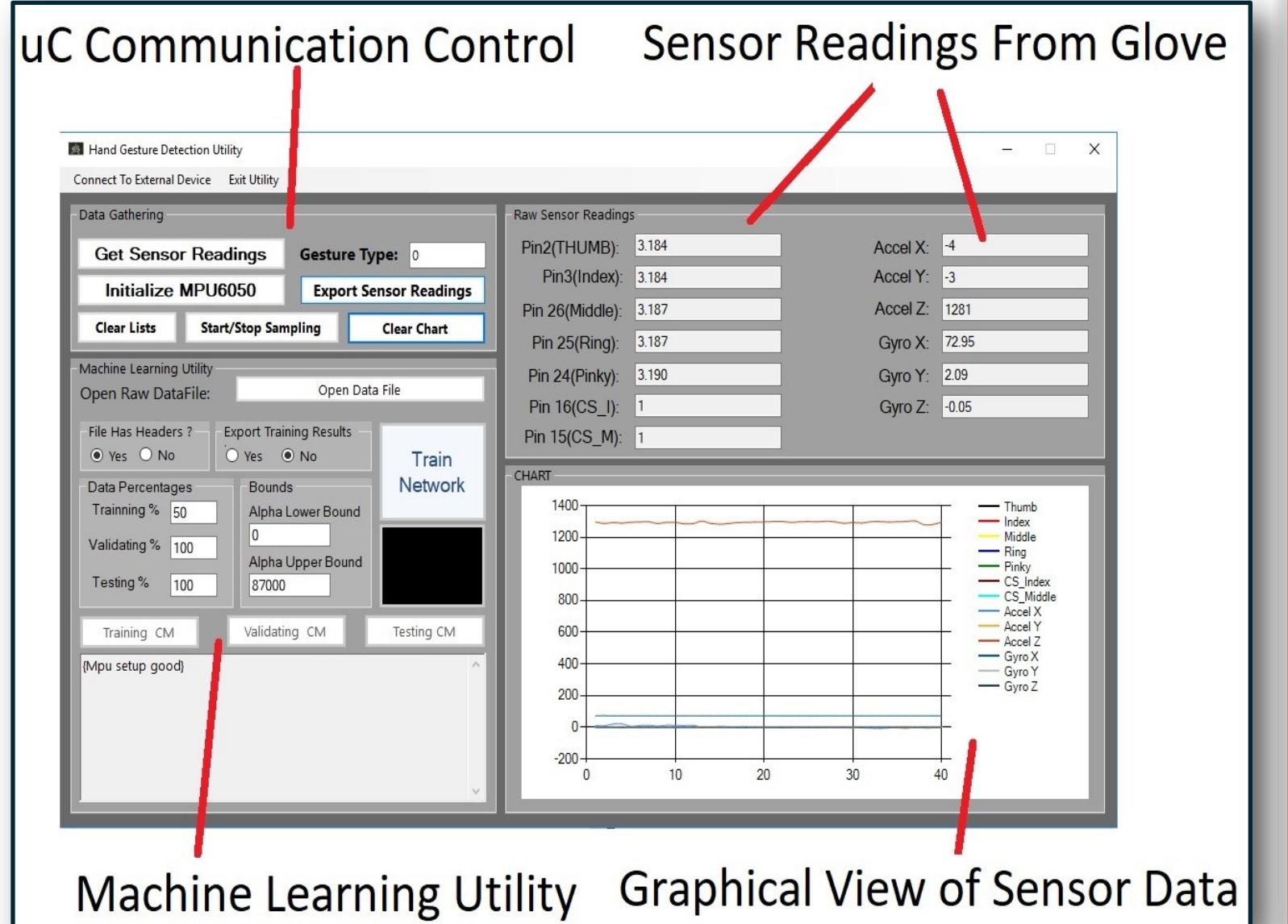


Abstract:

- ◆ People who cannot hear, speak or both must use sign language for communication.
- ◆ Sign language is not global language like English.
- ◆ People who must use sign language cannot properly communicate with people who don't need to use or know sign language.
- ◆ A device that could translate sign language alphabets into audible alphabets would allow some sort of communication to take place.
- ◆ A wearable glove with various sensors that captures hand gestures and uses electronic device to translate the captured sensor data to an audible letter is designed.
- ◆ Machine Learning is implemented in this system to train/recognize hand gestures.
- ◆ Final Product: A wearable glove which uses the sensors attached on it to capture sign language (American Sign Language) alphabet gestures, then use the captured data to output an Audible Letter.

