Design Credit Project

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TITLE - Dynamic and muscle stress correlation analysis for human hand

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Objective of the Project

- Electromyography (EMG) and human hand orientation measuring experimental setup
- Lifting weights using a dynamic human body model.
- Matlab data for simulation.
- By using the Machine learning model to analyse the Experimental Data.

Electromyography and Imaginary Design

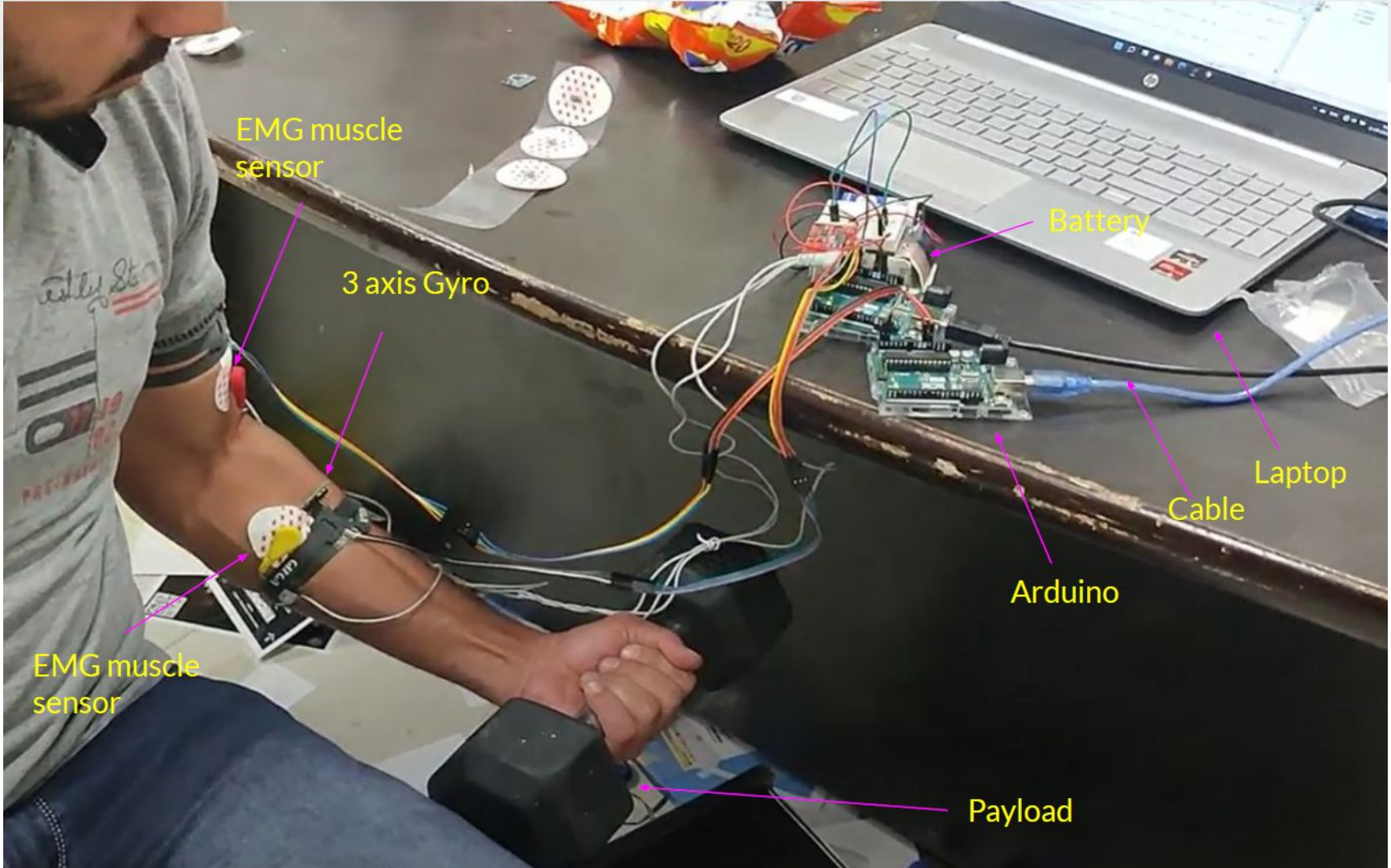
- Electromyography (EMG) is a diagnostic technique for assessing the health of muscles and the nerve cells that control them.
- EMG converts these impulses into graphs or figures that doctors can use to make a diagnosis.
- A 5-DoF (Degrees of Freedom) configuration is the fundamental design proposed for the exoskeleton modelling. This idea may be developed further to more properly simulate the exoskeleton.

