Detection of Migraine Stages and its Therapy

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***Abstract*- Migraine is a chronic neurological disorder which is a recurrent throbbing pain occur in one side of the head. It occurs when the proper blood supply does not flow through the brain. The headache is previously measured using Electroencephalograph (EEG) and the therapy is provided using Biofeedback method. In this project the stages of migraine are detected by measuring the intensity of pain using EMG sensor. The acquired EMG signal is given to the PIC Microcontroller. The therapy is given as massage to the patient by using DC Gear motor. In this paper, a combined prototype of diagnostic and therapeutic procedure for migraine using EMG sensors is discussed.**

Keywords: *EMG sensor, gear motor, microcontroller, surface EMG.*

I.INTRODUCTION

Migraine is a common headache, affecting one in every five women and one in every fifteen men. It is a neurological disorder that occurs due to throbbing pain in one particular region of head and neck. It also called as “neuralgia”. It is caused by vasoconstriction which decreases blood flow to some brain cells, therefore affecting sight and motor sensations. At the end of vasoconstriction, vasodilatation occurs creating a situation where in the vessels press on the adjacent nerves causing intense pain of the head. It is a hereditary brain abnormality; also it can occur after head trauma. It may occur with or without Aura. Migraine without aura mostly lasts up to 4 hours. If they are not treated or don’t respond to treatment, they can last for as long as 72 hours to a week. It may cause nausea, vomiting, sensitivity to light, sound and smell. Typical aura occurs in one third of people and it consists of symptoms like visual, sensory, speech or motor disturbances.

Migraine has many characteristic triggers which include hormonal imbalances, dietary factors, sleep disturbances, caffeine & alcohol intakes and medication overuse. Now-a-days mostly prescribed drugs are acetaminophen, dihydroergotamine, ergotamine tartrate, lasmiditin. Some drugs are causing dangerous side effects in women compared to men such as affecting pregnancy.

TABLE 1:Types Of Migraine

Migraine with aura:

- reversible focal brainstem or cortical dysfunction
- aura develops over>4 minutes,or 2 auras in succession
- each aura <60 minutes
- headache <60 minutes following aura

Migraine without aura:

- headache lasting 4hours to 3 days
- nausea/vomiting/and/or light and noise sensitivity
- unlilateral pain
- moderate or severe intensity pain
- aggaravation by simple physical activity
- pulsating pain

Episodic tension type headache:

- duration 30 minutes to 7 days
- no nausea/vomiting; may have light or noise sensitivity(not both)
- mild or moderate intensity pain
- bilateral pain
- pressing or tight(non-pulsating)pain
- no aggravation by simple physical activity

chronic tension-type headache:

- >15 days pain per month,for>6 months
- no vomiting
- mild or moderate intensity pain
- bilateral pain
- pressing or tight(non-pulsating)pain
- no aggravation by simple physical activity

Diagnosis of migraine will be obtained depending upon the patient's medical history and symptoms. The level of headache can be analyzed using various modalities like EEG, EMG and neuroimaging. Rest is the important factor for almost all migraine attacks; if possible the migraine can be aborted. The treatment procedure can be done using various techniques. It varies depending upon the age factor of patients. Psychiatrist consultation is one kind of treatment, because the headache is caused by their mental stress. Physiotherapy helps in relieving pain.

II.METHODOLOGY

DIAGNOSTIC METHODS:

Electrodes are used to generate a potential difference between two points. There are two types of electrodes available: invasive and non-invasive. For invasive, needle electrodes are used, for non invasive, surface electrodes are used. In this method, surface electrodes are used to acquire the EMG signal. This can be used to detect the neuromuscular abnormalities. Since it is placed superficially over the skin. It is no painful when compared to the use of needle electrodes. Disposable EMG electrodes are used.

Figure 1. Surface EMG setup

EMG sensor measures the electrical activity of the muscle. The filtered and rectified EMG signal is the output of this sensor. Adjustable gain, small form factor, and full integrated are some of the features of the EMG sensor. Easy to use and controller detects the muscle movements.

