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AUTOMATIC DETECTION OF EPILEPTIC SEIZURES

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ABSTRACT

Epilepsy is a neurological disorder which manifest by recurrent involuntary seizures. The seizures dynamics is wide ranging from blinking of the eye to severe muscle contraction. Seizures may occur during driving, sleeping hours or when the patient is alone. If it is not monitored and no proper attention is provided immediately by a bystander or a doctor, may even lead to the patient's death. Besides the existence of numerous technologies for diagnosing epileptic seizure, such as Electroencephalogram (EEG), Magnetic resonance imaging (MRI), Positron emission tomography (PET) etc., this wireless electronic diagnosing system can sense the aura of preictal stage in a few minutes advance and takes the necessary safety measures automatically. In this paper, a new scheme is proposed for detecting epileptic seizures from the skin conductance of epileptic patients using EDA sensor and Muscular convulsions using micro electromechanical sensors (MEMS) firmly attached to the body. The device is designed as a wireless, wearable and as personal equipment.

Keywords: Epilepsy, seizure, wearable, wireless.

I.INTRODUCTION

Epilepsy is a kind of brain disorder which is caused by the abnormal functions of clusters of nerve cells , or neurons in the brain. The electrochemical impulses from the neurons act on other neurons, glands, and muscles to produce human thoughts, feelings, and actions. The person affected by epilepsy will not have the normal pattern of neuronal activity. Further it becomes disturbed, causing strange sensations, emotions, and behaviour, or sometimes convulsions, muscle spasms, and loss of consciousness. During a seizure, the firing level of the neurons may vary from person to person. Sometimes 500 times a second, happens occasionally; or it may happen up to hundreds of times a day.

II.EXISTING METHOD

2.1. EEG Monitoring

Recording of brain waves using Electroencephalograph is one of the methods to detect epilepsy. The surface electrodes are placed on the scalp using electrode conductive gel. This is the most common diagnostic tool for detecting the abnormalities of brain's electrical activity and epilepsy. People affected by epilepsy may have changes in their normal pattern of brain waves, even when they are not experiencing a seizure. Some people

continue to show normal brain wave patterns even after they have experienced a seizure. In other cases, the abnormal brain waves which are generated deep in the brain cannot be able to detect using EEG recorder.

2.2. Brain Scans

The various methods of brain scans include CT (Computed Tomography), PET (Positron Emission Tomography), SPECT (Single Photon Emission Computed Tomography) and MRI (Magnetic Resonance Imaging) which uses ionizing and non-ionizing radiations. The structure of the brain can be obtained from CT and MRI which can be useful for identifying brain tumors, cysts, and other structural abnormalities. PET uses radio tracers which emits positrons that is used to monitor the brain's functional activity and detect abnormalities. SPECT is relatively a new kind of brain scan used to locate seizure foci in the brain.

2.3. Epilepsy Blood Test

An epilepsy blood test measures the amount of prolactin,a hormone present in the blood. It helps in determining whether a seizure is caused by epilepsy or other disorder. Epileptic seizures affects the hypothalamus and alters the release of prolactin, causing the levels of hormone to rise. This test helps in identifying seizures in adults and children accurately and distinguish them from non-seizure type. Levels of prolactin in the blood increase after seizures but not during non-seizure activity. The blood samples are screened for metabolic or genetic disorders that may be associated with the seizures. They may also be used to check underlying problems such as infections, lead poisoning, anemia, and diabetes which may lead to cause seizure.

III.PROPOSED METHOD

The main parts of the proposed system includes (1) power supply (2) PIC microcontroller (3) Electrodermal electrodes (4) Alarm driver circuit (5) LCD display. The working of the mechanical hardware design is controlled using these electronic circuits.

