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MEMS based Epilepsy detection using Virtual Instrumentation

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ABSTRACT

About one percent of the people in the world suffer from epilepsy and 30% of epileptics are not helped. Careful analyses provide valuable insight and improved understanding of the mechanisms causing epileptic disorders and helps in identifying epilepsy seizures.This paper deals with detection of the muscular movements that occur in the extremities of the patient suffering from epilepsy. The changes in linear and angular motion are detected using MEMS sensor and are used for exact measurement of occurrence of seizure. Here wavelet transformation and LabVIEW is used for signal processing and classification.The Abnormal and or sudden fall condition during seizure is detected using virtual instrumentation

Keywords: Epilepsy seizure, classification, MEMS sensor, Virtual Instrumentation,

INTRODUCTION

Epilepsy is an unpredictable symptom of the result of excessive abnormal imbalance of the neurons in the nervous system. In common term it is known as 'fit'. Sometimes it becomes fatal to a person suffering from it. The outward effect can be as dramatic as a wild thrashing movement or as mild as a sudden loss of awareness. It can be considered as an alteration in mental state, tonic or colonic movements and convulsions and also includes some weird type of psychic symptoms. All these kinds of wild abnormal activities can be defined as the tendency to have seizures.Usually it is not diagnosed at the first time and it is predicted only after a person has had more than one seizure. In medical terms of reoccurrence and gratuitous, seizures is termed as epilepsy. It can also be considered as one of the most threatened disease all over world. It does not have any limitation, and can be occurred to any age of a person, even in newly born babies. The major causes for seizure are because of low oxygen or any severe injury to brain.

CLASSIFICATION OF SEIZURE

Different types of seizures are organized according to whether the source of the seizure within the brain is localized or distributed. Partial seizures are further divided on the extent to which consciousness is affected simple partialseizures and complex partial seizures.

A. Simple Seizures: These seizures do not cause a loss in consciousness, but they can cause a change in consciousness. Hence this type of seizure is termed as Simple Seizures.

B. Complex Seizures: During a complex seizure, a person cannot interact normally with other person. And cannot remember afterwards what happened during the seizure. These seizures causes loss of consciousness and in turn can damage the nervous system of body.

C. Partial Seizures: These have a specific focus; they only concentrate to a certain part of the body area which is the source of the irritation. This is commonly a much protected area of the brain, often hurt due to events such as a brain injury or a blood vessel. A partial seizure may spread within the brain; the process of spreading of seizures in brain is known as secondary generalization. The generalized seizures are divided according to the effect of seizures on the body, but they have one thing in similar that they all involve loss of consciousness. They generalized seizures include myoclonic, clonic, tonic, tonic-clonic and atomic seizures.

D. Generalized Seizures: These seizures can widely-spread than partial seizures. Unlike partial seizures, it is not necessary for generalized seizures that they always have a focal point; they do not concentrate only at one part. In these cases the point of origin is unknown and sometimes it becomes difficult to know about a seizure.

E. Mixed Seizure: These seizures can be defined as the existence of both generalized and partial seizures in the same patient.

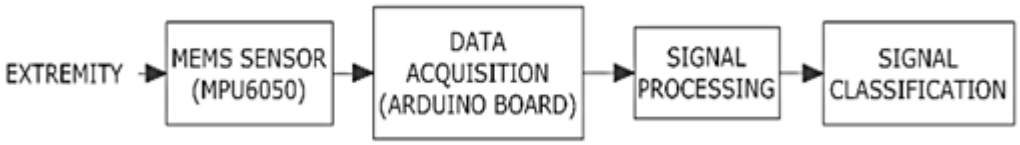

Figure.1.Basic Block Diagram

METHODOLOGY AND SYSTEM DESIGN

The process of automatic detection of epileptic seizures required different methods. These methods led to the indication of several activities, changing of activities, normal to rest position, normal and abnormal activities, and normal to sudden fall position etc. The different motions and movements in the form of signals occurred to different extremities (arms or legs) are taken and are acquired by the MEMS sensor. The MEMS sensor is a combine form tri-axial accelerometer and gyroscope in a small and compact chip. Both accelerometer and gyroscope obtain movement of in all the three directions. And finally signals are acquired through Arduino board. Classification of different activities are done on the basis of selecting a certain range for a particular activity and fixing a threshold value to differentiate between the normal and abnormal activity with the help of Lab VIEW, thus detecting seizures and through Lab VIEW.