Analog to digital converter(ADC) is an electronic integrated circuit and it is used to convert the analog signals such as voltages to numerical values by approximate the signal with fixed precision. Most of the ADC take a voltage input as 0 to 10V, -5V to +5V, etc. The purpose of ADC is to convert the analog continuous signal into discrete values. The process of conversion involves primarily two phases. They are Sampling & Holding and Quantizing & encoding. The accuracy of the A/D conversion can be improved by increasing both the resolution and the sampling rate.

The PIC 16F877A is the microcontroller used in this project. It is a most widely used PIC Microcontroller due to its high operational flexibility, availability and cheapness. It uses CMOS FLASH-based 8-bit microcontroller . It has a total number of 40 pins and there are 33 pins for input and output. The operating voltage is 2-5.5V. It has 5 ports from Port A to Port E. It includes three timers,two of which are 8-bit timers, while one is 16-bit timer. It facilitates many communication protocols such as, serial protocol, parallel protocol and I2C protocol. It allows both hardware pin and timer interrupts and has a total number of 8 interrupt sources in it.

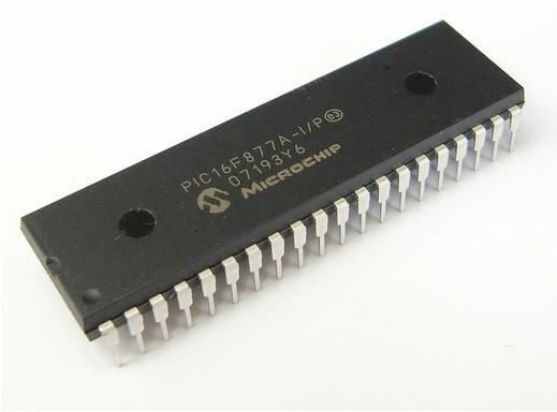

Figure 2. PIC Microcontroller

The features of this microcontroller are 256 bytes of EEPROM data memory,self programming,an ICD, 2 comparators, 8 channels of 10-bit ADC module, 2 capture/compare/Pulse Width Modulation (PWM) functions. Electrically Erasable Read Only Memory(EEPROM) is used to permanently store the data. MPLAB C18 Compiler is a official compiler of PIC Microcontroller which is used for writing codes and then compiling in it. A Hex file is created after compilation which we upload to PIC Microcontroller.As shown in the pin diagram, the port pins are bidirectional and most are multiplexed in function.

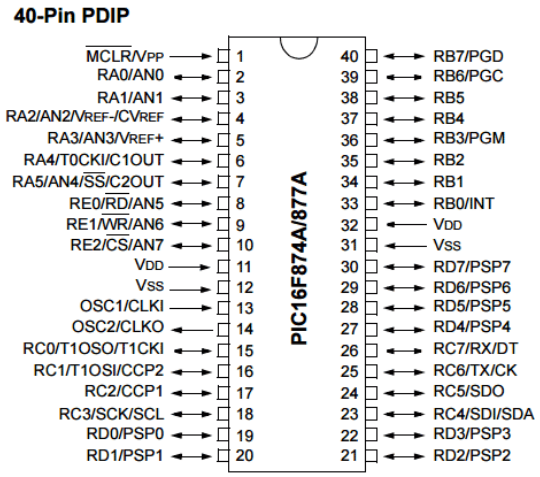

Figure 3. Microcontroller Pin Diagram

A LCD is an electronic display module which creates a visible image using liquid crystal.The LCD used in this project is a 16 x 2 lines ASCII character LCD display with yellow backlight and utilizes the mostly common HD44780 parallel interface chipset (datasheet). This LCD's operating voltage is 4.7-5.3V. It contains two rows in which each row will generate 16 characters. Current consumption is 1mA without backlight. Each character can be created with a 5 x 7 pixel matrix. The alphanumeric LCD's alphabets & numbers can operate on two modes,such as 4-bit & 8-bit. For use in 4-bit mode, 7 general I/O pins is used to interface to this LCD screen.

