Rock, Paper, Scissors
Machine Learning Application

CMPE 255 Data Mining
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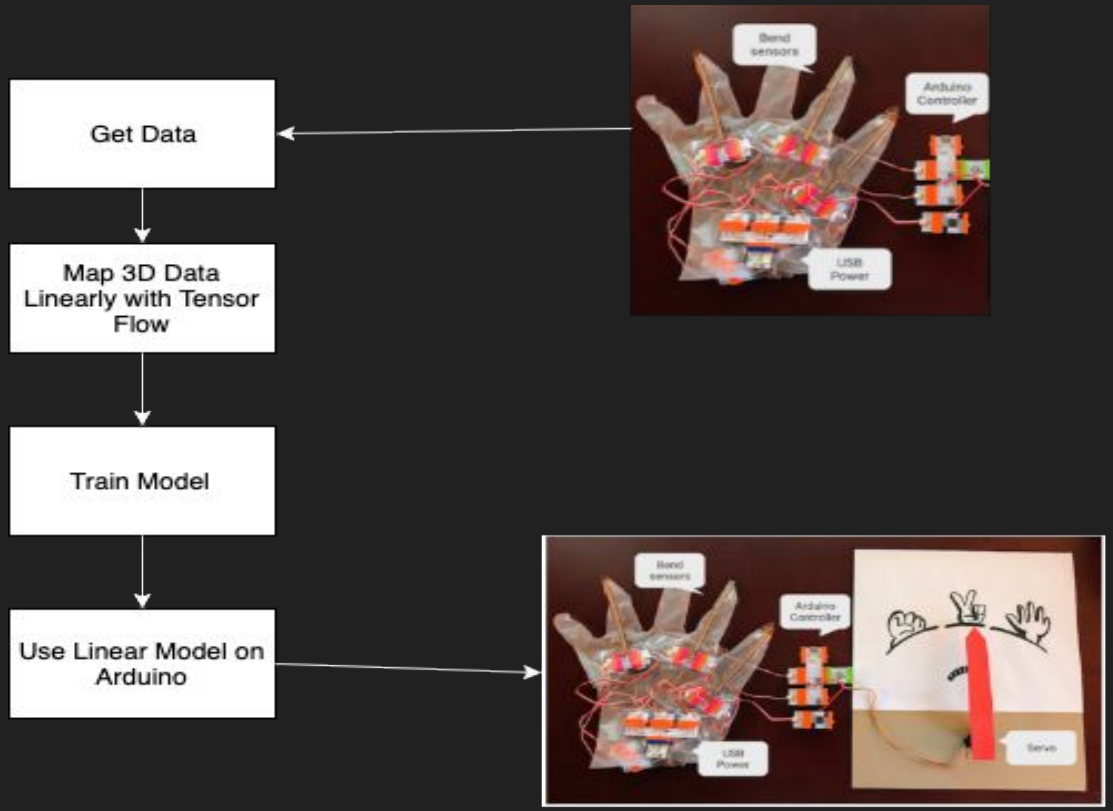
Introduction

