Smart Glove to Monitor Parkinson's Patients

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Abstract-The smart glove to monitor the Parkinson's patients is an efficient system to monitor the tremors and harshness levels of that patient. Parkinson disease (PD) patients hurt from a resting tremor, severity, bodykinesia, gait difficulty and postural instability. Commonmethod of evaluatingthe symptoms however, confide thickly on patient self-accessing, which frequentlyfall to contribute the essential details. Wearable accelerometer is a major tool which can identify and justly definethe movement anomaliesin patient's atmosphere as well as in the clinical setting. This model is unified into a smart glove where these accelerometers are embedded to record the movements and tremors to estimate the cardinal motor symptoms of PD (tremor and rigidity of hand and arm). The gloves are relatedto smart phones, which proceeds the information and transfer it to the neurologists in their offices. Moreover, the system helps the doctors to control the treatment plan of the patient every day, assuring that medication is working perfectly and eradicating the obligationfor patients to make stressful clinical visits regularly.

Key Words: smart glove, parkinson disease, symptoms, wearable accelerometers, Tremor level detection.

I. INTRODUCTION

PD isa kind of sickness pertinent to thecentral nervous system and it is a deteriorating clutter that weakens motor skills, speech and various operations of a person who experiencethis disease.PD is due to the absence of dopamine in a person brain cell and reverse it in the mode of motor complexity [1]. The logicbehind this disease is not yet precisely fixed. The PD improvement is reluctantbut the evolution may take many forms. The four considerable manifestations of PD arebodykinesia, postural uncertainty, rigor and tremor. It is possible to categorize the Parkinson's disease depending upon the bodykinesia. The various categorizationsincludefinger motion analysis, Unified Parkinson's Disease Rating Scale (UPDRS) and foot pressure analysis. It is found that the PD is in the second position among the neurodegenerative calamity. It is found that this is seen usually in the elderly people. Abnormal symptoms are to be seen in the body.The affected individuals experience weakness and are incapable to accomplishexcellent motor activity. They also experience body tremors and are not able to maintain [17] equity when the growth of disease is high [2].The difficulty rises with treating PD is equivalent to controlling its breakthrough which is idiosyncratic and it needs constant neurological diagnosis.

Nevertheless, assembling objective movement data from a toollike smart textile [15] [16]would precisely control movement and performance of medication.

In construction of the smart glove, it is necessary to keep in mind that the glove mustpossess a convenient artistic while also controlling its practical purpose [3].Initially for the first phase the simulation of the proposed system will be simulated using the Proteus Simulation Tool. There are two main modules in this system: Hardware module and Software module (designing smart app).The hardware part that consists of Arduino Nano, Force sensor, Accelerometer and Wi-Fi module is simulated in the Proteus software. Both the software and hardware part are combinedusing the Embedded C language.

II. RELATED WORK

Study of implementation of smart glove to monitor Parkinson's patients using a wireless microprocessor and a flex sensor is required to transmit motion information. A neoprene e-textile was created using a flex sensor, which was placed on the index finger to detect the length of motion. A BLE(Bluetooth Low Energy) Nano was used for processing and transmitting the information wirelessly. The IMU (Inertia Measurement Unit) was used to identify tremors.The circuitry was mechanized using a 3-volt battery and contacts were made with the help of conductive thread.TheArduino software reads the analog voltage converging from the flex sensor, sets up in a voltage divider circuit. The software then graphed the voltage onto a scale ranges from 0 to 1023. It also uses the voltage to detail the resistance from the flex sensor because the voltage is proportionate to resistance. After determining the above values, they are packed together into a data line of characters written in the format of AVRD scaled with 0-1023 volts in voltage resistance ohms analog value reading. The data packet is then disseminated to the Arduino serial port for every 10 milliseconds. This will allow the analog value to be enhanced at each sample. The results are obtained and further developed by a Visual Basic program. The datalines weregathered by Visual Basic program and stocked in order to map it on an Excel spreadsheet. The developed program is used to record info from the Arduino UNO via a wired connection so as to analyze the flex sensor's performance and accuracy when calibrating different fingers and hand shifts. It can beaccomplished using a Visual Basic program on the computer which

explainsthe USB serial port from theArduino. It independently defines the information packets collected from the Arduino. It then distributes the values it acquired and costructs a visual bar showing the degree to which the flex sensor was bent.