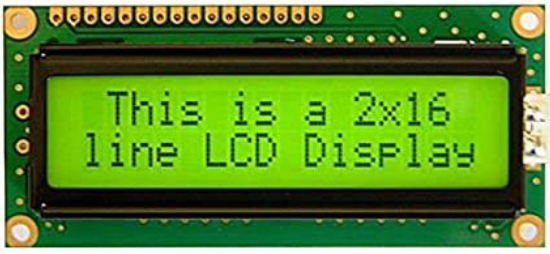

Figure 4. LCD Display

This LCD has two registers respectively, Command and Data register. Register select(RS) is used to change from one register to another. The command register is used to store the command instructions given to the display and predefined tasks like clearing the display , initializing and setting the position of the cursor can be done. The data register function is to store the information which is to be displayed on the LCD .

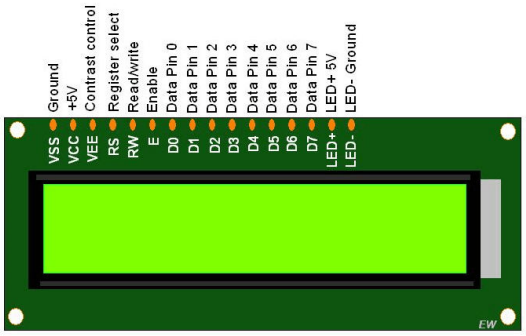

Figure 5. LCD Pin Diagram

Alkaline batteries are a type of primary batteries dependent upon the reaction between zinc and manganese dioxide (Zn/MnO2). This battery's features include compatible with all development board, reuse of specially designed cells and primary battery.

THERAPEUTIC:

Geared DC motor with 10 revolutions per minute is used. The features of this motor include high durability, metallic gears, high quality and precise rpm. The motor is connected to the microcontroller and the cap which consists of the elastomer and the fabric. The dc motor transforms the electrical energy into mechanical energy in form of rotation. This rotation is produced by the electromagnetism. The dc motors have inductors inside, which produce the magnetic field for the generation of movement. Elastomer is a plastic with elastic properties. It is fixed under the cup and it is connected with the gear motor. The motor starts and the elastomer rotates which gives a massage feel to the patient. A piece of fabric is placed under the elastomer to cover it which prevents the hair from getting tangled with the elastomer.

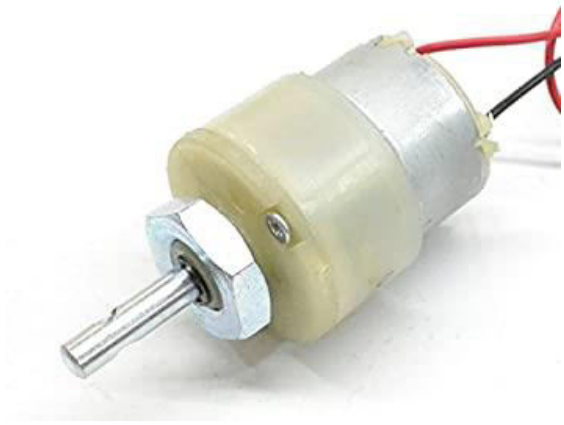

Figure 6. DC Gear Motor

III.PROCEDURE

Initially the patients were seated in comfortable position and close their eyes to enhance relaxation. The headache measurement is performed using embedded system. The system is the combination of both hardware and software configuration for obtaining desired output.

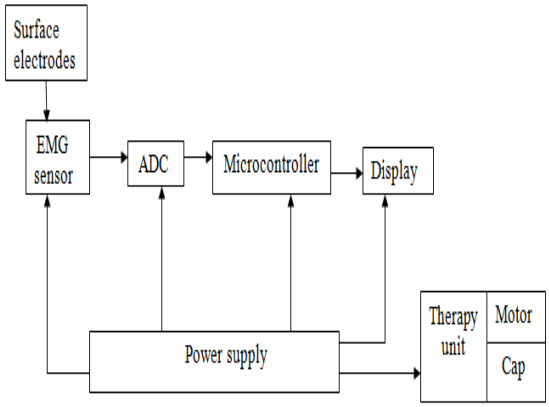

Figure 7. Block diagram

There are 3 surface electrodes which are used for acquiring the EMG signal. The two active electrodes are placed on the two sides of the forehead and another one reference electrode is placed on the forearm. These electrodes are connected to the EMG sensor which measures the EMG activity and produce the output as analog signal. The acquired analog EMG signal is converted into digital values. Analog to digital converter (ADC) is used for this conversion. The converted digital values are stored in the microcontroller. C program is used for the microcontroller.