Setup for Experiment and Working

- An MPU6050, jumper wires, an Arduino, a laptop, EMG sensors, a battery, and a USB connection cable for Arduino are all used in the basic circuit. The data is interpreted using MATLAB and Simulink software.

- The system receives velocity information from the MPU6050 sensor as well as EMG sensor readings. Both sensors are attached to the participant's triceps and forearms.

- Two Electrodes are connected to Bicep and tricep and One electrode is connected to the Forearms and Start the Simulation

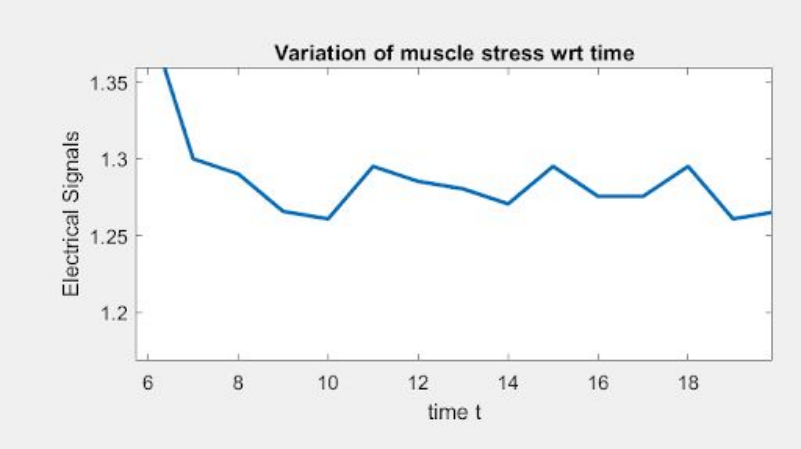

EMG muscle sensor
3 axis Gyro
Battery
Laptop
Cable
Arduino
EMG muscle sensor
Payload

Students were requested to volunteer for data collection, and we gathered the information in the following manner:

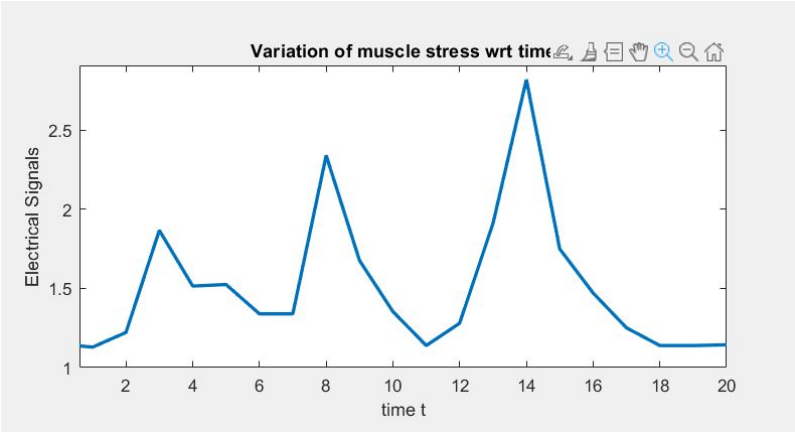
- Students were instructed to sit in a chair and attached the IMU and EMG sensors.
- They were given various payloads and were required to do flexion-extension motions with them.
- They were instructed to do three repeats with the same burden.
- Experiment performed on both Hands with Different weight like 2.5kg and 5 kg.
- Experiments are performed on Athletes (Students) based on their Strength level.
- Students like cricketers ,badminton players ,gymmers or Running Players.

Problem Faced

- The Experiment was done on 20 students, but the EMG sensor has a potentiometer in which sensitivity is low, so the graph of muscle stress variation is linear. So these experimental values are not working.



