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Health Monitoring Analysis

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***Abstract*- In today's health focused world, monitoring one's health has become an important aspect of maintaining one's fitness and health. We have many such applications for ECG monitoring, EEG monitoring, and various other health related electrography signals but very few for EMG monitoring. This system aims to solve that. Our system will be used to analyse and monitor EMG signals and feed the output to a fitness app which will relay the information to the user. The input will be raw EMG signals from EMG signal sensors and data collectors, perform analysis of the said signals and extract various information from it and then present it to the user. The extracted information will tell the user if he has any irregularities in his muscles or any abnormalities present as well as monitor muscle fatigue and nerves disorder. The proposed system will be used to monitor EMG signals for the purpose of fitness app for health monitoring.**

I. Introduction

Electromyography (EMG) refers to the collective electric signal from muscles, which is controlled by the nervous system and produced during muscle contraction. The signal represents the anatomical and physiological properties of muscles; in fact, an EMG signal is the electrical activity of a muscle's motor units, which consist of two types: surface EMG, and intramuscular EMG.[1] Surface EMG and intramuscular EMG signals are recorded by non-invasive electrodes and invasive electrodes, respectively. These days, surface-detected signals are preferably used to obtain information about the time or intensity of superficial muscle activation.[2] Electromyography (EMG) signals are considered most useful as electrophysiological signals in both medical and engineering fields. The basic method for understanding the human body's behaviours under normal and pathological conditions is provided by the recording of EMG signals. Whenever an EMG signal is being recorded from the muscle, various types of noises contaminate it. Therefore, analysing and classifying the EMG signals is very difficult because of the complicated pattern of the EMG, especially when EMG motion occurs.[3]

Our system will take these EMG signals collected from the sensors and analyse them to give appropriate output i.e. whether the patient has any muscle disorder or muscle fatigue during or after exercising

II. Literature Review

EMG signal interpretation is a growing and modern research domain today. Lot of research works have been carried out by different scientists in this domain from the previous decade. Some of the biomedical engineering labs in our country also have shown their interests in this research domains and started work. Still ergonomics has not been carried out on this research field. The brief literature survey towards EMG signal related to interdisciplinary work and signal interpretation techniques are characterized below.

For this project we looked up various papers and learned about various EMG processing techniques, how EMG signals are occupied and how are they processed and so on.

We surveyed the following papers:

• Fundamental of EMG Signal Acquisition by Delsys System [4]

In this paper we learned all the basics in signal processing and how signals are processed. What are filters, how they play a part in signal processing. Different types of filters used and what are recommended filters for EMG signal acquisition (Butterworth Filter).

• A Review for Feature Extraction of EMG Signal Processing [5]

In this paper we learned the various EMG signal extraction techniques and found out that SLEX based feature extraction using ANN gives us the highest accuracy of 98%

•Feature Extraction and Selection for Myoelectric Control Based on Wearable EMG Sensors [6]

This paper deals with the selection of sampling rate for EMG signal acquisition and compares the results between 200Hz and the commonly used 1000Hz and concludes that while 200Hz is more cheaply available, 1000Hz still provides the best results in terms of discriminative data collected for feature extraction.

III. Proposed System and Methodology

Proposed System

There is an EMG sensor which can be attached anywhere in the part of the body. This EMG sensor is connected to a microcontroller, in this microcontroller there is Bluetooth

which is connected the Bluetooth of the mobile. The EMG sensor data is transmitted to the mobile through the microcontroller. There is an app in the mobile which on receiving the data sends it to the cloud for processing. In this processing 1st the noise is removed then the features are extracted from the data, which gives us a better understanding about the data. After this algorithm are performed to show how accurate is the data and how it can be improved. After doing the analysis the data is sent back to the app for showing the graph monitoring the muscle functioning and its condition.

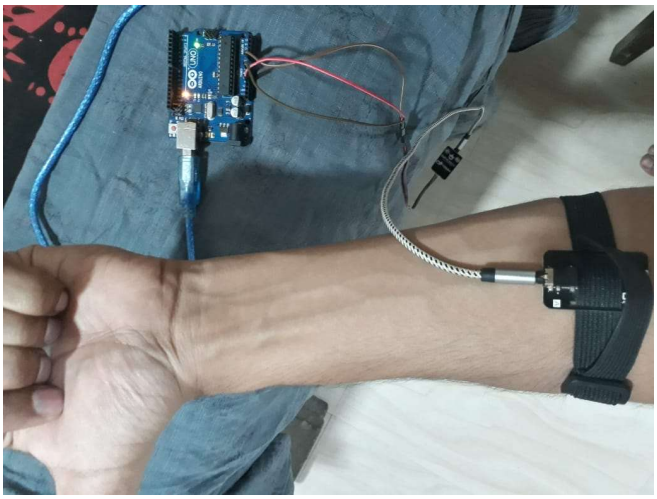

Fig 1: Setup of the microcontroller (Arduino) and EMG sensor attached to the patient

Methodology

EMG signals are collected by the sensor which sends it to the microcontroller. The microcontroller sends this to the mobile app via Bluetooth which is then sent to the cloud for feature extraction. In the cloud using python and NumPy we extract the features from the raw EMG signals and get the RMS values in Frequency and Time domains

Using this we can plot graphs in frequency and time domains and thus create a baseline for normal muscle output.

