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Research Article

Estimation of Hand Tremor from Accelerometer for Real Time Applications

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ABSTRACT

Introduction One prevalent movement issue that negatively impacts a person's life is tremors. Wearable tremor suppression devices are now a potentially practical alternative for managing tremors in Parkinson's patients thanks to recent advancements in wearable technology. A mechanical solution is required due to the numerous shortcomings of the current therapeutic approaches. The aim of this paper to develop a tremor estimator glove to detect the amplitude and frequency of the hand tremor of the elderly people or Parkinson's disease people. According to the frequency analysis, hand tremors result in hand oscillations with noticeable harmonics. Amplitude analysis results hand movement in x axis, y axis and z axis direction. An analysis of the tremor's behavior in Indian patient cohort revealed that the mean frequency of the tremor was 5.05 ± 2.03 Hz. Clinical trial conducted on 62 patients and estimated their hand movements in terms of amplitude variations where 41 patient's amplitude range is below 50 mille volts and 21 patient's amplitude ranges between 50 to 160 mille volts.

Objectives: The objective of this article is to develop a wearable synthetic glove to estimate essential tremors in elderly people or parkinsons diseased people so that futher device can be developled to suppress the tremor which will uable people to perform their day to day live work easily like eating, writing, carrying objects from one place to other.

Methods: The implemented device consist of an accelerometer sensor for sensing the hand movement of the tremor patient in x, y and z diection. A microcontreoller AT mega 138 to collect the data from sensor using a bluetooth device. The sensor is placed on the hands of the patient o measure the hand movement of the person in mille volts with respect to time in seconds. A rechargeable li ion battery is used for the supply.

Results: This show the analysis of the data collected from the 62 patients having essential tremor. The frequency of essential tremors ranges from 5Hzs to 12 Hzs. The data analysis shows that the amplitude of 41 Patients ranges between 0 to 50mV and 21 patients ranges from frpm 50 mv to 160mv in x, y and Z directions.

Conclusions: Individuals with essential Tremors, or any neurodegenerative condition for that matter, face numerous challenges in their daily lives and typically lead less fulfilling lives than others. Tremor estimator plays a vital roll while knowing the amount of hand movements in essential tremor patients. It is one of the necessary step required before tremor suppressions.

Keywords: Essential tremor, Accelerometer, Tremor Estimator.

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INTRODUCTION

The term "pathological tremor" refers to oscillatory, involuntary motions. Distal joints, such as fingers, typically experience more severe tremor than proximal joints, such as shoulders [1], [2].Tremor can often be divided into two types: pathogenic tremor and physiological tremor. Pathological tremor can be further divided into resting tremor, action tremor which can be specified as essential tremors. Physiological tremor is a normal, healthy part of voluntary motion. On the other hand, pathological tremor dramatically impairs a person's ability to perform fine motor skills, such as writing and eating. Furthermore, social humiliation brought on by pathological tremor may encourage people to avoid social situations. Action tremor happens with muscle contractions, whereas resting tremor happens when no muscle contractions are performed. Postural tremor [3], which happens when maintaining a particular posture against gravity, and kinetic tremor, which happens during motion, are two other subtypes of action tremor. Depending on the strategy used, the effectiveness of managing these pathological tremors varies. The cornerstone of treatment is medication, however it frequently has negative side effects and loses its effectiveness over time [4], [5]. Surgical interventions, including deep brain stimulator implantation and stereotactic thalamotomy, have been carried out in patients of severe tremor [6], [7]. Even though these therapies are frequently quite successful, there is a chance that the patient may experience serious side effects. However, the necessity for mechanical solutions is highlighted by recent studies that focus on tremor frequency fluctuations. Novel gadgets that use active, passive, and semi-active control techniques have been created to improve the quality of life for people with epilepsy and Parkinson's disease by preventing unwanted movements brought on by tremors. These developments represent a viable path for resolving the difficulties in managing tremors. Age-related neurological illnesses have become much more common as life expectancy has increased globally. Essential tremors (ETs) and tremors linked to diseases like Parkinson's disease (PD) are among the most common symptoms.

METHODS

Here in this article we propose a tremor estimator device for estimation of hand movement in the hands of elderly people in terms o amplitude and frequency. Frequency estimation in essential tremors patients is in the range from 5Hzs to 10Hz. Which can in any essential tremors type such as kinetic tremor, postural tremor resting tremor or task specific tremor. Kinetic tremor is when a person is trying to touch the dot on a page or any small point and there is unwanted movement in the hand. Postural tremor is when a person holds his hand in any of the posture. Resting tremor is when person keeps the hand in resting position on a surface. Task specific tremor is when a person performs any particular task such as writing, eating and at that time tremor occurs.

