PROJECT REPORT
ON "BRAIN WAVE DETECTION SYSTEM"

Submitted for partial fulfillment of the requirements for the degree of B. TECH in Department of Electronics and Communication Engineering

By:
Umar Farooq (1702731155)
Vishal Kumar (1702731168)
Salman Khan (1702731121)

Under the supervision of

Asst. Prof. Abhishek Tiwari
Department of Electronics and Communication Engineering

Ajay Kumar Garg Engineering College, Ghaziabad
27th KM Milestone, Delhi - Hapur Bypass Road, Ghaziabad 201009

Dr. A.P.J ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
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ABSTRACT

The project is focused on the detection and extraction of a brain wave signal with the help of analog as well as digital circuitry. Using active electrodes on human scalp, the brain signals were fed into a series of hardware and software stages. Simple conscious movements such as blinking caused a change in the detected waveform. Although the project was not successful in discriminating between different motions or utilizes the signal to control an electrical device, the team was able to successfully separate and display the alpha waves after filtering off all associated unwanted signals.

The traditional vehicle-based and vision based drowsy detection become apparent only after the driver starts to sleep, which is often too late to prevent an accident. In this proposed project a buzzer with low power consumption, is placed near the driver which would wake up the driver while he falls asleep while driving. The EEG- sensor senses the brain signals and also the eye blink of the driver using ADS1299, and the entire device is operated using an Op-amp. The EEG signal is converted to digital using ADS1299 Analog front end and the output is acquired using MSP430. The speed of the car will be varied according to the EEG signals. If the car slows down the indication is displayed at the back of the car using a LED display. Thus a sensor able to detect the activities and components of brain is important for comprehensive care and analysis of body conditions. The Low cost embedded drowsy driver detection system determines the sensor result and if it is below or above the optimum value it will indicate by the buzzer and the LED indication at the back of the car will help others viewing the vehicle slowing down.

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

Electromyography is the few important indicators of biomedical signals for computing and health monitoring. The substantial germaneness of electro encephalography (EEG) signal is to review the oscitancy and vigilance level of subject those who forced to do uninteresting, but mind debate on jobs such as driving. Now a day's lot of heavy accident happens due to inevitable drowsiness and tiredness, so it is necessary to have a real time system that supervises driver's drowsiness continuously. There are so many technical alertness system is existing already for drowsy detection. They are, drowsy detection using image processing by complete monitoring of eye open and close.

A brain– computer interface (BCI), often called a mind-machine interface (MMI), or sometimes called a brain–machine interface (BMI), it is a direct communication pathway between the brain and an external device. Most research investigating BCI in humans has used scalp-recorded electroencephalography or intracranial electrocorticography. The use of brain signals obtained directly from stereotactic depth electrodes to control a BCI has not previously been explored. In this paper, we present a smart home automation system using brain–computer interface. BCI is becoming progressively studied as the way users interact with computers because recent technological developments have led to low priced, high exactness BCI devices. These systems that can detour conventional channels of communication (i.e., muscles and thoughts) between human brain and corporeal devices, to provide undeviating communication and sway, by recasting different patterns of brain activity into commands in real time.

According to the output given from the comparator the LED glows indicating the state of the driver. Then the LED is connected to the MSP430 controller circuit through a flexible wire that controls the LCD, Buzzer and Engine of the vehicle. The LCD in our project is used to indicate that the driver is at drowsy state to the other vehicle driver which is coming behind. The buzzer is used to wake up the driver if he is in the drowsy state.

1.2 PROJECT IDEA: -

In this research paper we have designed a new instrument which reads the subject brain waves continuously and gives feedback in the form of led signal. In previous protocols, researchers concentrate on only drowsiness but they are not gives important while driving. Some of them have done this research using real car. But these protocols feedbacks only after the subject slept. So in order to rectify these problems we designed new protocol which identifies subject drowsiness before he is going to sleep.

With the help of this, we are analyzing the brain wave signals. Human brain has millions of interconnected neurons. The interaction pattern between these neurons is represented as emotional states and thoughts. This pattern will be changing as the human thoughts change, which in turn produces different electrical waves. In the proposed system, an alarm with low power consumption is placed near the driver which will wake up the driver while he falls asleep during driving. The EEGsensor senses the brain signals of the driver and if he falls asleep it will send the signal to the embedded system for further processing. The signal is sent to the amplifier and the amplified signal is given to the comparator that compares the input signal (amplified brain wave signal) with the threshold voltage that is set according to different sensation states of the driver.

