International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Epilepsy Monitoring and Analysis System using Android Platform

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Abstract: ***Today, epilepsy keeps its importance as a major brain disorder. Epilepsy patients are susceptible to fits. These fits can be occurs any times a day and the main problem is that the patient has no memory that he has had a Fit Attack. There is growing need for continuous monitoring and immediate respond to their seizures and to inform the concerned doctor for analysis which is not possible in now a day's hectic Work schedule where 24 Hours Nurse is very expensive. This implies high costs to the health system. The objectives of this paper were to continuously keep a track of all patients' activity using a mobile phone outside the hospital environment. Also we are differentiating between the types of Epilepsy. The user has to choose the epilepsy type and then the software will monitor various activities such as fall detection, Haphazard body movement, Urination, Loud noises and also develop an android app. Depending upon the type of activity the Android App will keep a track of Fits. We are sending an SMS to doctor and parents as soon as the fits start as well as an SMS when the FIT ends. Neurologists can refer generated report so that they can focus on the most important time periods of all recordings. The main idea of this is to monitor and analyze the Epilepsy attack and also track the progress of patient with in a given period of time.***

Keywords: Android App, Epilepsy, seizure, Smart-phone, sensor

1. Introduction

Epilepsy is a group of neurological complaints considered by Epileptic Seizures; it is experienced by one to two percent of the global population. 30% of the cases do not respond to medications or surgeries. Therefore, the potential for epilepsy patient requires continuous monitoring with seizure detection methods. [6]

The first step in improving epilepsy treatment is to do a precise diagnosis, since epilepsy is not only one disease with one cause and one treatment, but instead a variety of diseases with different treatments that express themselves as epileptic crises .The evaluation from epileptologist physicians is sometimes the only intervention used to elucidate the case. Moreover, electroencephalogram exams (EEG) help in diagnosing epilepsy but they have some practical limitations, especially due to the large amount of data that should be manually analyzed. One of its complicated phases is the using of thin wires placed deep in the patient's brains to detect the expected occurrence of seizures which make it very uncomfortable for patients for its insertion and removing procedures from their brains

A seizure is an involuntary alteration in behavior, movement, sensation, or consciousness resulting from abnormal neuronal activity in the brain. Patients suffering from epilepsy usually experience behavioral symptoms, such as involuntary movement and rage reaction. Some of epileptic patients even require the medical aid in an emergency. Conventional monitoring with electroencephalogram (EEG) and video can be very unpleasant for patients. It is also time-consuming for physicians and healthcare professionals to close watch the states of patients. There have been many researches focus on detecting the state of vigilance in human begins and animal models automatically. It was found that the accelerometer (ACC) is a reliable objective instrument to access the physical activity of the subjects. Accelerometers usually have a tiny size and low weight and can provide fine information about daily behavior of the subject [3].

2. Related Work

At first, due to the paroxystic nature of epilepsy, most part of ambulatory registers lasting in average 30 minutes are not long enough to identify the characteristic variations in EEG exams. In order to do longer recordings, patients must go to the hospital and stay as long as necessary to capture those variations. That practice is very expensive due to the low number of rooms in the hospital and the need for a team of professionals such as neurologists, nurses and neuro-physiologists with time and experience to manually analyze hours of recordings of many patients.[2]

There are number of solution for the continuous monitoring systems. One method focuses on reducing the time of the customization and the reconfiguration processes for healthcare reconfigurable embedded-based systems. This paper offers the continuous monitoring criteria, which is vital for the EPMS.[2]

It is also not uncommon to have a patient's relative next to the hospital bed pressing a button to identify and register the approximate timestamp of a clinical epileptic event. The doctors can then focus on the most relevant parts of the whole EEG recording, though at the expense of human intervention. Portable ambulatory EEG exams already exist, but they also require a neurophysiologist expert to analyze hours of data. [2]

There are differences between epilepsy in adults and Children. Although seizure types can be the same, causes are not. Seizures are more frequent in children having hundred Seizures per day and children respond differently, having different side Children with epilepsy have a bigger impact, since they are learning and understanding the word. Consequently, in this work we propose a process to support

pediatric physicians' decisions in a real context, which, whilst making conclusions harder, also makes them more relevant in a concrete sense. [4]

Besides, most ambulatory EEG equipments are not capable of sending signals to either hospital or doctors when a crisis is occurring, especially in the cases of pre-SUDEP situations. SUDEP is short for sudden unexpected death in epilepsy, a special condition where the patient eventually dies because of the disease. Due to the increasing number of patients and the costs of transport to and from the hospital as well as the costs of hospitalization, the remote care and monitoring of patients is a long and globally expected trend.[2]

