Tremor Quantification and Analysis of Various Parameters for Identification of Neurological Disorders

C. Narayanan [1]
[1] Professor,
Department of Biomedical Engineering,
Dhanalakshmi Srinivasan Engineering College,
Perambalur.

Bhagyalekshmi Omanakuttan[2], Bibina Alias[3],
Fatima[4], Karishma.S[5]
[2]-[5] UG Scholars,
Department of Biomedical Engineering,
Dhanalakshmi Srinivasan Engineering College,
Perambalur.

***Abstract*:-Tremor is a neurodegenerative disease causing involuntary muscle movements in human limbs. There are many types of tremor that are caused due to the damage of nerve cells that surrounds thalamus of the front brain chamber. It is hard to distinguish or classify the tremors as there are many reasons behind the formation of specific category, so every tremor type is named behind its frequency type. The main aim of this paper is to analyses the exact frequency of the tremor using cheaper and more cost-effective methods. A low-cost microcontroller with a built-in IoT technology is used to calculate the frequency from the raw accelerometer and flex sensor data. This frequency information is send to the particle cloud so that doctors can monitor the condition of the patient and categorize the tremor.**

Keywords:- Frequency, accelerometer, flex sensor, IoT, particle cloud

I. INTRODUCTION

Tremor is an unintentional rhythmic muscle movement involving to and fro oscillations of one or more parts of the body.It is the most common of all involuntary movements and can affect the hands, the arms, head, face, voice, trunk and legs. The frequency and amplitude of a tremor vary to the degree that the tremor may be hardly noticeable or severely disabling. Proper medication for the cure by physician is possible only when the disease is identified. Because of this argument, there is a need of a device or a technique to analyze the tremor and for extracting the parameters associated with the signal. These extracted parameters can be used to classify the tremor for onward identification of the disease.This paper proposes to build a prototype using embedded system (IoT) which would replace the more costlier method of EMG.Sensors used being the accelerometer sensor and flex sensor which determine the frequency and amplitude of the hand tremor. The controller used is an inbuilt wi-fi module which could be used to upload the values of the frequency and amplitude of the tremor to a doctor sitting at a hospital many kilometers away.

II. EXISTING SYSTEM

The existing model cannot distinguish or classify the tremor as there are many reasons behind the formation of specific categories. The model consist of a simple accelerometer sensor from which data is accessed and processed with the help of microcontroller and the frequency is being directly analysed and interpreted in a personal computer. So the data can be only viewed and analyzed in the specific computer only and no further evaluation and diagnostic analysis can be performed. In existing models only the amplitude was estimated so precise tremor quantification become difficult. The signal produces by the accelerometer is a bit weak, and it is difficult to extract the frequency components though the signal conditions are perfect. This problem occurs during the measurement on subject with low shaking in their hands. So there is a wide difference in the accuracy of the result obtained between the EMG based technique and newly proposed technique. The earlier model deals with the analysis of tremor using EMG measurement which is quite expensive and it is not affordable for all the patients for simultaneous checkups. In the existing the model the acquisition of the parameters was interpreted with the help of PC's and no further move was taken for the further analysis of data by physician at distant location.

III. PROPOSED SYSTEM

The goal of our paper is to develop a system for tremor quantification thereby acquiring the amplitude and frequency for the categorization of various tremors and thereby transmitting the data with the help of IoT wireless transmission to a doctor or physician in a cost-effective manner.

In this project we analyze the tremor that is produced in the hands of people, their average frequency of oscillation and the problems faced by the people.

The main objectives of the work are

- Aiming on the design a prototype that can perceive the tremor produced in the hands of people.
- The prototype would recognize automatically by differentiating the frequency at normal stage and at the shaking stage
- This paper proposes to build a prototype using embedded system (IoT) which would replace the more costlier method of EMG.

- The controller used is an in-built wi-fi module which could be used to upload the values of the frequency and amplitude of the tremor to a doctor sitting at a hospital many kilometers away.

IV. BLOCK DIAGRAM

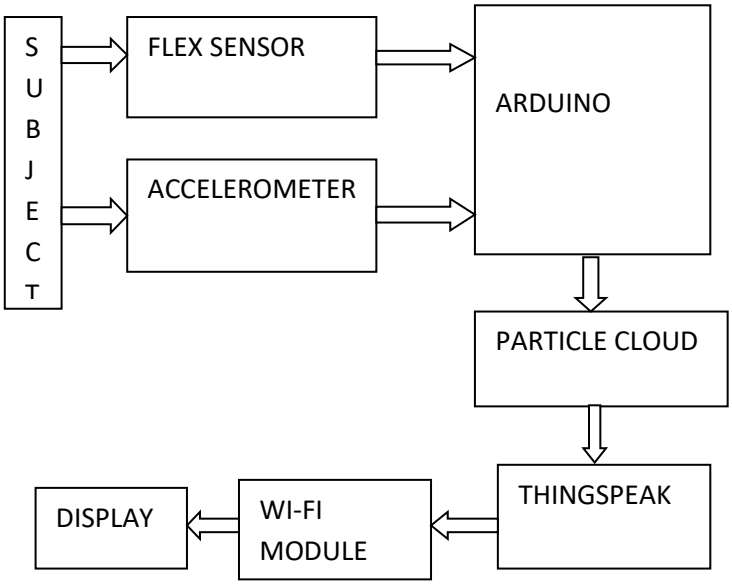

Fig no: 1. Block Diagram

V. SYSTEM DESCRIPTION

The primary signal acquisition is taken with the help of ADXL 345 accelerometer sensor. It estimates the change in position of the hand with respect to the prior position along with the shaking frequency. In addition a flex sensor which is being attached in the finger position which improves the accuracy of the acquired signal.The data from the ADXL345 and the flex sensor are sent to the micro controller using particle photon. The particle photon has an inbuilt Wi-Fi board which can be used to upload the data to the cloud. The cloud used here is thingspeak. With the help of the data from the sensors and the photon the frequency of the tremor is calculated and is uploaded to thingspeak.