Here in this article we analyzed the data collected from over 62 patients with essential tremors. Identified their hand moments in all the three directions in form of roll pitch and yaw. where roll represents x axis, pitch means y axis and yaw represents z axis.

Fig 1 show the proposed Schematic representation of Assistive Wearable Device to Stabilize the hand Tremors. Here we will be using Accelerometer, Microcontroller At mega 138, li ion battery for power supply, Servomotor for controlling the hand movements. Fig. 2 show the implemented circuit of tremor estimator. It consists of accelerometer that can identify minor movement changes in elderly patients that are invisible to skilled doctors. Results from a triaxle accelerometer worn around the waist revealed that people with essential tremor experience freezing of their stride. This system is applied to various patients and collected data of approximately 62 elderly people with essential tremors.

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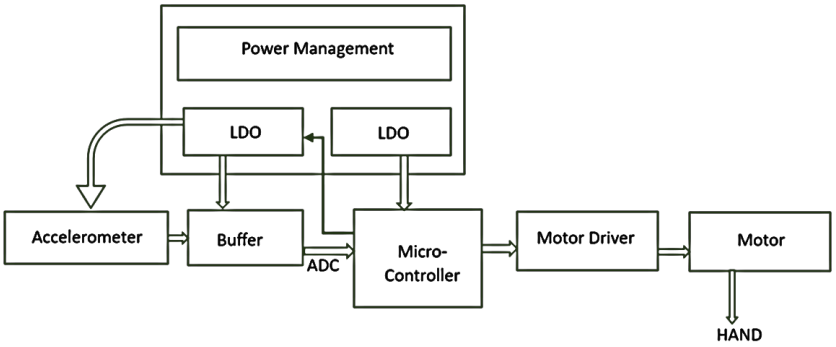

Fig 1. Schematic representation of Assistive Wearable Device to Stabilize the Hand Tremors

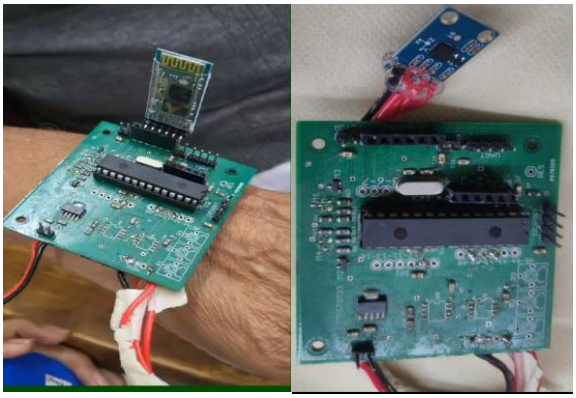

Fig 2. Circuit of Tremor estimator

RESULTS

Fig 3(a) to Fig 3(e) shows the Sensor value s(mille volts) Vs time(seconds) plot and amplitude (mille volts) Vs Frequency(Hzs) plot of the essential tremor patients as roll, pitch, and yaw values how they change over time. Fig 2(a) shows the patient 1 plot where amplitude in roll and pitch direction peak is at 12.5 mv and yaw direction peak is 10mv. which means that hand movement in x and y Direction goes till 12.5 mv and z direction is 10mv. Similarly, fig 2(b) shows plot of Patient 2 where roll direction peak is 12.5mv pitch and yaw direction peak is 10mv.Fig 2(c) shows plot of Patient 3 where roll direction peak is 25mv pitch and yaw direction peak is 15mv. Fig 2(d) shows plot of Patient 4 where roll direction peak is at 160mv pitch direction peak is at 60mv and yaw direction peak is 120mv. Fig 2(e) shows plot of Patient 5 where roll direction peak is at 10mv pitch direction peak is at 13.5mv and yaw direction peak is 12.5mv.