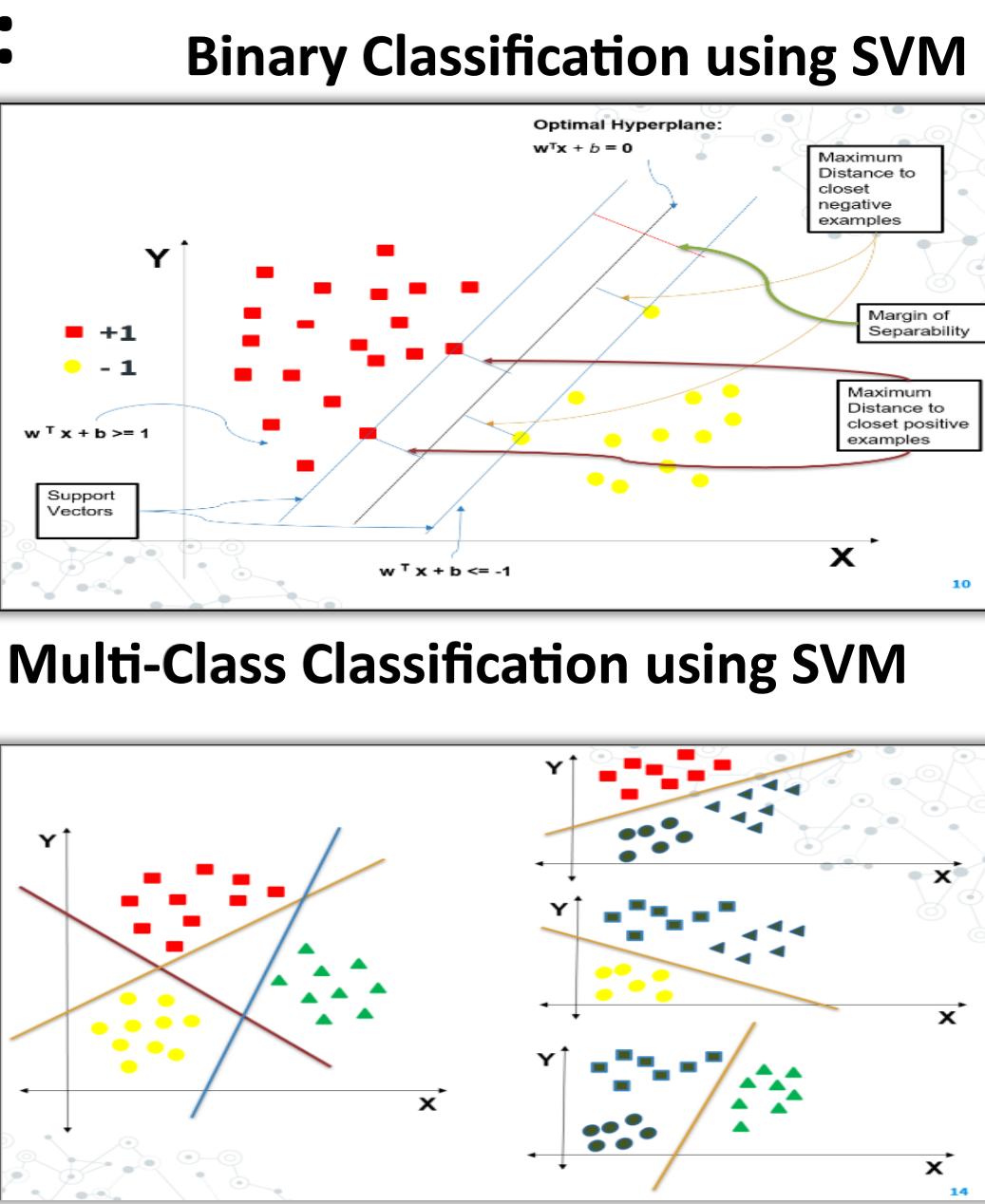
Software Components:

- ◆ The software component is a graphical user interface designed in Microsoft Visual Studio that can communicate with the microcontroller in hardware component to gather/capture data from sensors placed in the glove.
- ◆ The software component also contains a Machine learning Utility that can train a Machine learning Model and make prediction based on the training.

