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PARKINSON'S DISEASE ANALYTICS: SENSING AND ANALYSIS OF VIBRATIONS OF TREMOR

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ABSTRACT

Parkinson's disease (PD) is a chronic progressive neurodegenerative movement disorder characterized by a profound and selective loss of nigrostriatal dopaminergic neurons. Clinical manifestations of this complex disease include motor impairments involving resting tremor, bradykinesia, postural instability, gain difficulty and rigidity. Current medications only provide symptomatic relief and fail to halt the death of dopaminergic neurons.The main aim of this paper is to analyse the exact frequency of the tremor using cheaper and more cost-effective methods and also to reduce the frequency using gyrostabilizer. Accelerometer and flex sensor is used to precisely measure the hand vibration caused due to tremor. Hand tremor is controlled using gyrostabilizer containing high speed rotating disc which is driven by a dc motor. The rotating disc follows the law of conservation of angular momentum so as to maintain its natural position thus dampening the vibrations caused by the tremor.

KEYWORDS: Parkinson's Disease, Neurological Problem, Tremor, Accelerometer, Gyroscope, Arduino.

INTRODUCTION

Tremor is an unintentional, rhythmic muscle movement involving to-and-fro movements (oscillations) of one or more parts of the body. It is the most common of all involuntary movements and can affect the hands, 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 [1,3,5]. Sensors allow detection, analysis, and recording of physical phenomenon that are difficult to otherwise measure by converting the phenomenon into a more convenient signal.

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Sensors convert physical measurements such as displacement, velocity, acceleration, force, pressure, etc into electrical signals. Sensor size is often important, and small sensors are desirable for many reasons including easier use, a higher sensor Density and lower material cost [2,4,5]. The main purpose of this research is to identify a feedback control technique for the Suppression of essential tremor. Tremor can be defined as the nonlinear and no stationary phenomenon which is the most common movement disorder affecting more than 4% of elderly people [6,7]. In this research, a tremor is simulated using a stepper motor and is being sensed using a gyroscope. The Arduino UNO board is used to obtain the tremor data that is being sensed by a gyroscope. Designing and implementing the controller based on the obtained tremor characteristics is the central part of the research [4,5,8]. The simulation results are analyzed in the National Instruments LABVIEW software and another stepper motor is used to control the tremor. The long-term results are expected to lead toward a suppressed tremor without disturbing the voluntary motion of the hand [6,9,15]. Nearly 200 years later and there are still many unanswered questions about essential tremor. Medical therapies may reduce tremor to some extent but there is no permanent cure [5,6]. Researches have been made to develop a control system that can counteract the tremor vibrations [2,8]. In order to counteract the tremor, the tremor characteristics must be analyzed, which is the main purpose of this thesis [9].

Figure 1.Effects of parkinson's diease

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Figure 2.Effects of parkinson's disease

LITERATURE SURVEY

According to the literature review done, it was found that everyone has tremor, but each person has a different level of involuntary movement [2]. The movement for a healthy person should be typically small (physiological tremor), but for a neurologically diseased person, such as a Parkinson's disease sufferer, there is a significant hand tremor movement where the patient cannot control the movement. [3,4]. Human involuntary hand tremor frequency occurs at low frequency which is in the range of 1.5 Hz (cerebellum lesions) to 25 Hz (normal hand tremor) [2,3]. The frequency of the postural tremor may be identical with or higher than that of the rest tremor [5]. In studying the human hand tremor behavior, the acceleration movements caused by the oscillations of the hand are measured using accelerometers.

Norman et al. performed the measurement of tremor using a velocity transducer and proposed that the displacement tremor oscillates between + 4mm, velocity at + 200 m/s and acceleration in the range + 10 m/s [4,5]. From the above findings and other research, it can be concluded that the acceleration amplitude for postural tremor of Parkinson's patient is in the range of +10 m/ and displacement amplitude is in the range of + 5mm. The frequency and amplitude of tremor oscillations have an inverse relation in which the frequency will increase with the decreasing of tremor amplitude. From the literature review, it is found that the frequency of human postural tremor in Parkinson's occurred at low frequency coherence in the range of 5 to 12 Hz [3,4].

The main aim of this project is to develop a three axismicro electro mechanical system based accelerometer sensor for measuring involuntary hand motion. Initially hand movement or tremor of the patient is to be measured using accelerometer sensor, and thereafter microcontroller must be used to acquire the output data from sensor for onward transmission to personal computer (PC) via recommended standard 232 (RS232) serial communication port[1,3].