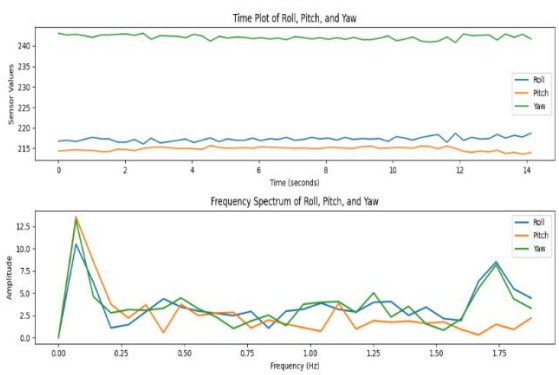

Fig 3 (a). Patient 1

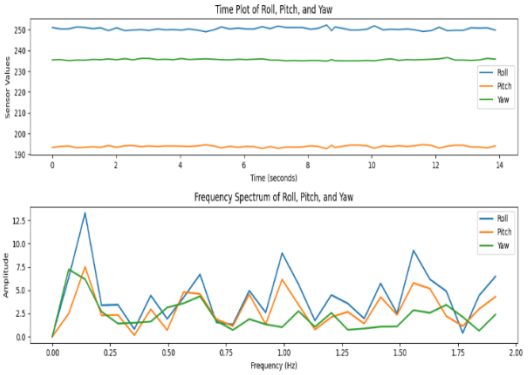

Fig 3 (b) Patient 2

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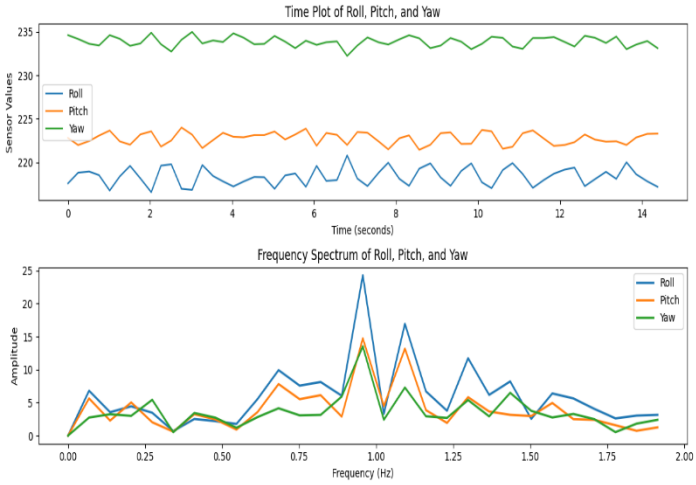
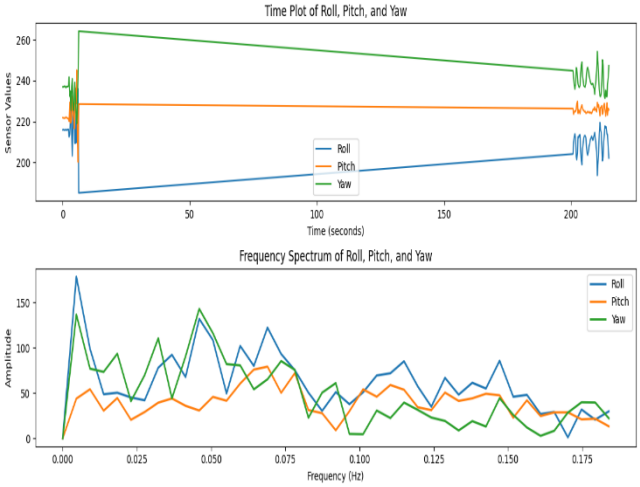
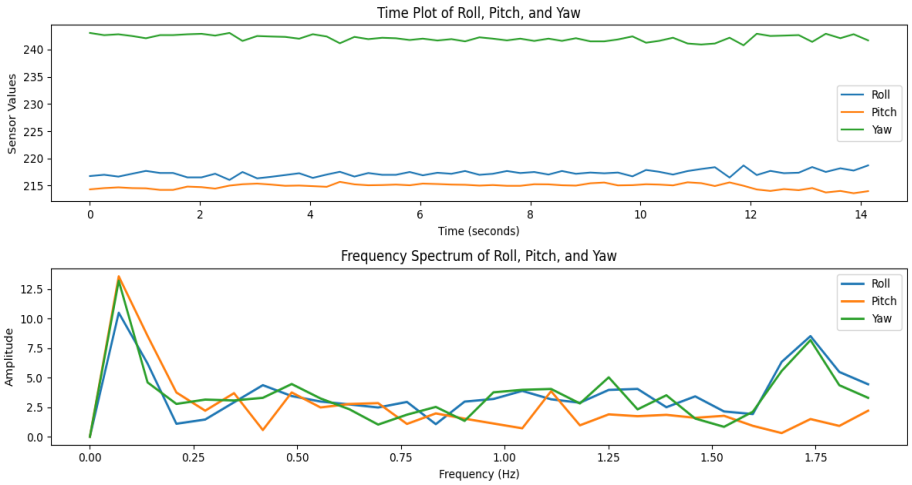


Fig 3(c) Patient 3



Patient 3 (d). Patient 4



Patient 3 (e). Patient 5

Here in this we have shown the plots of 5 Essential tremor patients with their hand movements in all the three directions. Table 1 shows the data collected from 62 patients of essential tremors. It show that 41 patients roll pitch and yaw directions ranges below 50 mille volts and 21 Patients roll pitch and yaw movement ranges from 50 mille volts to 160 mille volts.