- We then Increased the sensitivity and adjusted a few pins then the Experiment was again done again on 15 students having total 90 entries from the3 different weighs 0, 2.5 nd 5 kg respectively for both the hands.This worked well and we could proceed further.



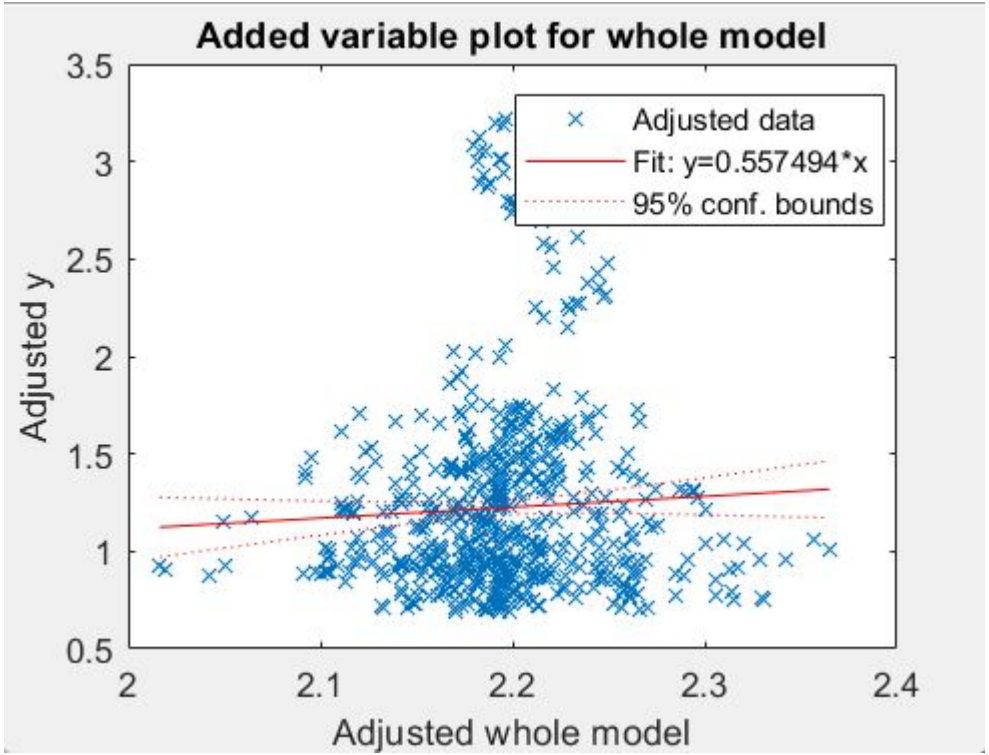
Prediction

- ➔ Now,the next step we want to do is predict :
    - The EMG signal required by hand to overcome a given weight
    - Th weight overcome by the muscles given the EMG data.
- ➔ For this we first had to prepare the data, and then after visualizing the data,we choose Linear Regression model.

Linear Regression Model

- A fitted linear regression model object is Linear Model. The connection between a response and its predictors is described by a regression model.
- A linear regression model's linearity refers to the predictor coefficients' linearity.
- The model display includes the model formula, estimated coefficients, and model summary statistics.