1.3 OBJECTIVE: -

The project is done to build a brain wave controlling device to control electrical devices. It is designed by an Arduino board, high speed op-amps, microcontroller and general electrical components. The main objective of this project is to detect the brain signal and operate certain electrical appliances with the help of any gestures caused by the human body. The project is done to observe human gesture by the palpitation of eye blinks and detecting the corresponding brain signal. Alpha wave is detected from the brain signals with the help of the active electrode and the collected data is used to convert to a digital signal for analysis and control. In the stimulation of our project, a similar range of frequency which matches the alpha wave was randomly generated to test the circuit. A signal generator was introduced with a frequency within the range of 8-13 Hz. Responses of different wave shapes were collected for the test circuit. Our proposed system could be modified to achieve more advanced goals like using it as a sensor to use in automated system or to communicate using the brain signals. There are many benefits to this project. This project is done in order to understand the brain signals and detect them by using an oscilloscope which will give different signals depending on the test subject's emotional responses and it can be analyzed. Though this is the initial stage of the project but it can be upgraded and can be used for advanced applications and thus give us a better understanding of the complexity of the brain.

CHAPTER 2 WORKING OF THE PROJECT

2.1 PROPOSED WORK: -

The proposed works are briefly described in this section. The system hardware consists of the signal acquisition module. The EEG signal is captured through the EEG electrode; the inbuilt amplifier will amplify the captured EEG signals. The EEG signals is then passed to the High Pass Filter which is capable of filtering 60Hz. Then it is given to the Low Pass Filter which is capable of filtering up to 5Hz. At the same time the amplified EEG signals is given to the LM339 comparator, the acquired voltage is compared with the reference voltage. From the obtained voltage ,the various states of the driver is indicated using LED whereas the red LED represents the active state of the driver, the yellow indicates the normal state of the driver and the green represents the drowsy state of the driver. The program for the whole module is dumped into the microcontroller. Whenever the drowsy state is detected, the microcontroller enables the motor to slow down and the drowsy state of the driver is indicated using LCD display and the alarm starts to ring.Fig.2.1.1, Shows the overall block diagram of the proposed system.