In Epilepsy care platform , a smartphone-Android based for long-term remote epileptic patient monitoring, comprising a pre-SUDEP detection alert. Through an automated analysis of epileptic recordings, it can provide doctors a more comprehensive and semi-automated decision platform, while providing the patient a more comfortable monitoring experience at home. [1]

An automatic seizure detection method by simply using the ACC signals was popularly proposed, either in animal Experiments or in clinical use. They all yielded good results but only detecting the occurrence of a seizure event. The main objective of this study was to develop the seizure detection method that has the advantages of low computational energy, low false alarm and high detection accuracy for a seizure recognizing system. [3]

3. Proposed Block Diagram

The block diagram of the proposed system as shown in Fig. 1 consists of different types of sensing unit such as moisture Sensor to measure urination, Temperature Sensor detects the body temperature, Accelerometer to detect fall detection, MIC Sensor to measure the presence of Loud noise.

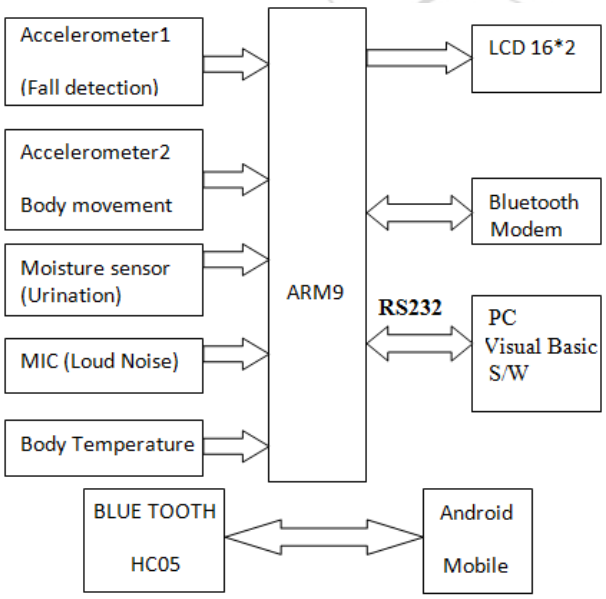

Figure 1: Proposed Block diagram

4. Proposed Architecture

A. Sensors

Sensors are the device which converts the physical parameter into the electric signal. The system consists of temperature, MIC, moisture, Accelerometer. The output of sensor is analog signal; the signal is converted into digital signal and then fed to the processor. The temperature sensor is used to measure the temperature of the body. Here LM35 temperature sensor is used. The output voltage of sensor is linearly proportional to the Celsius (Centigrade) temperature. The moisture sensor is used to measure the moisture (urine). Here we are connecting a moisture based Electrode sensor. As soon as the water dries up then the electrode voltage rises 0 to 5v. An accelerometer is an electromechanical device that will measure acceleration forces. The three axis accelerometers are basically used to identify the movements across the three axes. Accelerometer is an electronic device which is interfaced using I2C protocol and provides the reading after every 1msec. According to the requirement of the application, the microcontroller will take the reading from the accelerometer within a fixed interval of time and do the necessary operation according to the requirement of the application.

B. ARM9 Features

The LPC2929 combine an ARM968E-S CPU core with two integrated TCM blocks. operating at frequencies of up to 125 MHz, Full-speed USB 2.0 OTG and device controller, CAN and LIN, 56 kB SRAM, up to 768 kB flash memory, external memory interface, three 10-bit ADCs, and multiple serial and parallel interfaces in a single chip targeted at consumer, industrial, medical, and communication markets. To optimize system power consumption, the LPC2927/2929 has a very flexible Clock Generation Unit (CGU) that provides dynamic clock gating and scaling.

5. Overview of System

The system comprises the following components:

a) Patient monitoring kit
b) A smart-phone, here we are developing an Android APP for doctors / Parents for monitoring and analysis of epilepsy patients.
c) Emergency Center
d) Report for neurologist

A Patient monitoring kit

The monitoring kit is currently composed of accelerometer cap, wrist band along with temperature sensor and accelerometer, moisture sensor and Mic. The patient wear cap, wrist band with embedded sensor disposed in classic system. The cap and band wire attached to the board containing following component (i) controller (ii) a no-break and power supply; and (iii) Bluetooth modem

Figure 2: Epilepsy care platform

The power supply provides energy to equipment.

The device connects to the Bluetooth modem and provides filtered live digital data from the sensors, which can be read by the smartphone application.