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The software preservedthe distinctive values from the information packets into text files in realtime which were next interpreted into an excel spreadsheet to construct a graph [8].Sensors are fixed on the body, feet and arms of the patient. However,thesystemspossessbig dimensions and patients feel troublesome wearing such devices and systems have minimal advantage with respect to clinical applications[6].

A. Test Tasks and compatible Parameters

According to the ideas of neurologists, several functions are chosen to determine the syndrome and sharpness of parkinsonian tremor. The tremor is assessed as relief tremor, postural tremor, and force tremor. Each assessment task lasts ten seconds. The parameters obtained from sensor signal processing and displayed in the Graphical User Interface (GUI) are:

i) Magnitude of parkinsonian tremor (R)
ii)Dominant frequency of parkinsonian tremor (F)

The dimension of parkinsonian tremor (3.5–7.5 Hz) is decided by the dominant frequency of parkinsonian tremor. Tremor Analysis has been monitored by signal processing methods such as time-domain analysis, time-frequency analysis, spectral analysis and nonlinear analysis [6].

B. B. Parkinsonian Methods Tremor Assessment

In this study the signal processing controlsFIR (Finite Impulse Response) filters and IIR (Infinite Impulse Response) filters and other special methods such as Power Spectral Density (PSD) analysis. To detect tremors, the signals are then refined with PSD calculation.

C. C. Tremor state detection

The presence of tremor in patients rely upon many factors. The most notable factors are motor variation and the patient's mental health as well as physical health.[13] [14]. Tremor may disappear in a patient even with severe vibration. Therefore, it is important to calibrate tremor sharpness during the stable tremor state. The tremor state types are: valid state and invalid state [6]. Invalid state sensor signals will be neglecteddue to the inability of patient's tremor signal measurement.After a ten-second tremor-estimation task, the tremor signals need to be inquired. Valid state sensor signal is reliable in time domain as well as frequency domain. The decisions of valid state are given below:

1. Frequency domain: In this domain, the ten-second signals peakpower proportionmust be 85% greater than the entire power appraisal.

2. Time domain: In this domain, ten-second angular velocity range (peak-to-peak values of all axes of the gyroscope) standard deviation value needs to be more than 70% of the average signal ranges ofgyroscope [4]. The transmitting and receiving system of the proposedsystem is depicted in figure 1.

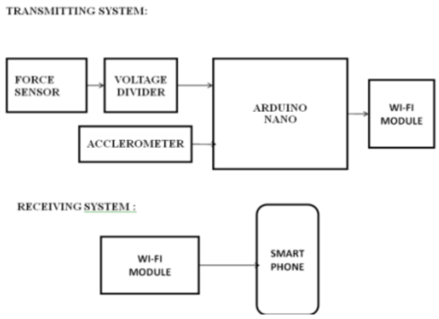

Figure 1. Block diagram

III. TRANSMITTING SYSTEM COMPONENTS

The Major Components used in the transmitting system are:

A) Arduino Nano
B) Force Sensor
C) Accelerometer
D) Wi-Fi module

A. Arduino Nano

The Arduino Nano is a small and complete breadboard-which is user friendly and it is based on the ATmega168 (Arduino Nano 2.x) or ATmega328 (Arduino Nano 3.0)

Force sensor

The force sensor is a polymer thick film. A decrease in resistance with an increase in the forced when applied to the active surface is notable in this device. Due to their force sensitivity they are used in human control of devices. They are not suitable for precision measurements.It is used to find and calculateproportionate change in force or applied load. It is also used to identify and calculate the rate of change in force, determine force thresholds and trigger properaction, realize contact or touch.