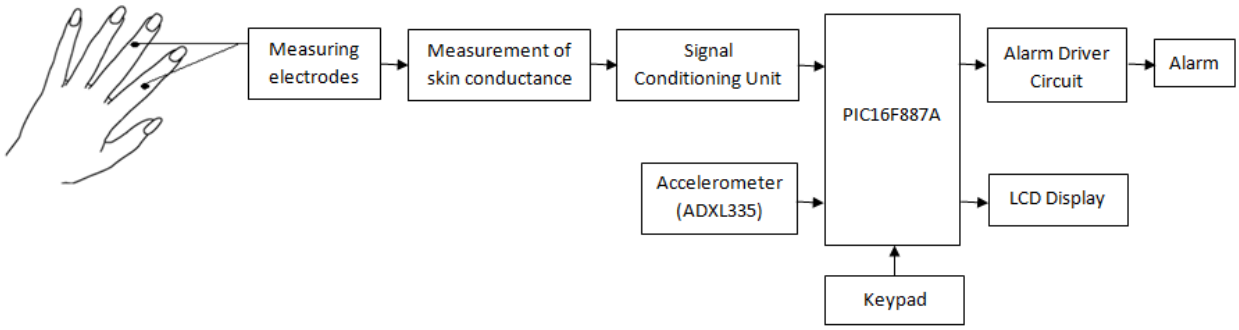

FIg.1 Block Diagram

The electro dermal electrode is placed on the fingers to measure the skin conductance. The electrode used here is silver – silver chloride (Ag-AgCl) unpolarizable electrode. The skin conductance value measured is then given to the signal conditioning unit where the signals are amplified and noise removed. The output voltage from the signal conditioning unit is then given to microcontroller PIC16F887A, which process the signals and send to MEMS accelerometer (ADXL335). The accelerometer senses the vibrations when the skin conductance exceeds the normal level. Simultaneously it sends the signal to alarm driver circuit. The alarm turns on whenever there is an occurrence of the seizure and alerts the attendee or the doctor to do necessary action.

In this proposed system of Automatic Detection of Epileptic Seizures, the measured parameters are skin conductance and muscular vibration. For detecting those parameters, two ECG electrodes and an tri-axial accelerometer are used. A transmitter electrode is placed on the distal finger, the receiver electrode is placed on the medial finger and the MEMS accelerometer is placed on the upper surface of the fore arm. Normal values of the patients are found and is set in the circuit. If the values exceed the normal range, the system sounds the alarm and LED starts flickering. This is used to determine the onset of seizures in advance. It is observed that the muscle vibrations are nil for normal persons. Before the onset of seizures, the muscular vibrations increased and the skin conductance values varies accordingly.

IV HARDWARE DESCRIPTION

Fig.2 Prototype

4.1 Power Supply

The power supply for the hardware part can be obtained using two different sources. The first source is a 230V power supply, which is further divided into 5V and 12V power lines. PIC microcontroller, level converter, and the reflective sensor will work in 5V DC supply, were as relay driver, relays and the motors will work in 12V AC supply. The 5V supply is obtained by using a voltage regulator (IC.7805) which is given to the reflective sensor, pin-16 of the level converter, and the shorted pins 11 and 32 of the PIC microcontroller. The 12V unregulated (the voltage obtained before the use of regulator in the circuit) voltage from the power supply is given to the pin-10 of the relay driver and six relays, connected in series. The second source is a solar panel which is connected to a 12V battery, which can also be used to power the device.

4.2. Ag-AgCl Electrode

We used Ag/AgCl disc electrodes with contact areas of 1.0 cm2 for our recordings . These electrodes are disposable and can be snapped onto or removed with ease. Although the electrodes are commonly placed on the medial and distal phalanges of the fingers and the thenar and hypothenar eminences, we use the ventral side of the distal forearms as recording sites. Placement of electrodes on the forearm are less prone to motion artifacts and highly correlated to palmar recordings [15].