B. Smartphone application

The smartphone application is currently executed on an Android based device. The application access the data provided by the monitoring kit through the Bluetooth modem.

Application running on the smartphone looks for signals coming from sensor that might lead to an emergency event. In such cases, the smartphone sends a message via SMS to a preconfigured telephone number at an Emergency Center, so that help can be provided on time. If connection to the PC is not possible, the smartphone stores data until the connection is restored. According to collected data seizure gets classified. Neurologists will have access on this data, so that Neurologists can focus on the most important time periods of all recordings, thereby decreasing the time to diagnose the disease. In this review process, physicians can accept or reject each automatic marking, allowing them to base their diagnosis.

C. Emergency center

The emergency center is responsible for dealing with critical situations. It receives notifications from the smartphone, which happens when an emergency event is identified. Fast response is mandatory since in this situation the patient can actually die if care is not provided shortly.

D. Report for neurologist

When patient admitted in hospital doctor have to select type of epilepsy for patient. According to selected type parameter sensed and report get generated on PC. On report we are maintaining time and date. So doctors can keep track the progress of patient with in a given period of time.

6. Flowchart

The flow system is explain in following diagram

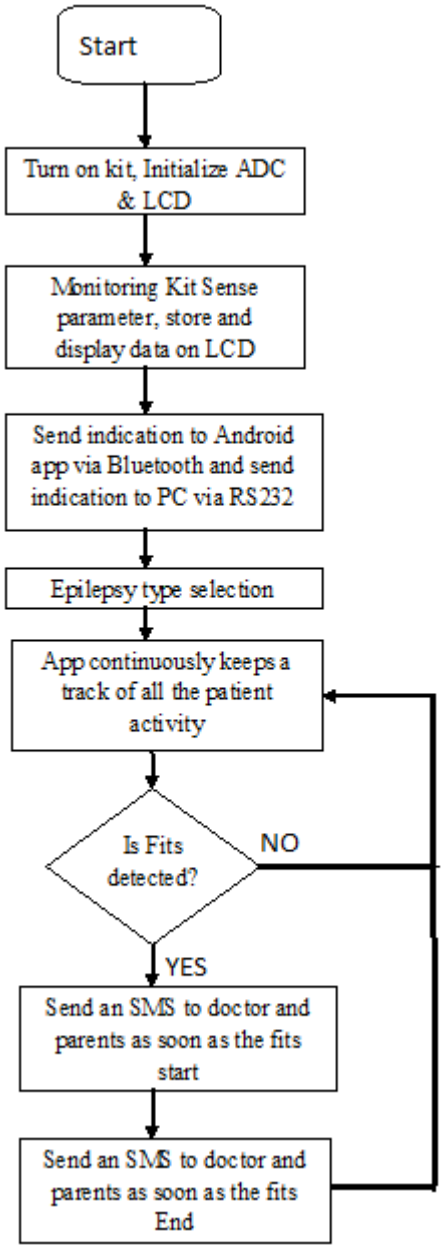

Figure 3: Flowchart of system

Sensors collect data and processed by controller. According to collected data select type of seizure. As per type of seizure continuously monitor parameters. Neurologists will have access on this data, so that Neurologists can focus on the most important time periods of all recordings, thereby decreasing the time to diagnose the disease.

7. Results

a) Patient report for doctor

When patient is admitted in hospital doctor connect kit on patient body and continously keep track of patient activity with the help of report get generated on computer. Report format is shown in following figures.