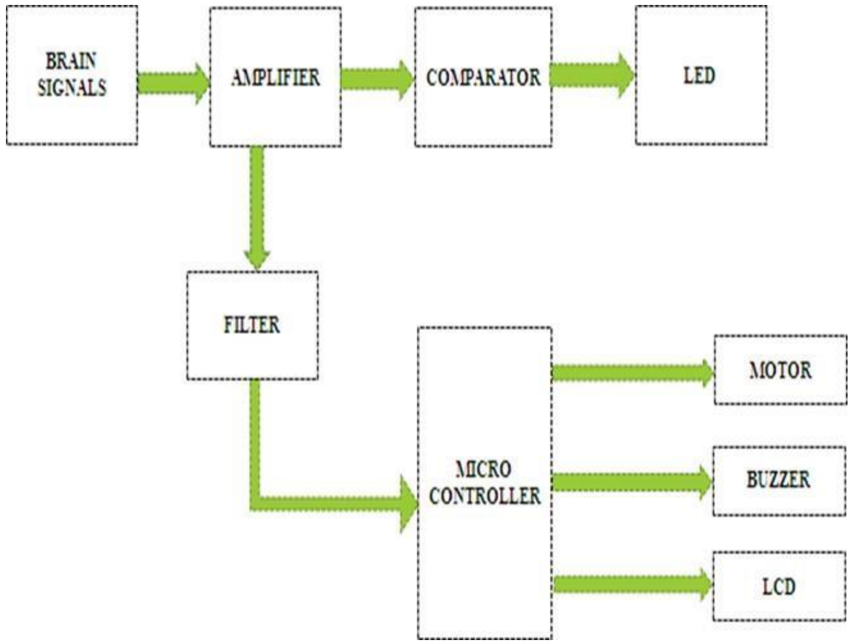

Fig 2.1.1 Overall Block Diagram

The Fig.2.1.2, shows the hardware work flow of the proposed system

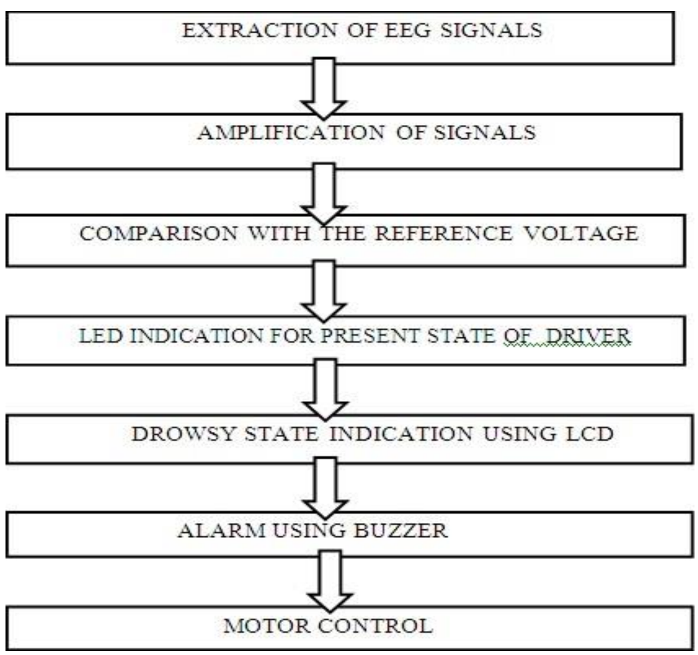

Fig 2.1.2 Hardware Work Flow

The proposed system is separated into three modules each module is discussed in this section. The modules are as follows

2.2 EXTRACTION OF BRAIN SIGNAL: -

The electroencephalogram (EEG) is a record of the electric signals generated as the result of brain activity. EEG provides important and unique information about the sleeping brain. While EEG signals have advantage in making accurate and quantitative assessment of alertness levels.EEG signal will be obtained from the Brain wave Sensor. EEG signal is quite small, ranges from 1Hz to 100Hz and amplitudes vary from 1µV to 100µV.

FIG.2.2.1 Brain Wave Sensor Components

The above Fig.2.2.1 is headset device is used to extract the EEG signals from the human brain. A pair of electrodes is affixed inside the headset which is responsible for the extraction of brain waves.

The overall block diagram of extraction of EEG signals is shown in the Fig.2.2.2.

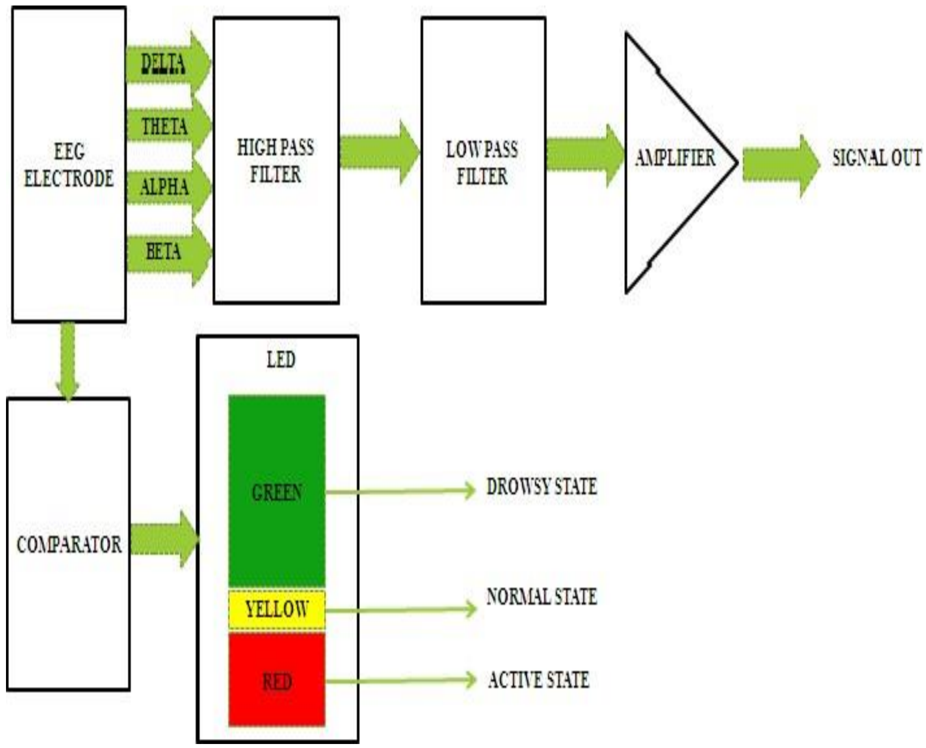

Fig.2.2.2 Block Diagram For Extracting EEG Signals

In this project EEG signals is obtained from the EEG Electrode. The electrode is in the form of mobile headset and the device consists of a headset with USB cable is shown in Fig.2.2.1 the EEG electrode is resting on the forehead above the eye. The headset transfers signal to the circuit board. It analyzes your brain waves to identify rhythms that reflect a calm meditative state and those that reflect an alert attentive state. The brainwave visualizing unit is used to understand how it 'feels' to pay attention and how it 'feels' to meditate so that you can better control your focus and attention