Fig.3 Electrode Placement

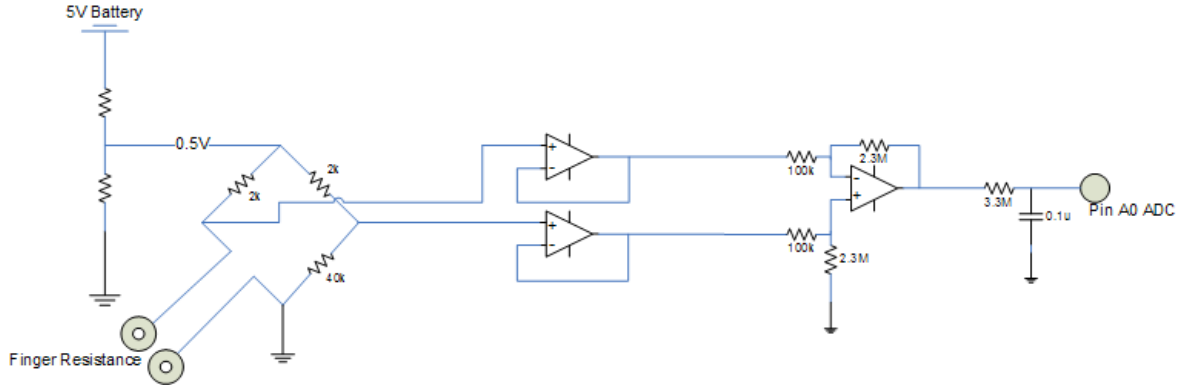

Fig.4 Electrodermal response

4.3 PIC Microcontroller

PIC 16F877A is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is perfect for applications such as control applications, measurement devices, study purpose, and so on. The PIC16F877A features all the components which modern microcontrollers normally have. It has 5 input/output ports, 3 timers, 2 serial port communication(MSSP,USART), PSP parallel communication port and power saving sleep modes. PIC16F877 chip is available in different types of packages. According to the type of applications and usage, these packages are differentiated.

4.4 Accelerometer

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer which sense the change in dynamic movement or vibrations during the occurrence of seizures. Tri-axial MEMS accelerometer measures the muscular activity in 3 axis (x,y,z). Up on the onset of seizures, the vibrations of the muscle will gradually increase. Depending up on the sweat secretion, the skin conductance value varies accordingly.

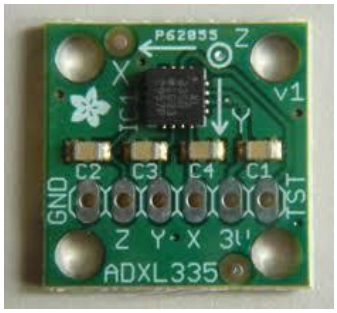

Fig.5 Tri-Axis Accelerometer

4.5 LCD Display

Liquid crystal display (LCD) is a flat panel display unit which uses the properties of light modulating crystals. It is also called as electronically modulated optical device. It uses the backlight or reflector to produce images in color or monochrome instead of emitting the light directly. It is composed of several layers of polarized panel filters and electrodes. The principle of operation of LCD is, when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. Due to this, there is a change in the angle of light passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. This results in a fine light that is allowed to pass the polarized glass through a particular area of the LCD. In this paper, the LCD displays the skin conductance value during onset of seizure.

V. RESULT AND DISCUSSION

The prototype of the hardware is designed which helps the patients in the early detection of epileptic seizure. It is based on the principle of skin conductance and vibration values as shown in Table 1. The vibration value increases for the patients who have the onset of epileptic seizures. The developed prototype is portable, simple design, easy to fabricate and needs less supervision by the clinician. However it requires some modifications before it can be commercially used. The quality of the material used to construct the electrode and sensor can be upgraded and the electronic components used can be miniaturized.

Table.1 Analysis of Epileptic Seizure

S.No.	SKIN CONDUCTANCE (mho)	VIBRATION (Hz)
1	670	nil
2	431	nil
3	35	27
4	160	nil
5	131	12
6	170	nil
7	90	15

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