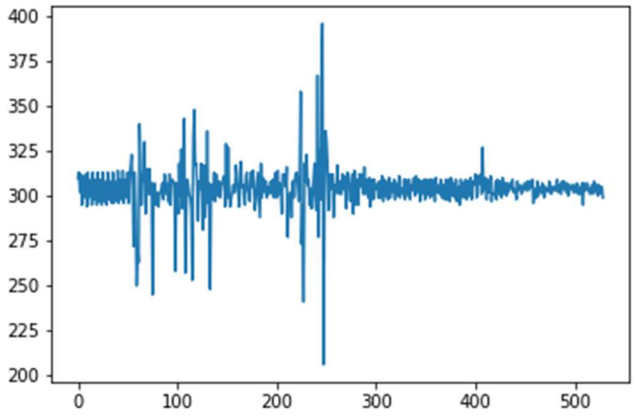

Fig 2. Graph of amplitude against time after taking EMG signals for fist action

Feature Extraction

We are using NumPy and Pandas to work on the datasets.

Using these we can extract RMS values, graphs for time and amplitude, graphs for frequency and so on.

Time Domain:

The features in time domain are root mean square, absolute mean square, variance, log detector and standard deviation.

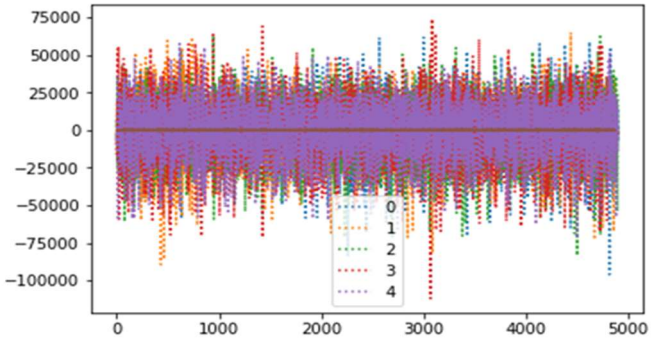

Fig 3. Standard Deviation in Time Domain

Frequency Domain:

The features in time domain are power spectral density, cross spectral density, mean frequency, group delay and coherence.

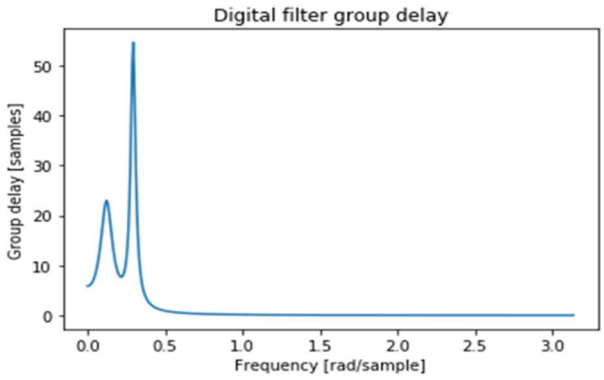

Fig 4. Group delay graph

IV. Design

As this system makes use of datasets and numerical analysis, we used Python as it has many libraries and modules for this purpose.

We will deploy this in a server so Linux will be out environment for processing.

The EMG sensor modules and microcontroller, Arduino in this case. The sensor sends the data to Arduino which then saves it as CSV file which is then worked upon by Python code.

We then work upon this CSV file using python to convert it into data sets and then extract the features in the respective domains to get a baseline and aggregate from our data.

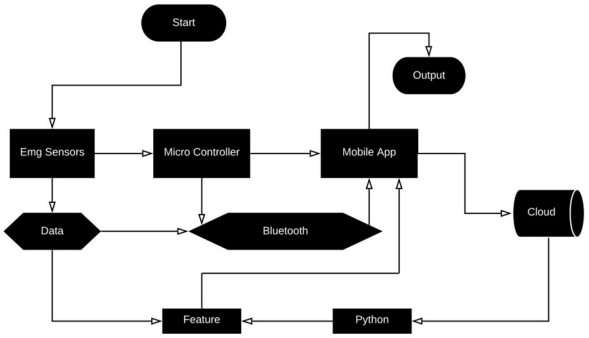

Fig 5. Flowchart of purposed system

V. Future Scope

As the system now requires a pc in order to function, we would like to implement Bluetooth stack so that it can be used with any mobile device via Bluetooth. We'd also like to make it so that the system can be linked to any front-end interface like mobile app or web app.

Finally, we would make the system compatible with wide range of microcontrollers and EMG sensors.

VI. Conclusion

In this age of health focus, our system makes it easy for anyone to measure EMG signals and get the data from it without having to resort to any doctor appointments or lab work. Thus, our system enables people to measure and know their muscle health and modify their lifestyle accordingly.

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[6] Feature Extraction and Selection for Myoelectric Control Based on Wearable EMG Sensors Angkoon Phinyomark , Rami N. Khushaba and Erik Scheme