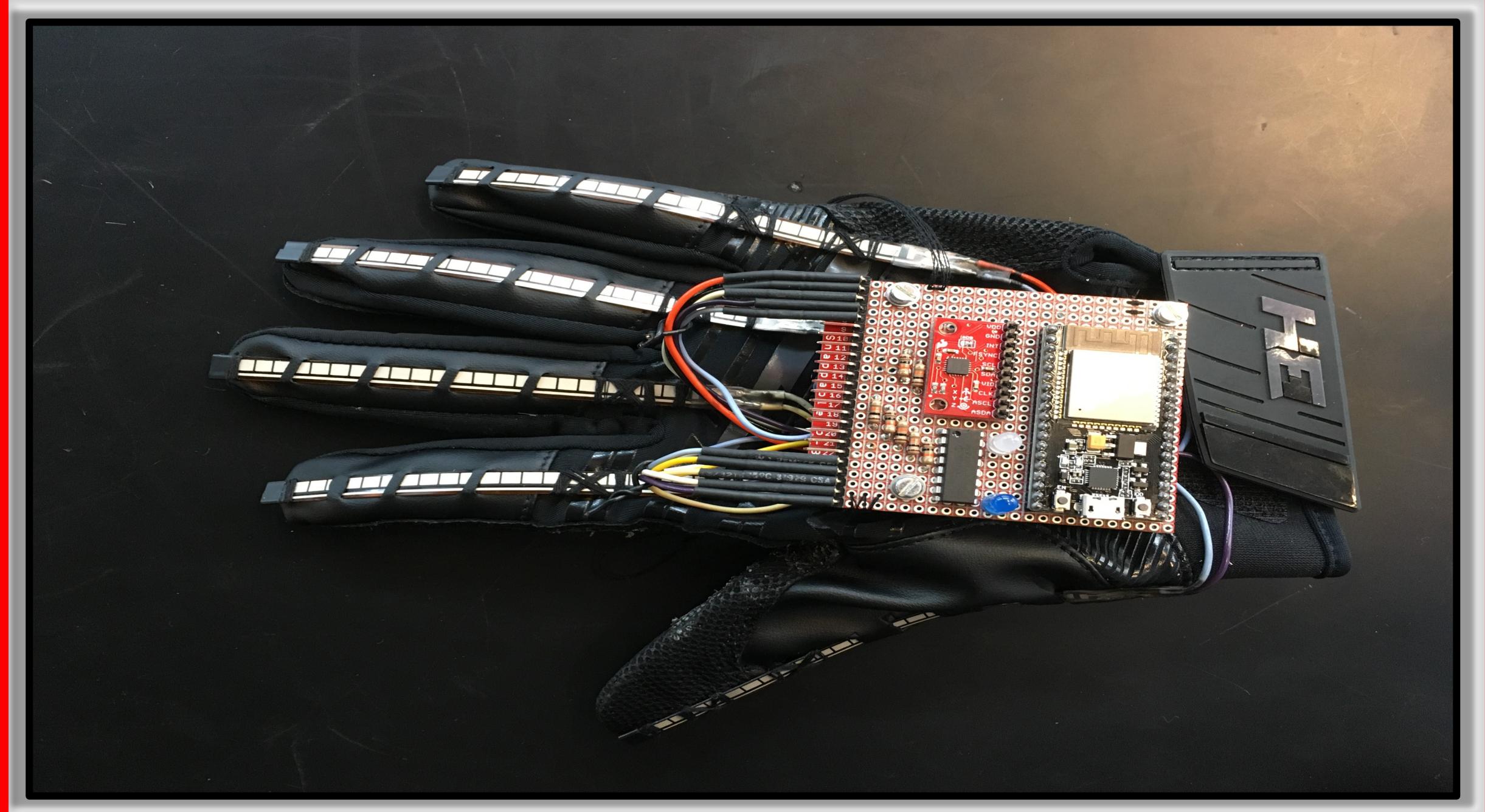