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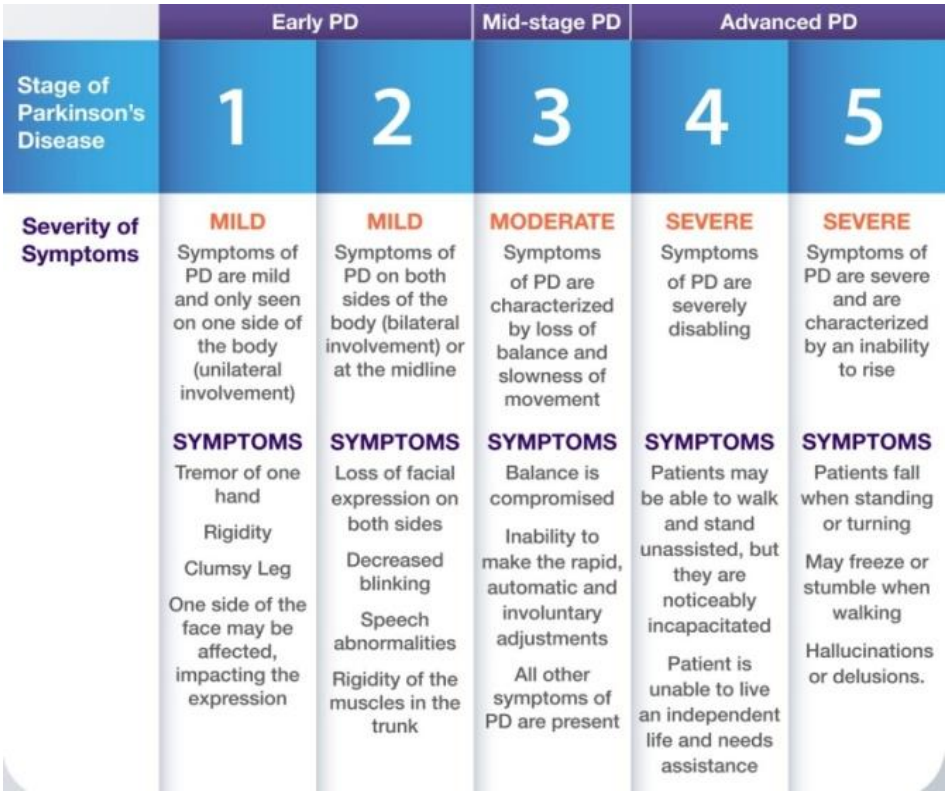

Figure 3.symptomps of parkinson's disease

The collected data must used for signal processing and parameter determination using matrices laboratory (Mat lab) software[4,5]. Finally, the acquired data need to be processed in such a manner to identify the parameters that can be used to diagnose / assess the subjects for certain neurological problems [8].

THEORY

Patients with PD suffer motor fluctuations at advanced stage. Under these conditions, routine clinical examinations do not provide sufficient clinical information for proper management of these patients, since they can only estimate one point of the condition[4,6]. Unfortunately, patients cannot visit the hospital at the time of worst motor deficits. In addition to these problems, freezing of gait is hardly observed in the examination room due to increased attention[7,8]. Thus, medical interviews and physical examinations in the clinics often do not provide the full picture of the condition, as they do not include the events at homes[10]. In other words, without information about the condition outside the hospital/clinic, treatment will be less than ideal[12].To overcome this problem, diaries have been used for proper estimation of Parkinsonian condition throughout the 24 hours.And with this 6.

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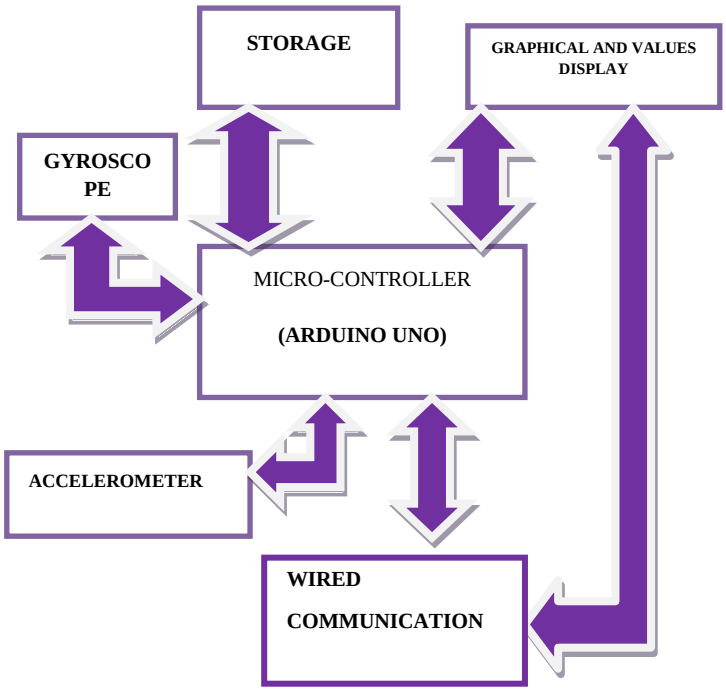
WORKING PRINCIPLE



