On Body Movement Sensing and Diagnosis of Tremor

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Abstract: **The monitoring of tremor or shivering signal will give a brief detail about the various neurological disorders. Since, the tremor or shivering is happen as a common symptom to all neurological disorder. Our goal is to capture and monitor the tremor or shivering signal and to overcome the lack of features in the existed methods. This technique will be very useful in classifying the various tremor conditions whether it is mild, moderate or severe. By which the physician can get to know about the status of disorder in the patient. And here the transducer used is accelerometer which captures the tremor or shivering signal and the waveform were displayed using LABVIEW software and the type of tremor is classified.**

Keywords: **Accelerometer, G-select, Inertial Sensing, Tremor Assessment.**

I. INTRODUCTION

Tremor, the rhythmic, involuntary movements of body parts, is the most common form of movement disorder. It mostly affects the people who are above the age of 60 in worldwide [1]-[2]. Those who are affected by mobility impairment or some neurological disorders, their Activities of Daily Living (ADLs) become very frustrating and tiresome. While clinicians and medical researchers work to study, diagnose, and treat movement disorders, they are hampered by the limitations of modern methods for data collection. For example, the most widely practiced tremor assessment methods are expert evaluation and patient self-report, but the former is invasive and time clustered, while the latter is notoriously inaccurate, and both are qualitative and imprecise. The Embedded system, which allow clinicians and medical researchers to non invasively record accurate, precise, quantitative human movement data via wearable inertial sensors [3]. Consequently, embedded technology improves the current state of clinical tremor assessment and enables research and evaluation of tremor etiology and tremor treatment efficacy, respectively Fig. 1.

This paper also discusses advancements in how the movement data are processed to reveal clinically significant information in relation to tremor symmetry. The primary contributions of this paper are the development and presentation of lightweight inertial assessment devices and easy way of monitoring the tremor signal.

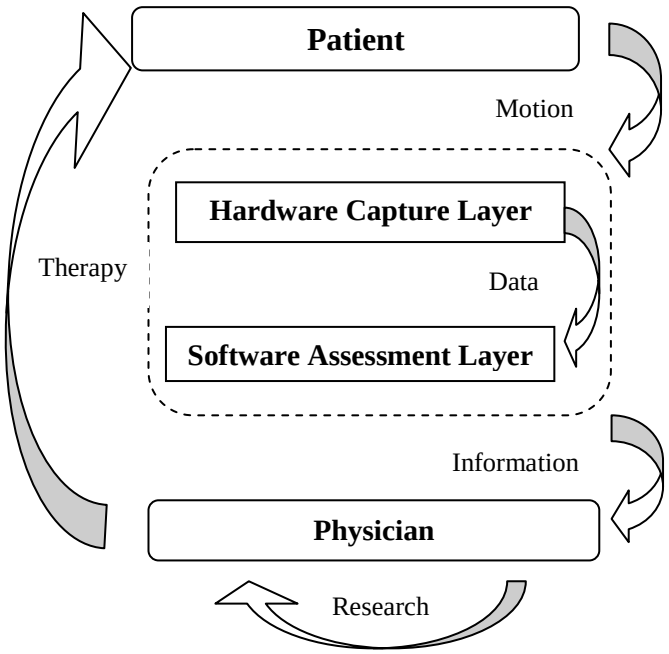

Fig. 1 Embedded system for tremor assessment

II. LITERATURE SURVEY

There are several existing methods were there to detect the tremor or most common of movement disorder. They existing method are following as EMG evaluation, Mechanical measurement system, Palpatory measurement, Patient self report. Efforts to study, diagnose, and treat such movement disorders are complicated by a dearth of quantitative, precise, or accurate methods for motion data collection and assessment. In EMG, it has intrusiveness and potential discomfort of needle electrodes make them undesirable for clinical application, and surface electrodes are plagued with problems of contact impedance of the skin. The bioelectric amplifier also must contend with difficult problems in obtaining small-amplitude bio-potential signals from muscle contract while ignoring 60-HZ interference from the environment. The local alternating current power source serving appliances, lighting, and electrical beds pervades.

Slight degrees of shivering are often difficult to differentiate from the bioelectric activity from voluntary movement, respiratory activity, and cardiac conduction. Amplitude of EMG activity depends on the number of active motor units in the involved muscle and the frequency of their discharge [4]. Therefore, variations in the size and placement of EMG electrodes can cause differences in measurement in within and between subjects. Rectified or integrated EMG signals might reliably be used as arbitrary representations of shivering changes in a given subject within the same observation period.

III. METHODOLOGY

In this paper we are proposing an embedded system which has consists of a wearable MEMS sensor and LABVIEW software to measure and monitor the tremor or shivering signal in a feasible way.

A. Proposed system

Fig. 2 explains the block diagram of proposed system. The proposed system consists of an Accelerometer MEMS sensor which measures the shivering or tremor signal then the signal is given to the microcontroller for processing. The whole system works on 5V DC supply [5].