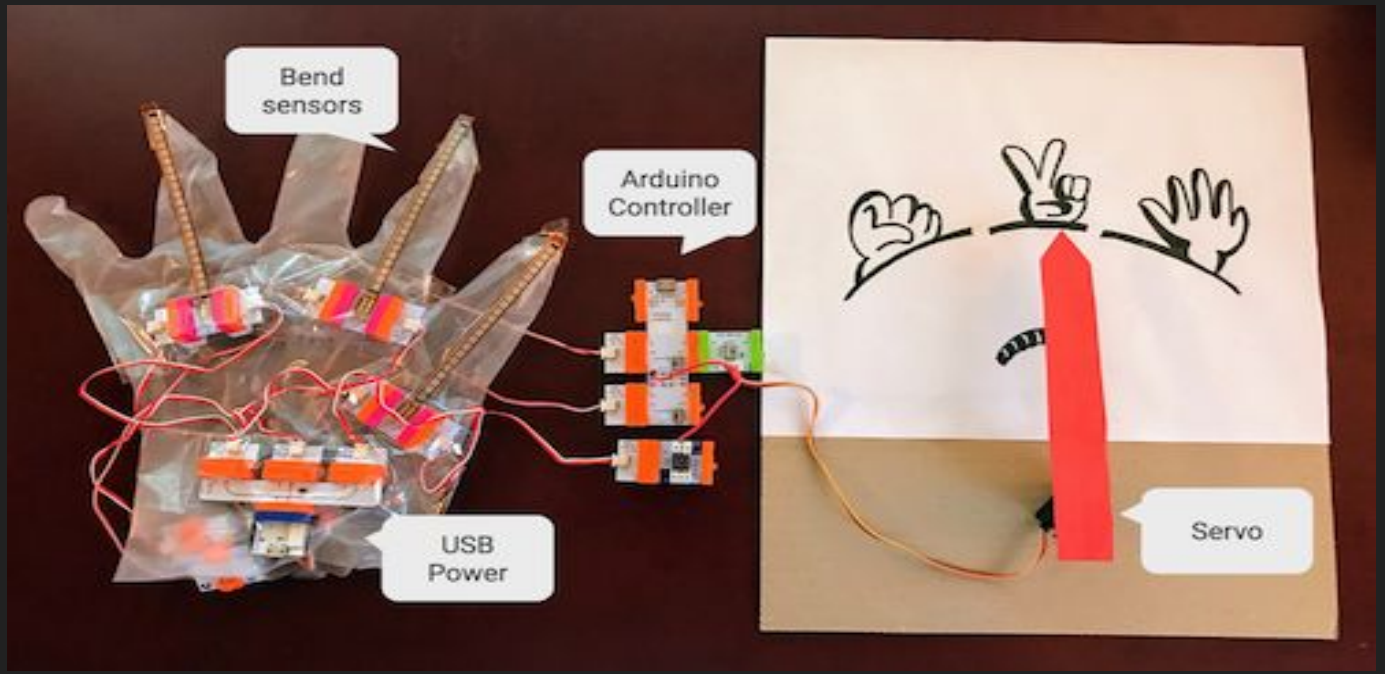
Rock, Paper, Scissors application utilizes both hardware and software components to capture/predict responses for a typical game