The human brain generates electrical signal called EEG signal that have been classified into 4 categories as follows,

Table.2.2. EEG Signals with frequency ranges

S.NO	SIGNALS	FREQUENCY
1	Delta	0.3 – 4 Hz
2	Theta	4 – 8 Hz
3	Alpha	8 – 13 Hz
4	Beta	Above 13 Hz

Table.2.2 shows different levels of EEG signal has been shown in the. For the drowsy state detection the alpha and theta waves are very important. Our brainwaves change according to what we're doing and feeling. When slower brainwaves are dominant we can feel tired, slow, sluggish, or dreamy.

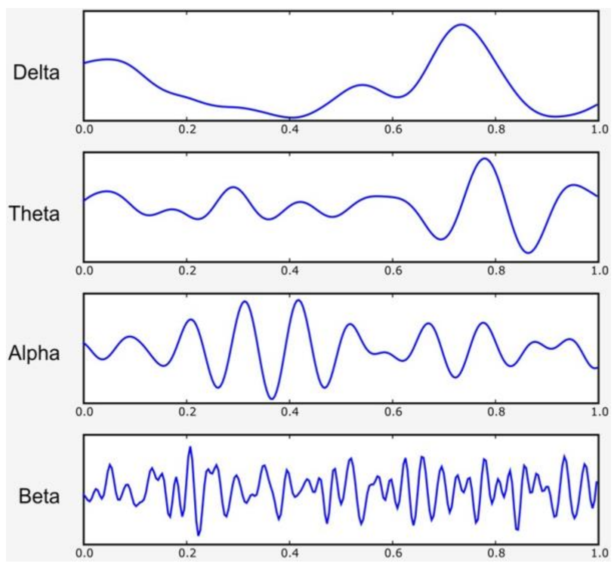

Fig.2.2.3 EEG Signal – Classification

The four types of waves from the EEG electrode are given inside high pass filter and then low pass filter to extract the required signal that is used to detect the drowsy state of the driver that is to extract the Theta wave. Then the output of the filter is given inside the amplifier to amplify the signal as required for further processing. The four waves from the EEG electrode are fed into the comparator and the LED is controlled. There are three types of LED they are green indicating the drowsy state of the driver, yellow indicating the normal state of the driver and red indicating the active state of the driver.

This EEG electrode keeps on sensing the brain activities of the driver. If the frequency obtained from the EEG electrode is between 4-8Hz it means that the driver is in drowsy state then it will give an alarm to wake up the driver and an LCD indication to the driver who is coming at the back that the driver is in drowsy state. The signal abstracted from the driver is the input for the amplifier and then to the comparator, it is then given as input to the 17 rows of LED when the last row of LED glows when the Theta waves are detected constantly then the voltage from the LED is given as the operating voltage to the MSP430 microcontroller that controls the buzzer, LCD, motor.

CHAPTER 3 HARDWARE DISCUSSION

3.1 HARDWARE DISCUSSION: -

Whenever the drowsiness is detected the speed of the motor will be reduced, the message will be displayed on the LCD display to indicate the vehicle coming behind and the buzzer which is placed near the seat will ring. The processed signal is given to the high pass filter followed by the low pass filter and to the amplifier for the proper extraction of signals.

to the high pass filter followed by the low pass filter and to the amplifier for the proper extraction of signals.