The above flowchart shows the working of PD. For the analysis of tremors due to Parkinson. So here is block diagram of a tracking device to aid the clinicians in making better, objective decisions about health care outcomes of patients' suffering with PD. Here we are using to sensor modules gyroscope MPU-6050 and accelerometer DXL345 module. These modules are connected to the microcontrollers as we use Arduino uno here. Data collected from sensors or simulators are further stored and passed to the system. These data or readings are used to prepare a continuous graph which helps to continuous analysis of the condition of the patient. These two sensors gyroscope and accelerometer are the prime components. The gyroscope shows the rate of change in rotation on its X, Y and Z axes. Temperature output data and raw measured angular rate is accessed from the selectable digital interface whereas accelerometer can measure acceleration. It contains a MEMS sensor. MEMS stands for Micro-Electro-Mechanical Sensors. For graphical and visual display we will use MATLAB software. The true cause of Essential Tremor is still not understood, but it is thought that the abnormal electrical brain activity that causes tremor is processed through the thalamus. The thalamus is a structure deep in the brain that coordinates and controls muscle activity. Genetics is responsible for causing ET in half of all people with the condition. A child born to a parent with ET will have up to a 50% chance of inheriting the responsible gene, but may never actually experience symptoms. Although ET is more common in the elderly -and symptoms become more pronounced with age-it is not a part of the natural aging process.

CONCLUSION

Actually Parkinson's disease affects the nerve cells in the brain that produce dopamine. Parkinson's disease symptoms include muscle rigidity, tremors, and changes in speech and gait. After diagnosis, treatments can help relieve symptoms, but there is no cure. If you have Parkinson's disease, you have a lot of choices for treatment. There's no cure, but medicine and sometimes Medicine can often keep your symptoms in check for years.

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This paper proposes a method for frequency analysis of hand tremor at low-cost and tremor control using gyrostabilizer. With the frequency information, the appropriate cause for tremor can be known thus the correct treatment can be given for permanent cure. This device is an improvement to existing solutions such as medication, as it has no side effects and is not costly. The Signal produces by the accelerometer is a bit weak, and it is hard to extract the frequency components though the signal conditions are perfect. This problem occurred during the measurement on subjects with low shaking in their hands. Adding an amplifier to the hardware circuitry may solve the problem permanently and this enhances the performance of the overall system.

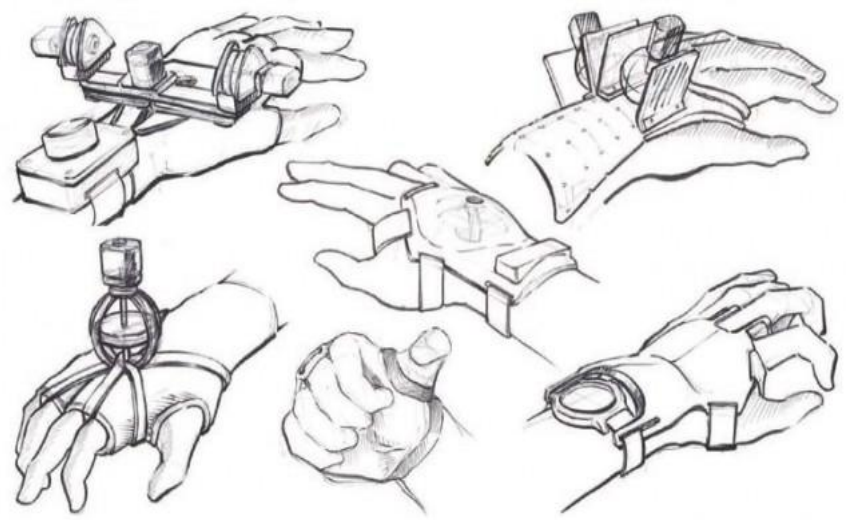

Figure 4.example of stabilizer device

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