High Level Diagram



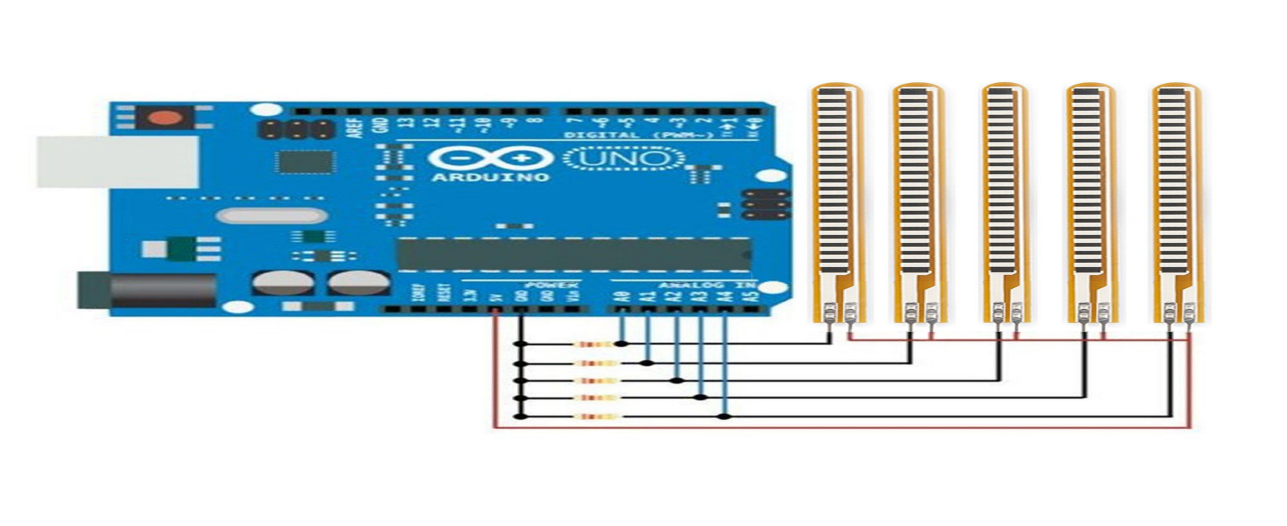
Hardware Setup 1

Overall hardware



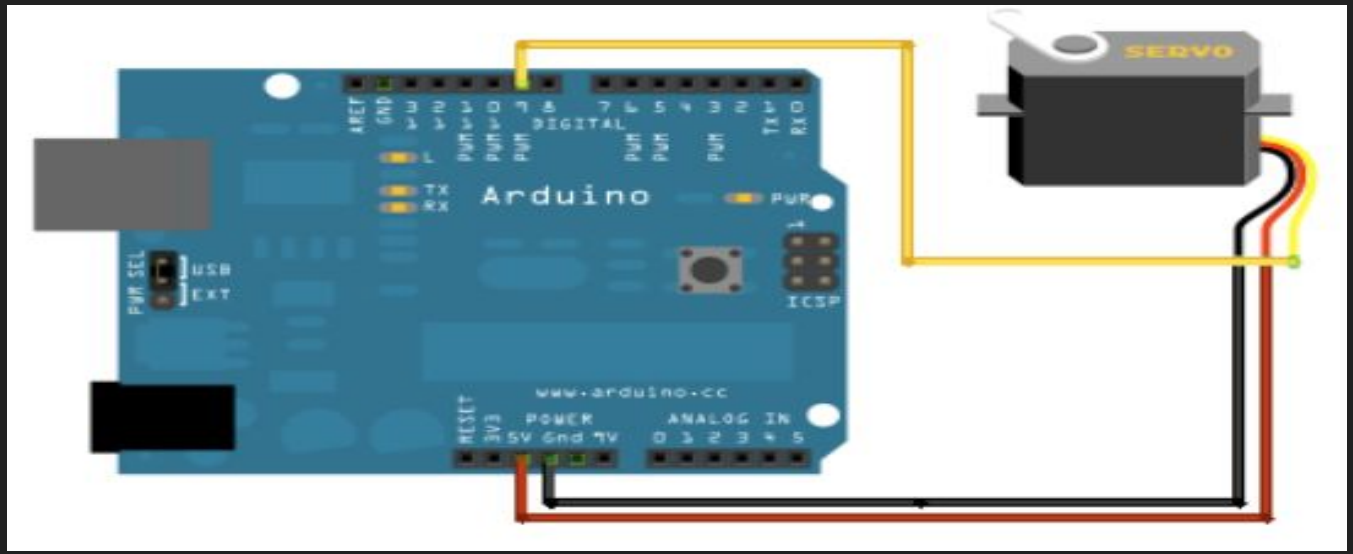
Hardware Setup 2

Connection between flex sensors and Arduino microcontroller:



Hardware setup 2:

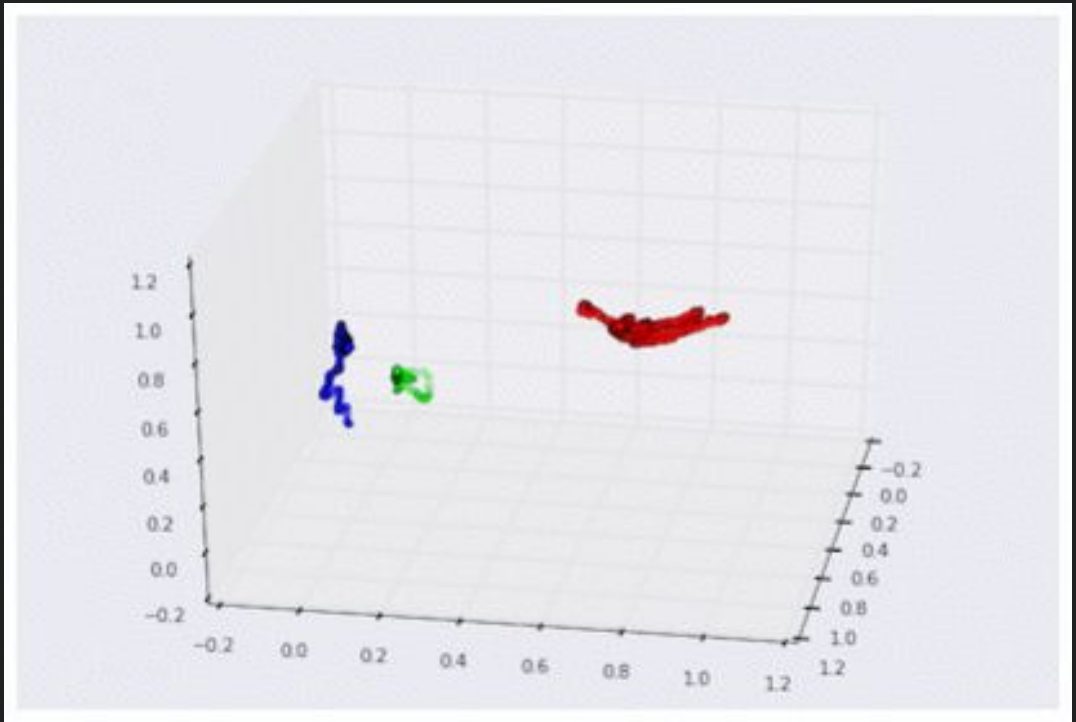
Connections between a Arduino microcontroller and Servo motor:



Step 1 : Getting the Data

- Coding is done on the Arduino module so that it reads data from the bend sensors
- The data is read from the flex sensors every 0.1s and then logged on the serial console
- The Arduino module converts the input signal voltage (0V - 5V) to numbers ranging from 0 to 1023
- The data of rock, paper, and scissors is stored in three different csv files

Step 2 : Visualizing the Data



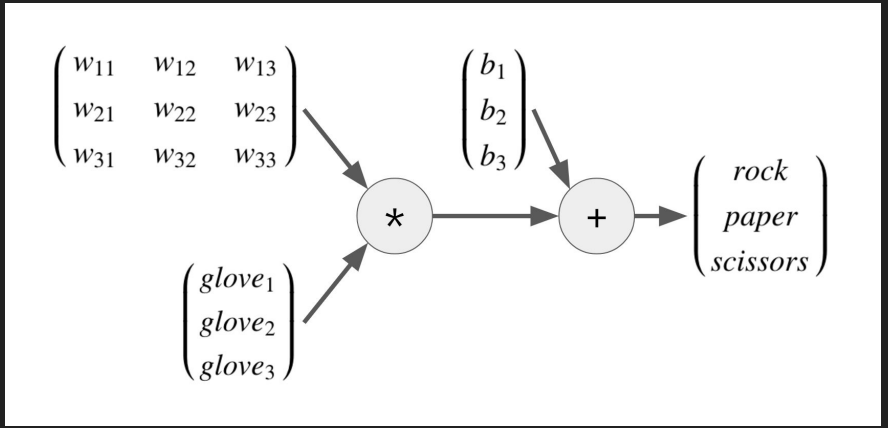
Step 3: Linearly Mapping 3D Data with TensorFlow

- Significant to this project as it allows dynamic determination of dataset values (without need to hardcode ranges).
- TensorFlow attempts to find the best weights and biases that will fit into the linear transformation by calculating them backward in the graph (training the model).
- Formula when transforming 3D data into a linear representation:

$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} w_{11} & w_{12} & w_{13} \\ w_{21} & w_{22} & w_{23} \\ w_{31} & w_{32} & w_{33} \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} + \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$$

Step 3: Linearly Mapping 3D Data (cont.)

- y = wx + B
- 3 x 3 weight matrix dynamically determined by Tensorflow algorithms.
- 1 x 3 glove matrix representation of data gathered by sensors. Represents the linear equations' independent variable.
- Bias dynamically determined by predicting any potential skewing present in dataset.