MEMS SENSOR

The Micro-Electro-Mechanical Sensor is a combined form of tri-axial accelerometer and tri-axial gyroscope in a small well-defined chip. MPU6050 is a six degree of freedom chip. It is used for both fast and slow motion tracking. It is operated off 3.3V supply and communicates via I2C at a maximum speed of 400 kHz. This has onboard digital processor and can be used to directly output Euler angles and even perform filtering along with integrating data. (T. Ryan Burchfield, 2010)

1. Tri-Axis Accelerometer:The tri-axis accelerometeris an electromechanical device that measures linear acceleration. They are used to detect the minor vibrations of the proper acceleration and monitor it. Acceleration forces may be static like the constant force of gravity pulling at feet or can be dynamic caused by moving or vibrating the accelerometer. The tri-axis accelerometer is an integrated module that can sense gravitational force ±3g on three axes X, Y and Z. These three axes are available to detect the magnitude and direction of proper acceleration and to sense the orientation because the orientation of weight changes in differently in different direction.

2. Tri-Axis Gyroscope: A tri-axis gyroscope is a device with a spatial mechanism which is basically used to control the angular motion of the different extremities. It is a device for measuring and maintaining orientation. Mechanically, it is a spinning wheel or a disc in which a free axle is assumed at any orientation, although these orientations do not remain fixed, it keeps on making changes. In MPU6050 sensors it provides 6 component motion sensing and acceleration for X, Y and Z axes. It measures the rate of rotation in space. It measures the angular acceleration having three principles of working. We call different rotation in space in different axes by different names. Forces that changes directions in different ways can also be measured by tri-axis gyroscope. It indicates the angle of an object by calculating it against the gravitational force. They are as follows: YAW- Rotation about vertical axis (X-axis); ROLL-Rotation about longitudinal axis (Y-axis); PITCH- Rotation about transverse and lateral axis (Z-axis).

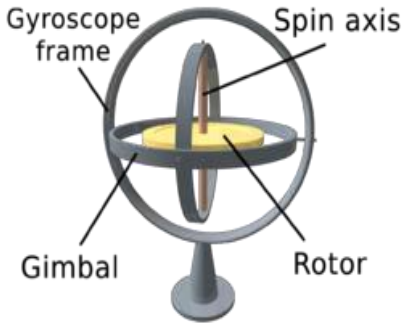

Figure.2.Gyroscope with freedom in 3 axes

Data acquisition: Data Acquisition involvesthe process of acquiring signals that measure real world physical conditions by sampling and converting the resulting samples into digital numeric value that can be manipulated by a computer. A microcontroller based Arduino Uno (board) and National Instruments lab VIEW 2010 does the overall work of data acquisition. Signals are acquired continuously by interfacing Arduino Board and MPU6050 to PC. Using the different COM ports the readings for different muscular movements in six axes is acquired by the MEMS sensor and it is rendered by serial communication (J Yoo, 2013)

Signal processing & classification: The signal processing is carried out by LabVIEW software, LabVIEW is a system design platform known for its use for data acquisition, instrument control, and industrialautomation on different varieties of platforms. Here wavelet transformation is used for simulating the output

The different signals and the respective activities that occur on human body are classified with the help of algorithm flowchart. By proper classification and detection of abnormal signals, seizures can be predicted. Rising of alarm at the time of abnormal signal and Lowering of alarm during normal condition can be done here.

Flowchart: The different signals and the respective activities that occur on human body are classified with the help of algorithm flowchart. By proper classification and detection of abnormal signals, seizures can be predicted. Rising of alarm at the time of abnormal signal and Lowering of alarm during normal condition can be done here.

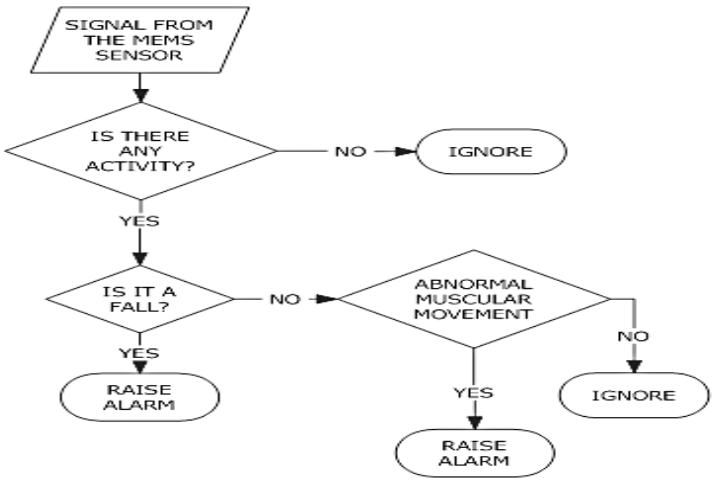

Figure.3.Flowchart for detection of Abnormal signals

RESULTS & DISCUSSIONS

The simulation for the detection of various muscular movements is implemented in Lab VIEW. The block diagram is given in Figure 4. The measurement of acceleration in x-axis(ax) ,y-axis(ay) and z-axis(az) respectively are done. And similarly the measurement for gx, gy and gz is constructed with a vector magnitude. The signals received from the MEMS accelerometer (ax) are differentiated and the mean is taken and compared with threshold value. Based on the value the state of the body is classified as activity and rest. The wavelet transformation is also done and displayed in waveform chart for monitoring purpose. . The implementation of the detection of normal and fall is also done.