Power to the Photon is supplied via the on-board USB Micro B connector or directly via the VIN pin. If power is supplied directly to the VIN pin, the voltage should be regulated between 3.6VDC and 5.5VDC.The raw accelerometer data are collected through the i2c protocol and flex sensor values are collected through the analog input pin. ADXL345 library is used for getting the x, y and z values from registers using I^2C protocol. I^2C protocol requires only two wires for data transfer which is energy efficient. The microcontroller has to send the address of the sensor along with the read or write operation. Then the controller will send the address of the registers from which the raw digital values are stored. The threshold values are set for the amplitude of the tremor by taking the modulus of the difference between two consecutive accelerometer and flex sensor values at regular intervals according to the range of frequency going to be measured.

VI. RESULT& DISCUSSION

SUBJECT	FREQUENCY	ANALYSIS
Patient 1 (No shaking)	0-4 Hz	Absence of tremor (Normal)
Patient 2 (Mild shaking)	5-8 Hz	Mild occurrence (Abnormal)
Patient 3 (Vigorous shaking)	>8 Hz	Severe condition (Abnormal)

Through the combination of multiple parameters and various surveys from different patients the outcome for stroke patients is obtained. Stroke outcomes can primarily be derived through the program return in python language and thus the severity of the stroke is evaluated. From the data obtained the categorization of frequency comes across three ranges. The major specialization is opted for stroke and the frequency ranges are estimated. From the analysis table given the first category comes in a range of 0-4Hz, the indication is lack or absence of tremor and other vibration conditions. The second category range is 5-8 Hz, it indicates there is possibility for tremor occurrence and

the patient has to be treated cautiously. There is a possibility for adequate occurrence of tremor occurs in such patient. And the last range is above 8 Hz, which is critically danger, such patients has to be given adequate checkups and treatment procedure.

In terms of treatment dosage and arrival at hospital to start the treatment where the most important. The treatment is initialized quickly as soon as the patient is hospitalized. So from the overall discussion let us clear that the categorization of tremor is accurate and the result is obtained instantly. Further discussion are made based on the physical conditions and the data report of the patient in consultation with the doctor or technician.

VII. CONCLUSION

This paper proposes a method for frequency analysis of hand tremor at low-cost. The analysis is very efficient as it takes very less power and lower cost than the EMG technique. With the frequency information, the appropriate cause for tremor can be known thus the correct treatment can be given for permanent cure. IoT helps doctors to keep track of patient's condition all the time from any part of the world. Since no medications using the drug and deep brain stimulation are required to control tremor, it is very safe to use this method as there are no side effects and provides instant results.

VIII. REFERENCE

[1] Giuliana Grimaldi and Mario Manto * FNRS, Neurologie ULB-Erasme, 808 Route de Lennik, 1070 Bruxelles, Belgium;E-Mail: giulianagrim@yahoo.it, Neurological Tremor: Sensors, Signal Processing and Emerging Applications

[2] Hakima Chaouchi 1,* and Thomas Bourgeau 2,* 1 Telecom Sud Paris, Institut Mines Telecom, 9 Rue Charles Fourier, 91000 Évry, France2 KB DIGITAL, CH-4125 Riehen, Switzerland * Correspondence: hakima.chaouchi@telecom-sudparis.eu (H.C.); thomas.bourgeau@kb-digital.ch (T.B.), Internet of Things: Building the New Digital Society

[3] Kyrylova, T. Desplenter, A. Escoto, S. Chinchalkar, and A.L. Trejos, *Member, IEEE*, Simplified EMG-driven Model for Active-Assisted Therapy*

[4] Oana GEMAN2 1 SC Flow Meter SRL, R&D Department, Iaşi, Romania 2 "Stefan cel Mare" University of Suceava, A WEARABLE SYSTEM FOR TREMOR MONITORING AND ANALYSIS, Department of Health and Human Development, Romania

[5] Strahinja Dosen, *Member, IEEE*, Silvia Muceli, *Member, IEEE*, Jakob Lund Dideriksen, *Member, IEEE*, Juan Pablo Romero, Eduardo Rocon, *Member, IEEE*, Jose Pons, *Senior Member, IEEE*, Dario Farina*, *Senior Member, IEEE4*, Online Tremor Suppression using Electromyography and Low Level Electrical Stimulation

[6] Wellington C. Pinheiro, Bruno E. Bittencourt, Lucas B. Luiz, Lucas A. Marcello, Vinicius F. Antonio, Paulo Henrique A. de Lira, Ricardo G. Stolf and Maria Claudia F. Castro, Parkinson's Disease Tremor Suppression A Double Approach Study - Part 1 Department of Electrical Engineering, University Center of FEI, S˜ao Bernardo do Campo, Brazil