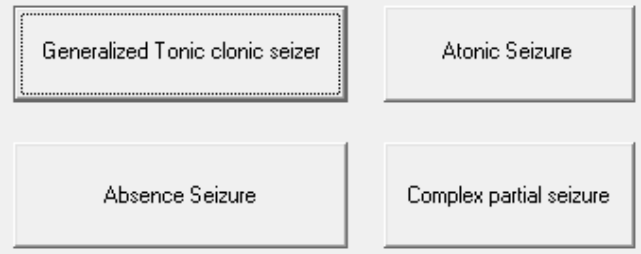

Figure 4: Generalized Tonic clonic seizer

For generating report doctor have to select type of seizure as shown in fig.4

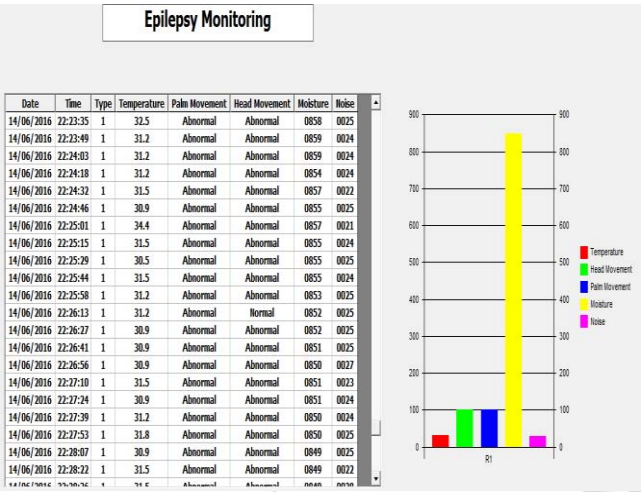

Figure 5: Epilepsy type selection on PC

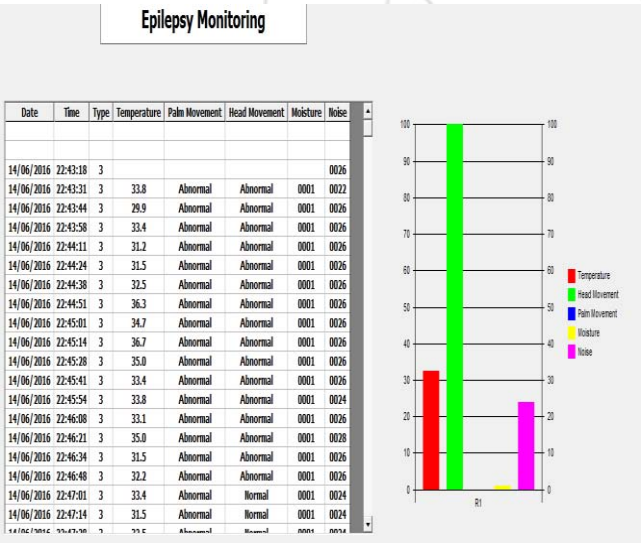

Figure 6: Atonic seizer

b) Android App design

When patient is outside the hospital kit is attached to patient body. Sensed parameter are send to smartphone using bluetooth.Patient have to select type of seizure and then App continously monitor parameter. The design of App is shown in following figures.

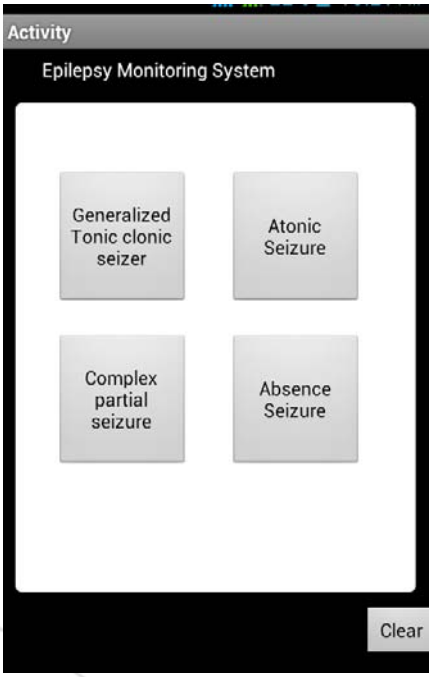

Figure 7: Epilepsy type selection on App

Figure 8: Activity Monitoring on App

Enhanced reliability of seizure diaries (number, order, duration, sub-clinical seizures, and behavioral factors), Risk factor assessment. The Early detection of seizures can be possible. Possibility to provide therapy during the times of greatest seizure susceptibility, prevent accidents and limit injury. Cost of equipment is Low. It can detect and inform epilepsy accurately. This is User friendly GUI (Android GUI). It works 24 Hours. Signal more directly related to seizure symptoms Measurement more widely applicable, less obtrusive!

Automated detection algorithms are less complex, smaller and less expensive and power-consuming devices. Many devices for physiological signs and movement detection in other medical conditions on the market: transfer of knowledge.

8. Conclusion

Epilepsy disorders are difficult to diagnose and treat. Sometimes long term EEG exams at the hospital are the only resource applied to diagnose the disease. The average local cost for inpatient monitoring is currently very high day per patient.

Our approach intends to reach more patients, reduce costs, and provide neurologists with a more comprehensive set of data to help in the diagnostics. At present, some initial results were obtained in both main research areas. The software profiler already works on gathering real time information from a running application on Android.

The system that will be implemented would be feasible and cost effective for Epileptic Patient. The system would continuously keep a track of all the patient activity using a mobile phone. This System sense parameter and send data to android app and PC. Send SMS when attack start and end. We can monitor and analyze the Epilepsy attack and also track the progress of patient with in a given period of time.

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