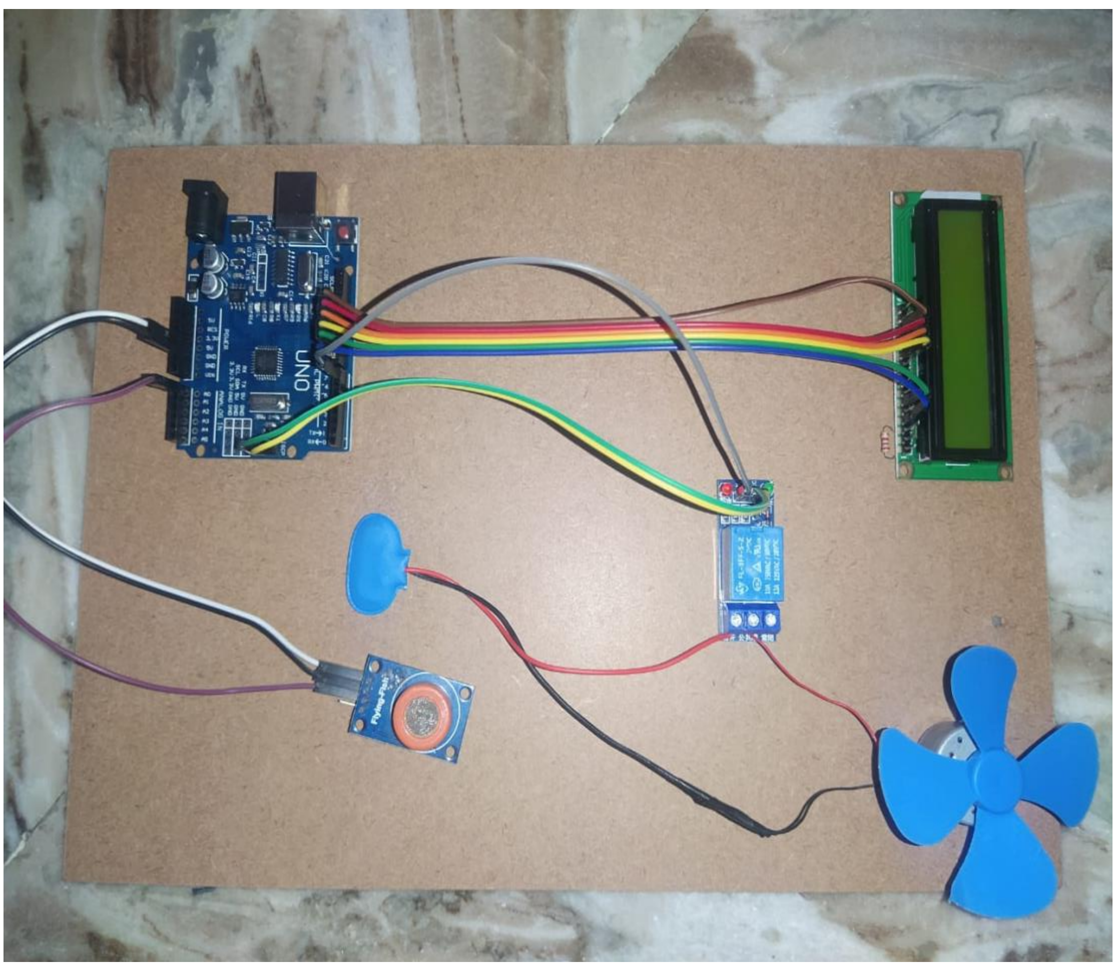

Fig.3.1.1 shows the amplifier circuit.

Fig 3.1.1 AMPLIFIER CIRCUIT

The EEG signals are given to the comparator. The comparator compares the acquired voltage with reference voltage. The output voltage denotes the various state of the driver that is depicted using LED indicates the active state of the driver which is depicted using red LED indicates the normal state of the driver which is depicted using yellow LED indicates the drowsy state of the driver which is depicted using green LED.

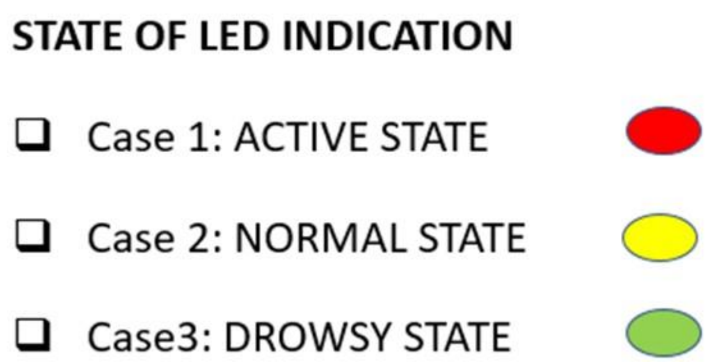

Fig .3.1.2 LED Indicating State Of A Driver

For each and every variation in the state of the driver, different rows of LED begin to glow. Whenever the last row green LED glows the speed of the motor will be reduced. At the same time a message will be displayed on the LCD which is to indicate the vehicle coming behind and the alarm starts to ring. Fig.3.3.3 shows the LCD output during the drowsy state of the driver

Fig.3.3.3 LCD Output.