The program of the final desired output is written in such a way that there will be three levels. The levels are Low, Medium, and High. The output of the microcontroller is displayed on the LCD. The digital values are in the form of milli volts. The displayed level of migraine is depending upon the intensity of pain. The high level denotes that the person is having a headache. The low and medium levels indicate that the person is in a normal state. The low level represents the values between 100 to 200 mV. The medium level represents the values between 200 to 300 mV. The high level represents the value between 300 to 400 mV. The output readings may vary depending upon the electrodes and the accuracy of the EMG sensor.

After detecting the stages of migraine, proceed onto the therapeutic procedure. The role of the therapy is to provide relaxation to the patients experiencing migraine. The therapeutic cap is connected to the diagnostic hardware. This method involves the use of vibrating massage as therapy. A gear motor is mounted over the cap and inside the cap an elastomer is fixed with a fabric material under it. The elastomer and motor is connected. When the output value of microcontroller reaches a high value the motor starts working. The motor rotates in a clockwise direction for 30 seconds. This rotation will create a massage feeling to the patient and increases their relaxation state. The process will continue until the patient gets relief from the pain.

IV. RESULT & DISCUSSION

The intensity of pain produces a voltage in EMG sensor which is used for the detection of stages of migraine. The threshold value is set to separate the stages into three levels as low, medium and high. The low and medium are normal states of a person. The high level indicates that the person is having a headache. Then the therapy is given to the patient by giving a vibration as a massage feeling to relief the pain.

Figure 8 . Neural Activation State

The motor speed can be increased or decreased according to the patient preference by adjusting the power supply voltage given to the DC gearmotor.

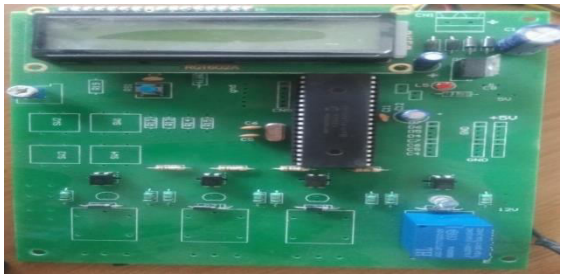

Figure 9 . Interfacing LCD with PIC Microcontroller

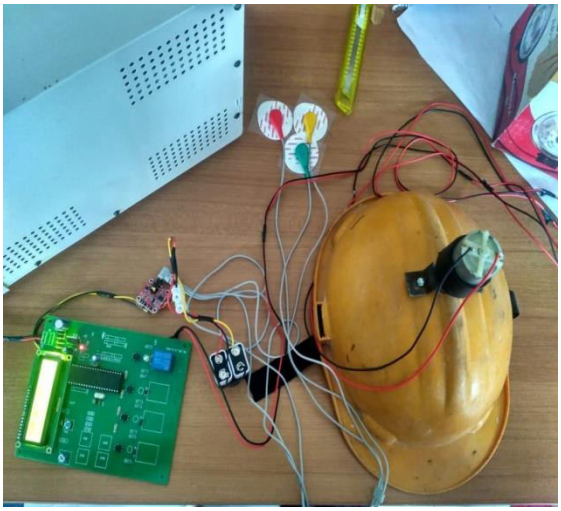

Figure 10 . Experimental Setup

V. CONCLUSION

The detection of migraine stages depends on the accuracy of the EMG sensor and the type of surface electrode used. In future, this project can be extended into a real time application as a portable device with the combined diagnostic and therapeutic procedure by using EMG for migraine.

VI. REFERENCE

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