Step 4 : Training the Model

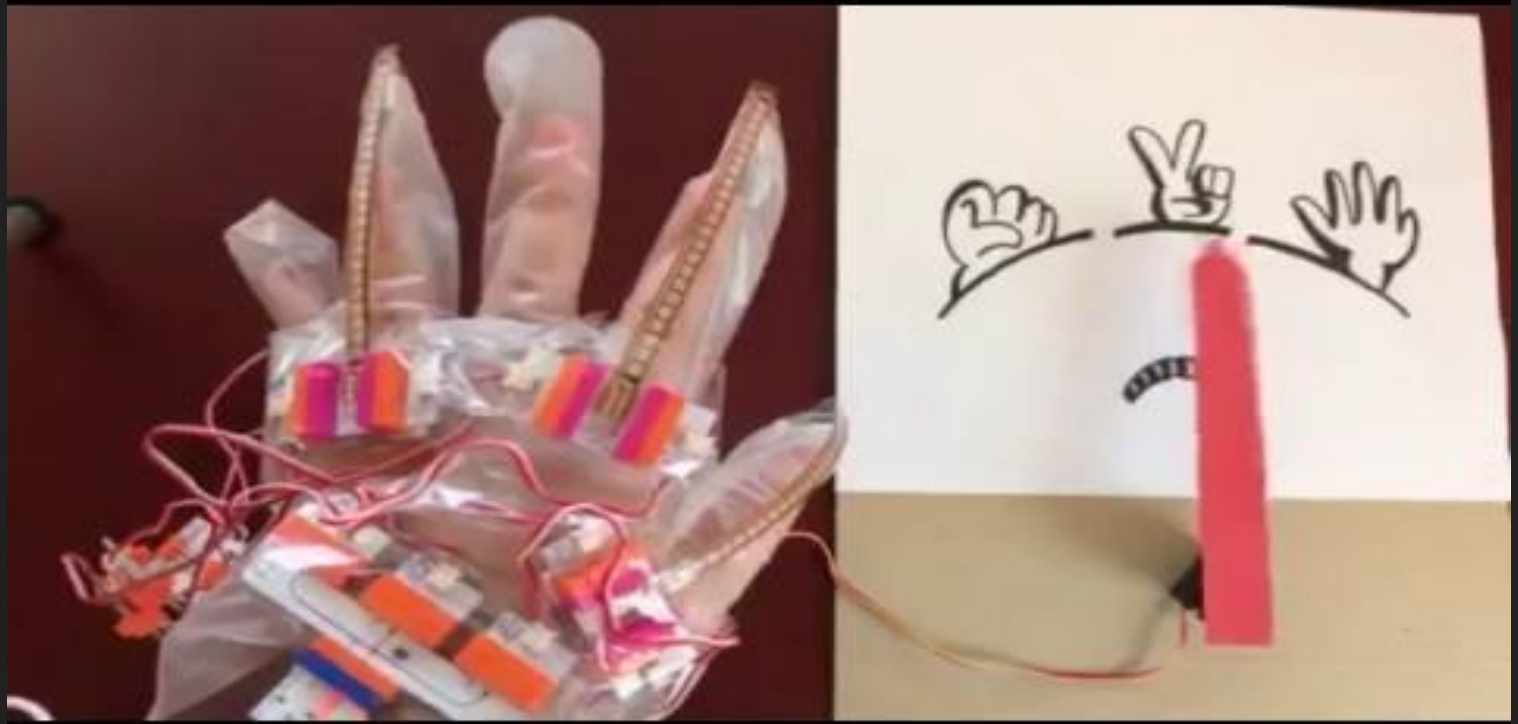
- Define a “coach” for the training
  - Pass hundreds of labels (one-hot labels) for each glove sensor data
    - [1 0 0] for rock
    - [0 1 0] for paper
    - [0 0 1] for scissors
  - Define the loss function (how much error the model has) with a combination of softmax and cross entropy
    - Softmax: squish data into range of 0.0 to 1.0 -- estimated probabilities
    - Cross entropy: returns difference between one-hot labels and estimated probabilities
  - This function will create the “coach” for Tensorflow that will guide it to find the best parameters

Step 4 : Training the Model (cont.)

- Train the Linear Model
  - Run Tensorflow to train the model using an optimizer - Gradient Descent algorithm
  - To run the actual training:
    - create a Session
    - call run method to pass the glove sensor data and labels to the optimizer
    - call run method thousands of times
  - Result of training: good set of weights and biases that can map the glove sensor data into the rock paper scissors space with softmax probabilities

Step 5 : Use Linear Model on Arduino

- Weighted data from the linear model is fed into the Arduino
- Then the linear model on the Arduino maps the glove sensor data into the rock paper and scissors space by doing matrix multiplication on the weights and biases
- From the matrix multiplication we can get the highest value to predict whether it is rock paper or scissors
- Depending on the prediction of the input, the Arduino will determine which output the servo should point to in order to win



References

https://github.com/kazunori279/ml-misc/tree/master/glove-sensor

https://cloud.google.com/blog/products/gcp/my-summer-project-a-rock-paper-scissors-machine-built-on-tensorflow

Thank You