D. Accelerometer

Piezoelectric sensing of acceleration is quitenormal. This is because the acceleration is directly proportional to force. The charges with opposite polarity are assembled on opposite sides of the crystals when certain types of crystals are constricting. This is referred as piezoelectric effect. The charge is assembled on the crystal in a piezoelectric accelerometer. The assembled charges are finally rendered and amplified into either an output voltage or current.Piezoelectric accelerometers oppose to AC phenomenon like vibration or tremor. Piezo-film accelerometerswill measure AC phenomenon like shock or vibration, rather than DC phenomenon namely acceleration of gravity. They are reasonable and opposite to the phenomenon's includingsound, pressure and temperature.

IV. D.WI-FI MODULE

ESP8266 providesexhaustive Wi-Fi networking solution, permitting it to either proceed the operation or to parole all Wi-Fi networking functions from other application processor. It has combined features to improve the

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completion of the module in such applications and to reduce the requirements of memory.

A.Receiving System

a.Android app development

An android app is developed using any one of the android app development tools such as Xamarin, Appcelerator, Phone gap etc., an app which receives data from the transmitting system is developed. The set of values measured by the accelerometer is converted into a range and sent to the receiving system using a Wi-Fi module. These received values will be continuously monitored by the doctor to prescribe a proper medication plan for the patients and to know about the condition of the patient.

b..Software: proteus design suite

The Proteus Design Suite is a leading software tool which is mainly suitable for electronic arrangement automation. The software is primarily used by engineers and technicians working in electronic design module to constructdiagrammatic and electronic prints for assembling Printed Circuit Boards (PCB).This software tool was inaugurated by Lab Center Electronics and it is used for 2D CAD drawing project and can also be used for simulation and PCB scheming.

- The ISIS software is primarily used for depicting schematics and for circuits simulation. Real time simulation issupplied by the software as it allows human access during the run time.
- For the design of PCB, ARES is used.
- Design suite has the privilege of exploring the output in 3D view of the designed PCB with the components.

V. RESULTS AND DISCUSSION

A particular level which is considered to be the normal level is found by measuring thedifferent tremor levels of a parkinson’s patient, which is loaded as the normal level into the sensor. The values exceeding this normal level value is categorized as different tremor levels in the patient. In place of the accelerometer a variable potentiometer is used in the simulation. As the potentiometer is varied there is a change in the values which is displayed on the LCD screen and the output terminal. In case of simulation the screen that displays the levels of the tremors will be replaced by the smart phone in case of hardware. The simulation result is shown in figure.2. The smart glove which is proposed efficiently determines the various levels of tremors in a parkinson’s patient. Determination of patient’s willingness for Deep-Brain Stimulation (DBS) surgery and discoveringpostoperative clinical reactionwith the frequency, period and sharpness of these symptoms are describedelaborately. Wearable accelerometers can identify and equitably distinguish the

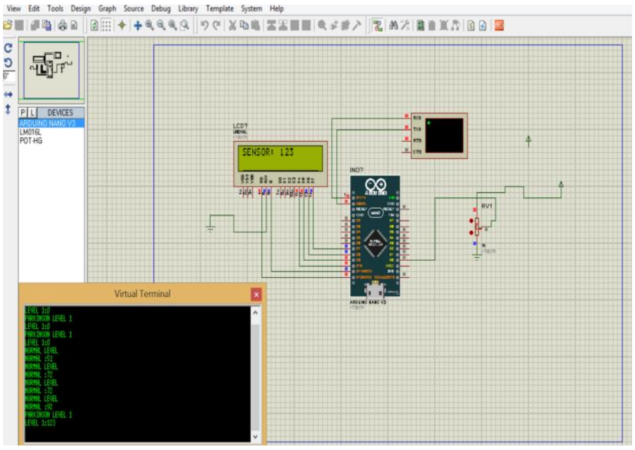

Figure.2 Simulation result of the proposed system

VI. CONCLUSION

movement anomalies in clinical setting as well as the patient's atmosphere. A better system to treat Parkinson’s disease which can control the tremors and the rigidity in the body movements could be developed. A sensor that could apply pressure at particular Acupressure points to control these tremors could be developed.

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