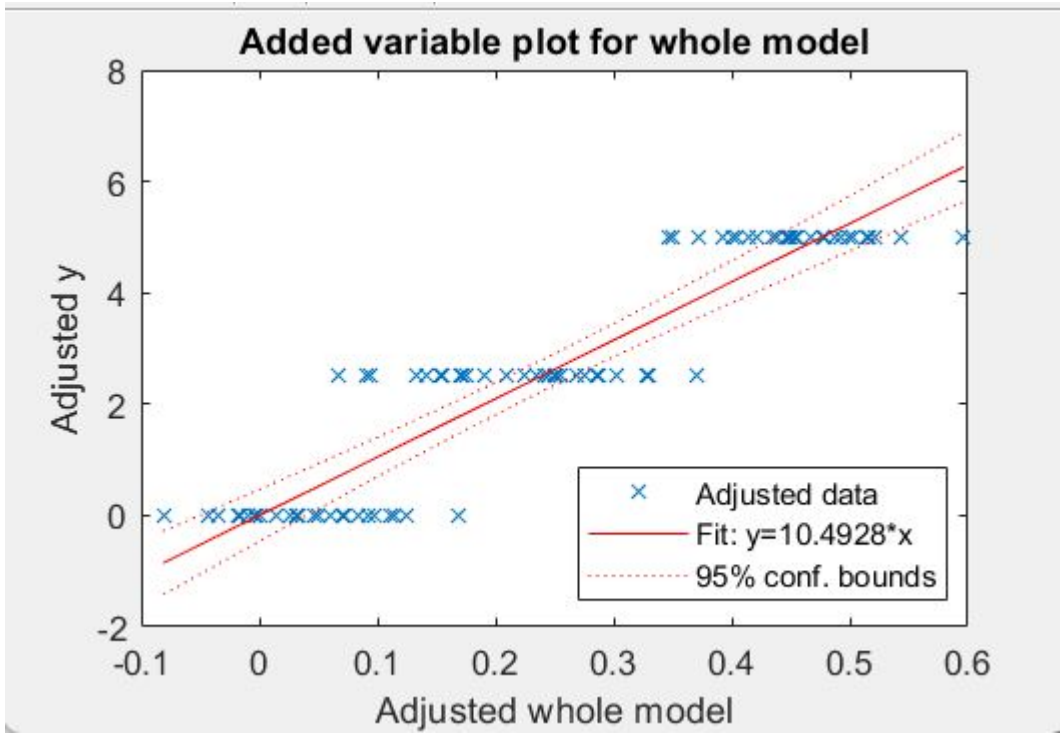
```
% training and fitting the model to predict the EMG
model_EMG_0=fitlm(data_x_emg_0,data_y_emg_0);
model_EMG_2=fitlm(data_x_emg_2,data_y_emg_2);
model_EMG_5=fitlm(data_x_emg_5,data_y_emg_5);

% training and fitting the model to presict the Payload
model_PAYLOAD=fitlm(FINAL_PAYLOAD_X,PAYLOAD_Y);
```



For 2.5 Kg

Root Mean Squared Error: 0.486

Linear Regression Model Equation
"y=(0*1) + (0.0017669*x1) + (0.00013023*x2) + (0.55749*x3)"



Final Payload

Root Mean Squared Error: 1.31

It have many Intercepts to Determine the Linear Regression Model Equation

Problem encountered in prediction.

While predicting the weight we found that instead of giving estimation for every second , we should give the prediction at the end of the motion. This improved our accuracy by 35%.

Also since we performed our experiment on 0,2.5 and 5 kg respectively, we focused on these weights only.Meaning our prediction won’t predict outside of these values.

MATLAB R2022a - academic use

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Value
1x1 arduino
1x21 double
1x1 arduino
1
oReadings1 [-0.2120,-0.2657,...
oReadings2 [-0.1275,0.0598,-...
21
1x1 mpu6050
1x1 mpu6050
0.5000
1x21 double
1x21 double
0.5000
1x21 double
1x21 double
1x21 double
1x21 double
1x21 double
1x22 double
1x22 double
20

Command Window

```
                obj.initHardware(varargin{:});

In arduino_check (line 2)
a = arduino('com10','uno');


>> arduino_check
Warning: Incorrect device ID read from the connected sensor.
Expected device ID (value stored in WHO_AM_I register) for MPU6050
is '104'. Make sure that the correct device is connected.
>> arduino_check
Warning: Incorrect device ID read from the connected sensor.
Expected device ID (value stored in WHO_AM_I register) for MPU6050
is '104'. Make sure that the correct device is connected.
>>
>> arduino_check
Warning: Incorrect device ID read from the connected sensor.
Expected device ID (value stored in WHO_AM_I register) for MPU6050
is '104'. Make sure that the correct device is connected.
Operation terminated by user during subplot


In arduino_check (line 39)
    subplot(2,2,2);


>> arduino_check
Warning: Incorrect device ID read from the connected sensor.
Expected device ID (value stored in WHO_AM_I register) for MPU6050
is '104'. Make sure that the correct device is connected.
fx >>
```

Screen Recorder is sharing your screen. Stop sharing Hide

ENG IN 13:49 22-05-2022

THANK YOU