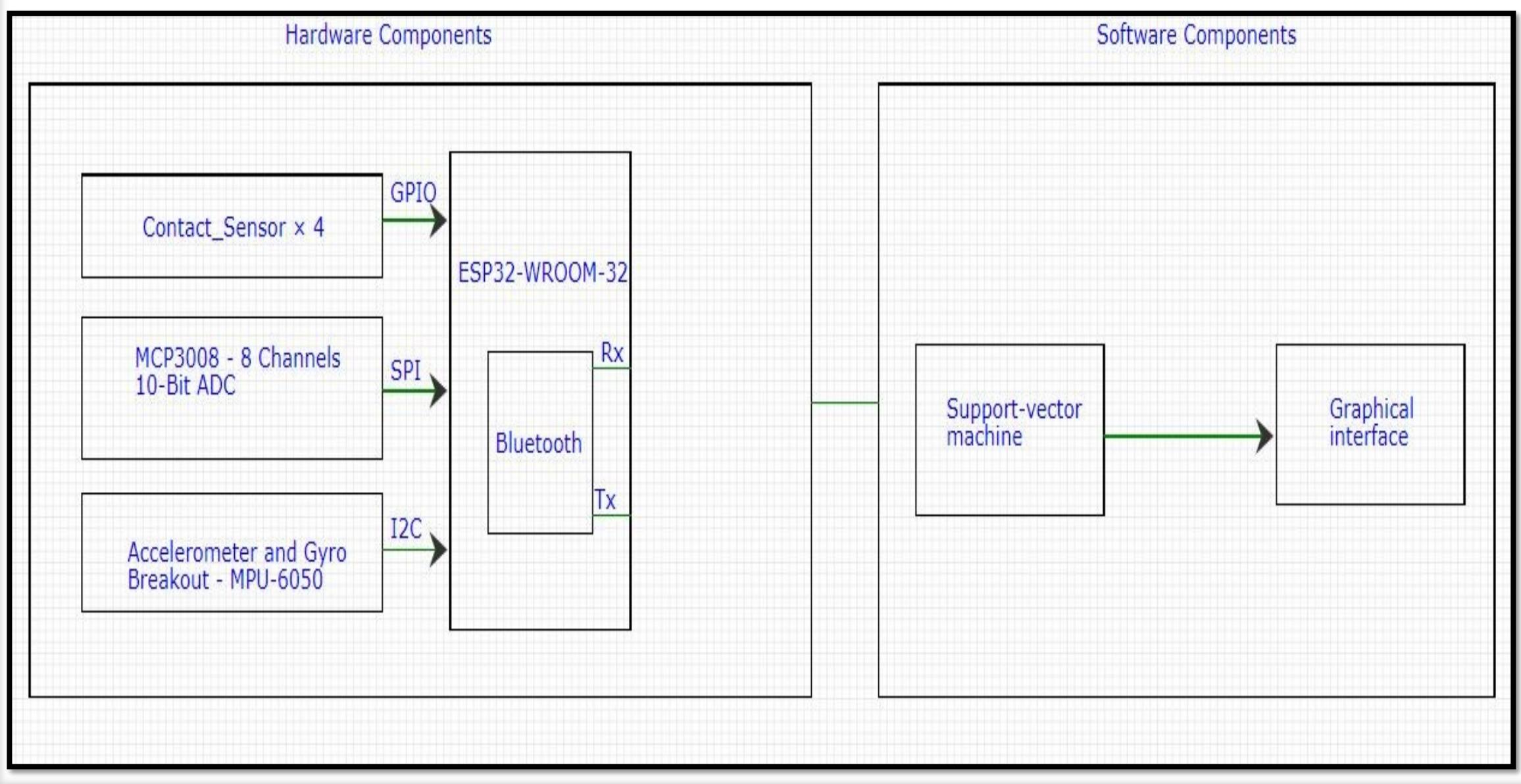