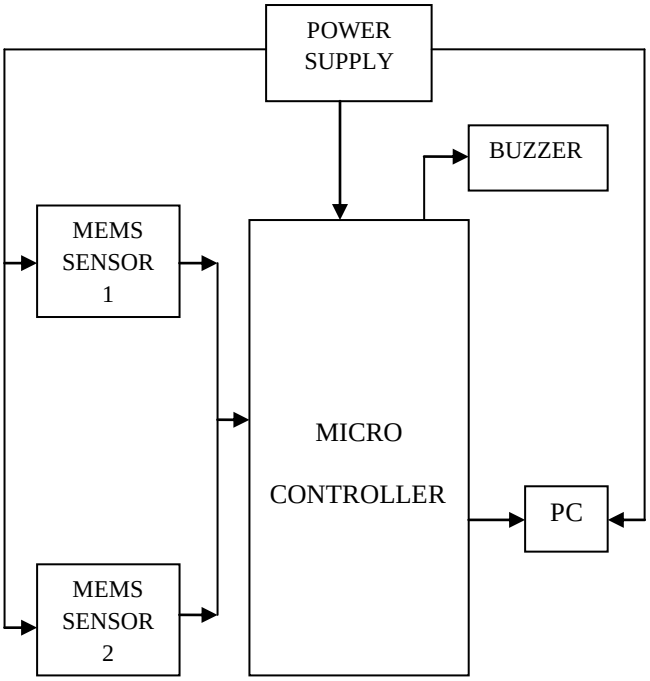

Fig. 2 Block diagram

The analog data is converted into digital data by inbuilt ADC present in the microcontroller and then the shivering signal is transmitted through the UART serial communication port to the PC to the LABVIEW software where the shivering or tremor signal is plotted as a graph and monitored.

And even with this a buzzer is added. So that whenever patient gets shivering or tremor, the buzzer will be activated and the physician will get an alert or awareness.

B. Accelerometer

Fig. 3 shows the top view of the sensor. The MMA7361L is a low power, low profile capacitive micro machined accelerometer featuring signal conditioning, a 1-pole low pass filter, temperature compensation, self test, 0g-Detect which detects linear freefall, and g-Select which allows for the selection between 2 sensitivities. Zero-g offset and sensitivity are factory set and require no external devices. The MMA7361L includes a Sleep Mode that makes it ideal for handheld battery powered electronics.

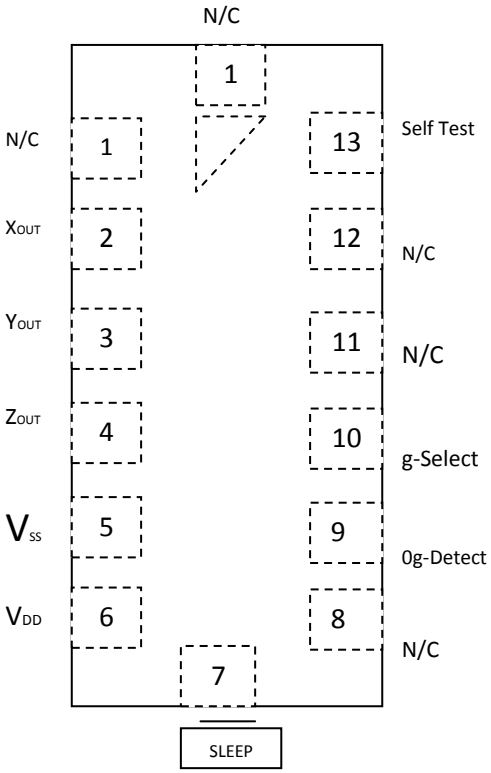

Fig. 3 Top view of the MEMS sensor

1) *Principle of operation:*

The Free scale accelerometer is a surface-micro machined integrated-circuit accelerometer. The device consists of a surface micro machined capacitive sensing cell (g-cell) and a signal conditioning ASIC contained in a single package. The sensing element is sealed hermetically at the wafer level using a bulk micro machined cap wafer. The g-cell is a mechanical structure formed from semiconductor materials (poly silicon) using semiconductor processes (masking and etching). It can be modeled as a set of beams attached to a movable central mass that move between fixed beams.