Patient No	Roll (mv)	Pitch (mv)	Yaw (mv)	Patient No	Roll (mv)	Pitch (mv)	Yaw (mv)
1	10	13	13	32	2	3	3
2	13	7.5	7	33	12.5	15	7.5
3	25	15	15	34	42	42	32
4	160	60	120	35	30	40	40
5	10	13.5	12.5	36	21	30	20
6	6	5	3	37	25	25	20
7	5	2.5	4	38	25	40	20
8	8	3	8	39	30	30	30
9	6	4	6	40	45	40	40
10	10	7	6	41	22	15	25
11	25	16	24	42	30	20	30

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12	9	7	4	43	80	40	80
13	8	7.5	12.5	44	120	120	60
14	38	6	43	45	110	40	120
15	40	42	10	46	70	30	120
16	12	5	20	47	60	20	80
17	40	20	18	48	100	10	80
18	20	23	15	49	160	110	80
19	20	15	15	50	82	10	80
20	30	15	25	51	82	10	82
21	30	25	30	52	62	40	40
22	20	25	35	53	80	20	60
23	10	10	12	54	42	100	80
24	7	8	8	55	50	110	50
25	10	15	12	56	30	60	30
26	28	40	18	57	70	30	50
27	10	22	6	58	160	60	60
28	10	17	8	59	60	100	25
29	7	11	12	60	60	100	40
30	3	8	8	61	70	60	100
31	3	5	5	62	50	19	70

Table 1. Essential Tremor Patients data

Fig 3 show the plot of hand movement of patients in roll and pitch direction above 50mille volts amplitude. Higher the value of amplitude the movement of hand in that particular direction is more.

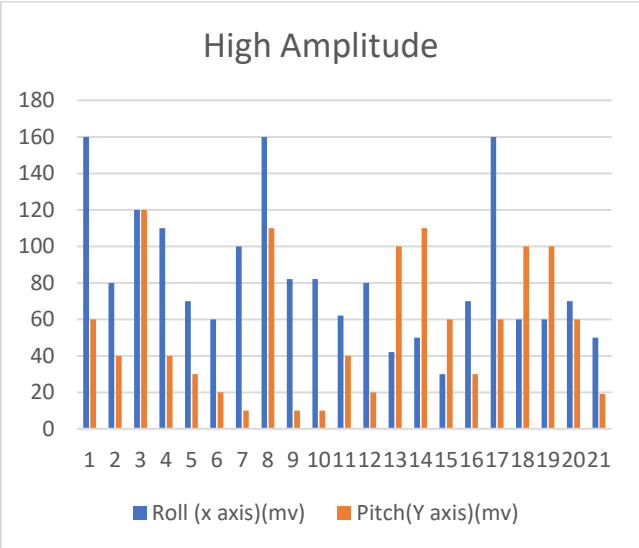

Fig 3. Patients with High and Low Tremors

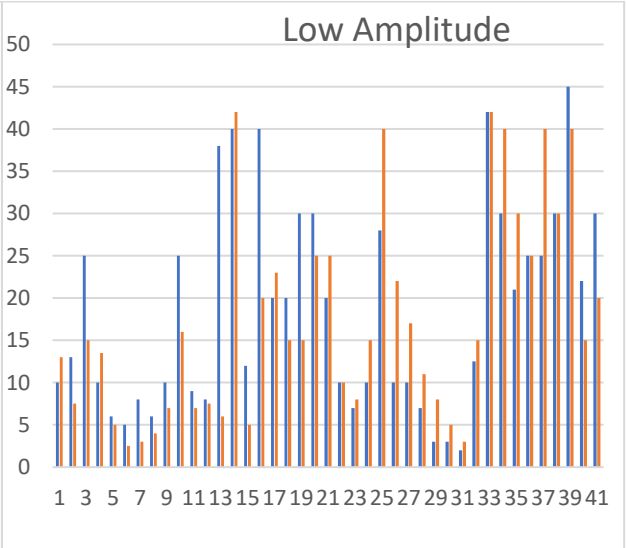

Fig 4. Patients with less Tremors

Fig 4. show the plot of hand movement of patients in roll and pitch direction is below 50mille volts amplitude. The value of amplitude shows the movement of hand in that particular direction.

DISCUSSION

Tremors can be incapacitating and have a detrimental effect on a patient's quality of life, despite not being a life-threatening movement disorder. The difficulty of creating successful or curative pharmacotherapies has arisen from our incomplete understanding of the pathophysiology of tremors. Numerous medical gadgets with a wide variety of

methods have been created in recent decades to control tremors in various facets of daily life. However, for suppression of tremor, tremor estimator plays a vital role without estimating tremor, suppression is not possible. Here in this paper we implemented a tremor estimator which easily majors the hand movement of the patients with essential tremor. Which can be used before tremor suppression device. This device can be future extended and implemented using different mechanism for Tremor suppression. To live up to this promise, more study is required to fully comprehend the tremor suppression devices' long-term effectiveness, safety, and affordability.

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