Machine Learning Algorithm:

- ◆ Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial Intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention.
- ◆ Support vector machine (SVM) is the Machine Learning Model/Algorithm used in this project.
- ◆ It is a binary classifier, which when given training samples, constructs a hyperplane as the decision surface in such a way that the margin of separation between positive and negative examples is maximized.



System Design:



Results:

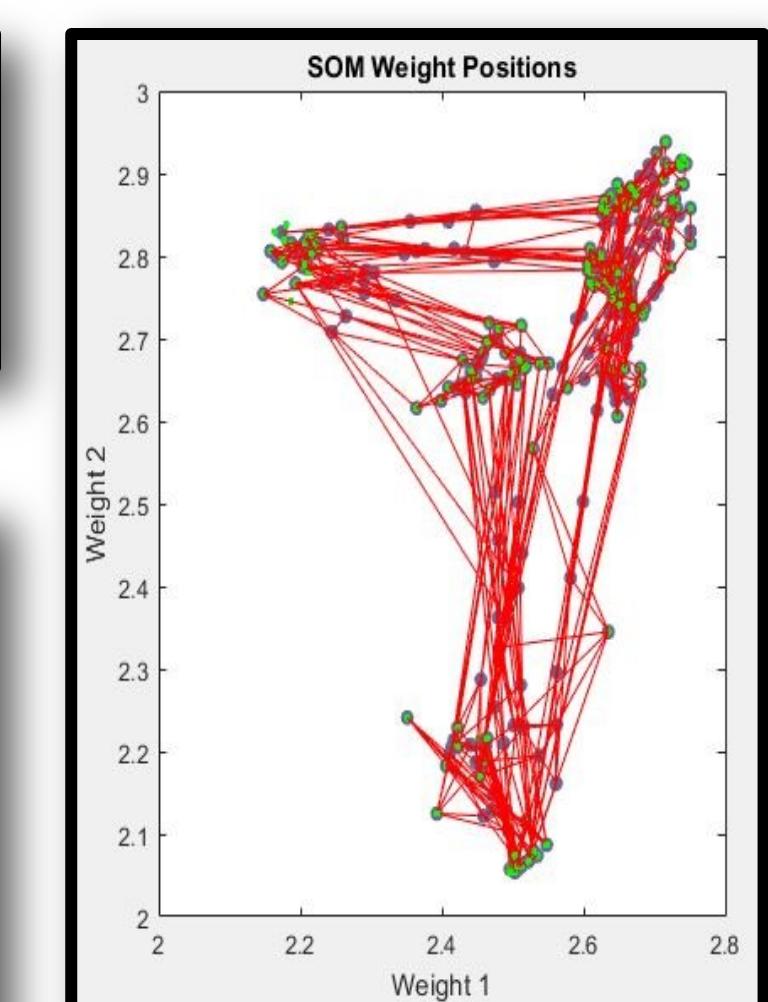
Distance between Data Clusters

```
Points Trained: 78
Quadratic Optimization Time(minutes): 0.002216666666666667
Margin[0]: 0.079917960507482
Margin[1]: 0.0854991742509413
Margin[2]: 0.10333513466141
Margin[3]: 0.0155615238404766
Margin[4]: 0.00342793096344266
Error %: 0
```

Confusion Matrix to show Training Accuracy

		Target Class:0	Target Class:1	Target Class:2	Target Class:3	Target Class:4	Recall %
Predicted Class:0	12	0	0	0	0	100.00	
Predicted Class:1	0	11	0	0	0	100.00	
Predicted Class:2	0	0	13	0	0	100.00	
Predicted Class:3	0	0	0	19	0	100.00	
Predicted Class:4	0	0	0	0	23	100.00	
Precision %	100.00	100.00	100.00	100.00	100.00	100.00	