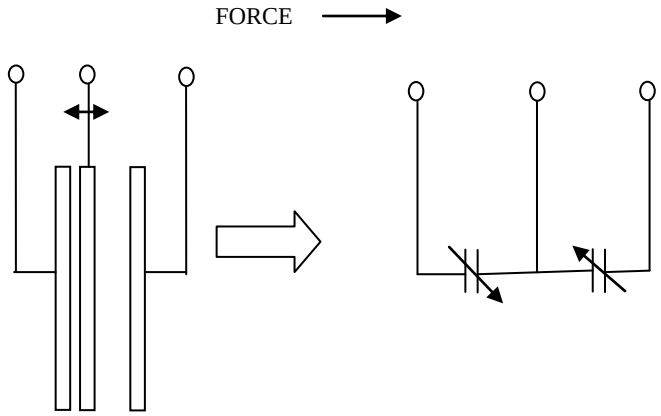

Fig. 4 Simplified transducer physical model

The movable beams can be deflected from their rest position by subjecting the system to acceleration Fig. 4 As the beams attached to the central mass move, the distance from them to the fixed beams on one side will increase by the same amount that the distance to the fixed beams on the other side decreases [6].

IV. ILLUSTRATION AND RESULT

The implementation of the sensing unit is shown in Fig. 5. The unit comprises of three MEMS sensors, control circuit and PC with a LABVIEW software application and buzzer. The user must plug in components in order to activate power and data collection. After that the accelerometer sensor automatically senses the shivering signal and it measures the body tilting and its acceleration.

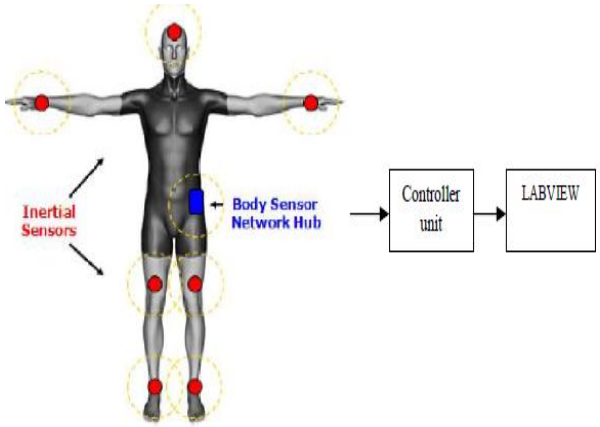

Fig. 5 Illustration of System Hardware

It produces an output as 3-axis tilting variation to the microcontroller where it converts analog signal into digital and transmits to the PC by UART serial communication. And the LABVIEW software plots the graph from output of the microcontroller unit and also the controller unit initiates the buzzer to create an alarm. Fig. 6 shows the graph plotted by the LABVIEW software. After that the tremor or shivering signal is classified mild, moderate or severe by depending upon the frequency range variation from the tremor signal waveform.

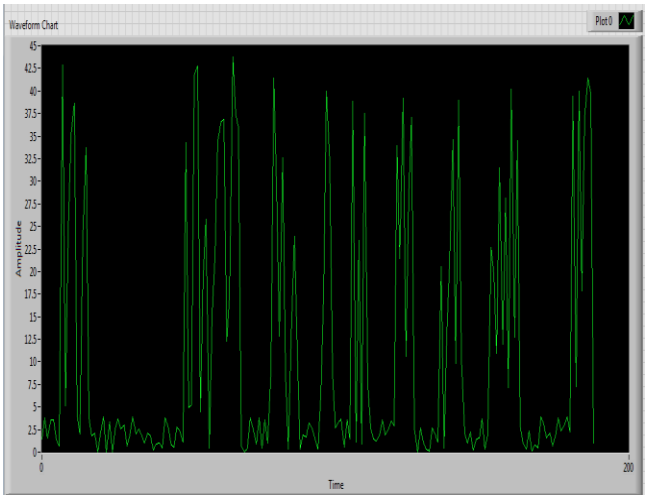

Fig. 6 Waveform or graph of the tremor signal

V.CONCLUSION

The available systems are way too complicate to take the information about the tremor or shivering by self reporting from the patient themselves. And EMG measurement which has low accuracy, high noise and even it is an invasive technique to be proceeding which makes most of the patients to feel discomfort with a procedure. This paper describes about a system which is used for body inertial sensing and measuring of tremor signal for its assessment. And it is very useful in medical studies related to movement disorder which are resulted by many neurological disorders. Since various neurological disorders like seizure, muscle spasms, Parkinson's disease, stroke, thalasemic syndrome, cirrhosis and Alzheimer has the tremor or shivering as a common symptom. It has been deployed when measuring the shivering or tremor signal by which physician can get to know about the improvements of patients who are affected by any neurological disorders and the degree of shivering or tremor attack or how severe of the disorder. And the result of the LABVIEW software which gives a notion that at what frequency the tremor or shivering signal is varying. So that doctor can easily assess the condition of the patient by its varying frequency and the level of tremor signal is varies with a frequency. Eventually severity of disorder increases with an increase in the frequency range. And also results reveal that the application of buzzer with the system uses to give alert or make aware the doctor or physician when the patient gets back to the conscious stage from the unconscious stage since there is an involuntary movement of the body of a patient. And sure it is a low power consumption and low cost with high accuracy in measuring the tremor or shivering signal.

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