The figure 5.shows the waveform of the body muscular movements during the attack of seizure. The regular and periodical muscular movements which indicate the repetitive action of the same muscular body part can be monitored. It also shows the indication the seizure at the mode range set for the seizure attack. When the range of mode set for seizure is reached then the indicator indicates the occurrence of seizure by glowing and when it is not reached it indicates it as normal activity.

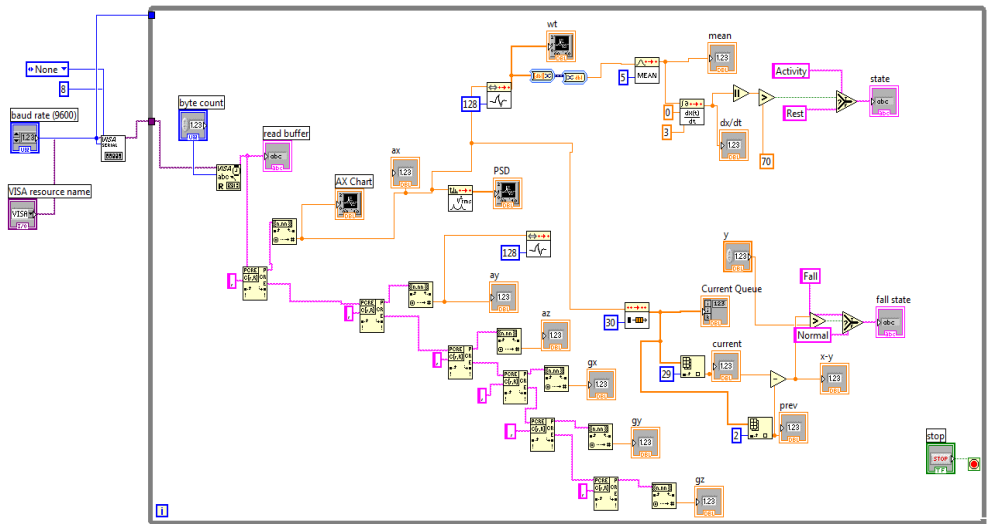

Figure.4.Screen Shot of Lab view Block diagram for detection of Seizure

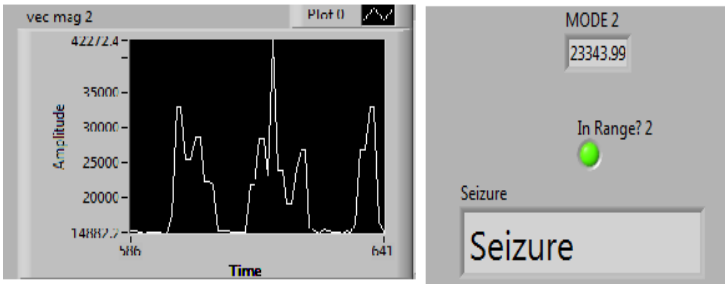

Fig.5.Waveform graph showing seizure movements in muscle

CONCLUSION

This paper, proposes a technique for detection and monitoring of epilepsy seizure using MEMS sensor. The muscular movements are categorized into activity and rest state of the body and the seizures are detected by observing vibrations occurring in the extremities (arms or legs) or sudden fall because of the effect of seizure. The results are promising and are better than existing method for identification epilepsy seizure. The future work is also concerned with the development of a means to stimulate the brain in order to stop seizures

REFERENCE

J Yoo, L Yan, D El-Damak, MA Bin Altaf, AH Shoeb, AP Chandrakasan, An 8 channel scalable EEG acquisition SoC with patient-specific seizure classification and recording processor, IEEE J. Solid State Circuits, 48(1), 2013, 214–228.

M. Estuidillo- Valderranna, L. Roa, J. Reina Toisna and Roman Martinez, Ambient Assited living : A methodological approach", in Engineering in Medicine and Biology Society, International Conference of IEEE, 2010, 2155-2188.

PrzemysławKorohoda, Jacek Kołodziej and Jacek Stepien, Time FrequencyAnalysis of Accelerometry Data For Seizure Detection, Bio-Algorithms and Med-Systems, 2013, 65–71.

T. Ryan Burchfield and S.Venkatesan, Accelerometer- Based Human Abnormal Movement Detection in Wireless Sensors Networks, Proceedings of the 1st ACM SIGMOBILE, 2010, 67-69.

Varun Bajaj and Ram Bilas Pachori, Epileptic Seizure Detection Based on the Instantaneous Area of Analytic Intrinsic Mode Functions of EEG Signals, The Korean Society of Medical & Biological Engineering and Springer, 2013, 17-21.