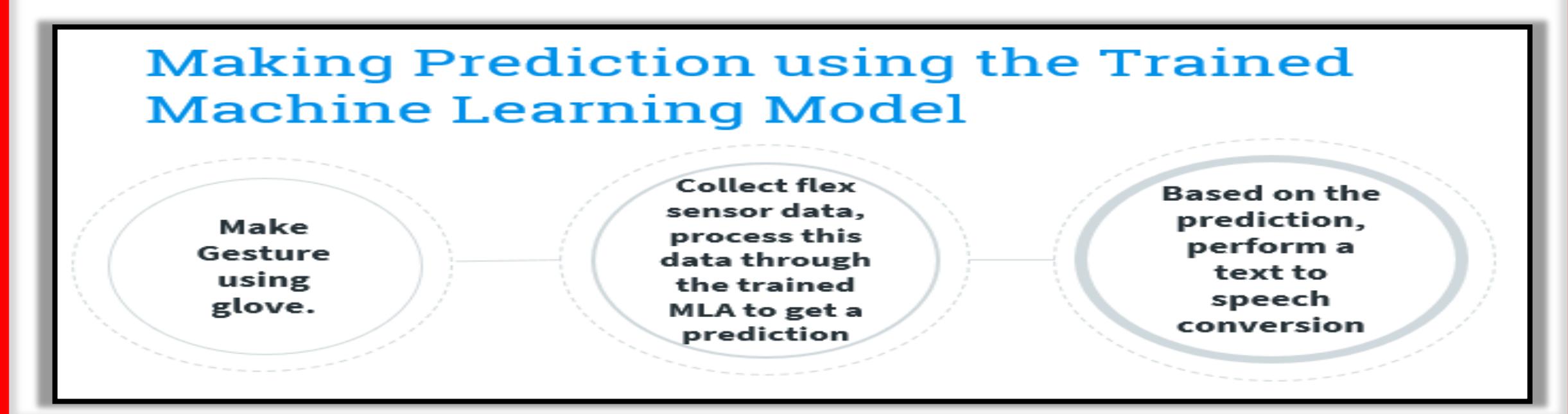
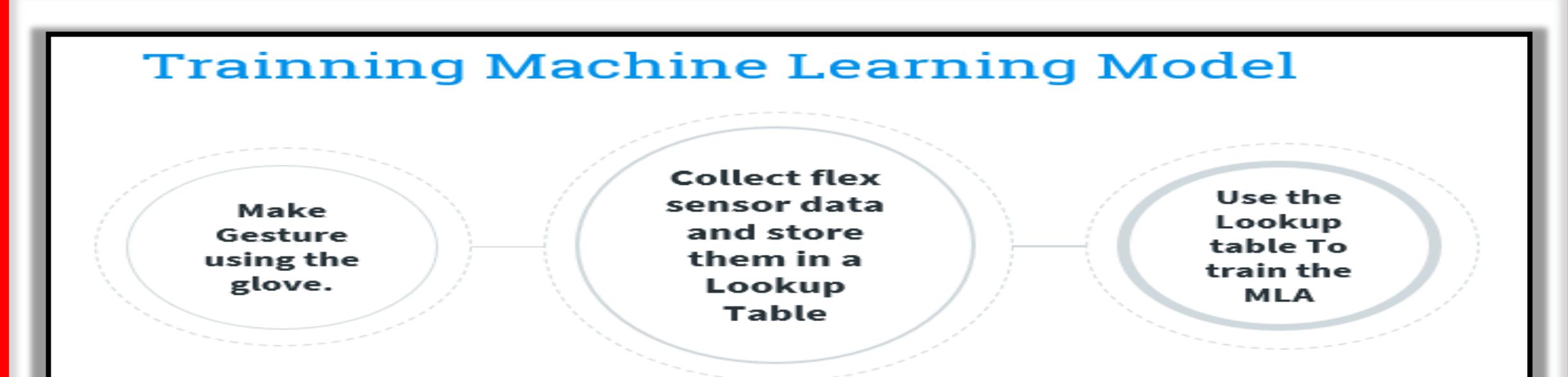
Self Organizing Maps to show data Clusters



Hardware Components:

This system is a glove that has a circuit which consists:

- ◆ Flex sensors : Used to measure bentness of fingers.
- ◆ Contact sensors: Used to distinguish gestures that have similar bentness.
- ◆ Accelerometer and Gyroscope: Used to measure gesture orientations and movements
- ◆ Analog to Digital Converter (ADC): Used to collect data from flex sensor and send it to Microcontroller .
- ◆ Microcontroller (uC) with Built in Bluetooth: Used to collect data from all the above mentioned sensors and send them wirelessly using Bluetooth communication to Software Component for further Processing.



Conclusion:

- ◆ The project explored the possibility of designing a device that could recognize sign language gestures.
- ◆ A glove consisting of varieties of sensors was designed to capture sign language gestures (ASL alphabets only). The captured data was used to train a machine learning model which later was able to predict sign language gestures.
- ◆ Based on the prediction from machine learning model the system was able to output audible letters.

References:

- https://en.wikipedia.org/wiki/Support-vector_machine
- <https://www.csie.ntu.edu.tw/~cjlin/papers/mlbook.pdf>
- <https://www.learnsparkfun.com/tutorials/flex-sensor-hookup-guide>
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- <http://www.microchip.com/downloads/en/DeviceDoc/70292G.pdf>