Whenever the drowsy state is detected the controller will enable the motor to slow down which is connected with a relay. At the same time an alarm is given using a buzzer to the driver to make him awake and the state of the driver is displayed in the LCD screen which is to be placed at the back of the car to indicate the person coming behind.

3.2 MICROCONTROLLER FUNCTION MODULE

This section describes about the programming part that is to be dumped into the microcontroller. Through the EEG signals are captured from the skin of the driver. The tapped input is given to the amplifier. That data is extracted and processed for further process. That input data is passed to MSP430 microcontroller through the CCS coding and the process is carried out. The fig.3.2.1 shows the flowchart of the program

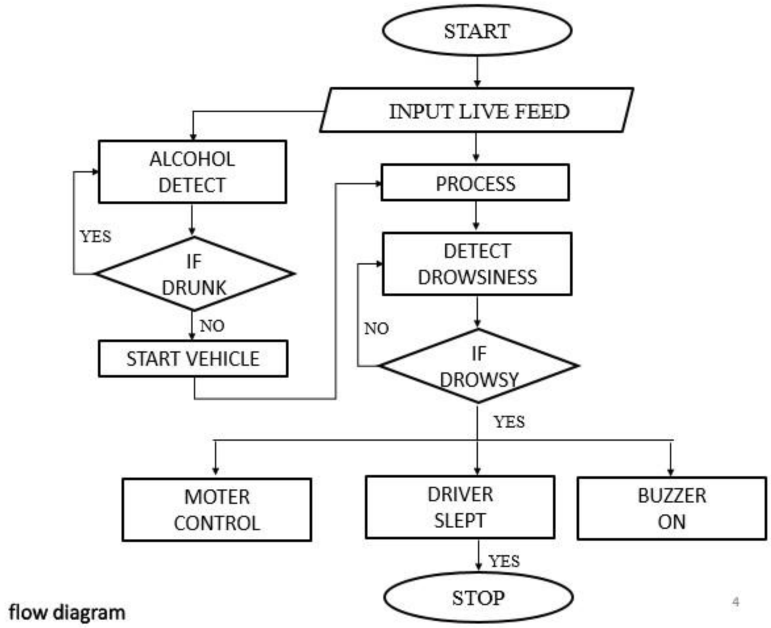

Fig.3.2.1 Flowchart For Program

INTERFACING CONTROLLER WITH OUTPUT UNIT

This section describes about the controlling part that is interfaced with the output unit.

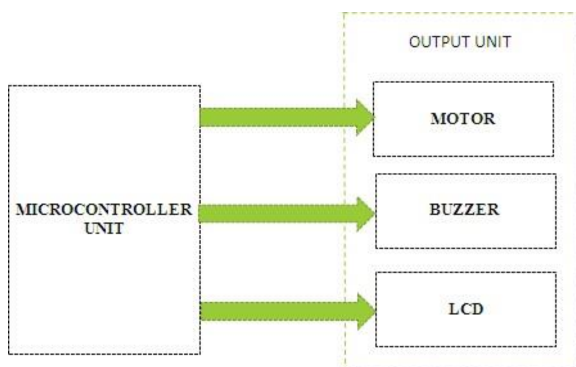

Fig.3.2.2 Interfacing Controller With Output Unit

As soon as the frequency obtained is between 4 to 8 Hz from the amplifier, the drowsy state of the driver is being detected and input voltage of 5volts is given as input to the microcontroller MSP430.As the microcontroller is being interface with the output unit containing Buzzer, motor and LCD is controlled. As soon as the drowsiness of the driver is detected buzzer that helps to wake up the driver, motor gets slows down and the LCD indicating that the driver is at the drowsy state. In this paper, focusing of the electrode to acquire the accurate bio signal from the subject is achieved. After signal accusation, the signal is amplified with the help of preamplifier and then the amplified signal is given to the suitable controller which has both system interface and sensor interface features. Each blocks of this implementation is explained below in detail.

SOFTWARE DESCRIPTION :

```
#include<pic.h>
void delay(int e)
{
while(e--);
}
void lcd_cmd(unsigned char n)
{
RE0=0;
RE1=1;
PORTD=n;
delay(1000);
RE1=0;
}
void lcd_data(unsigned char *p)
{

while(*p!='\0')
{
RE0=1;
RE1=1;
PORTD=*p;
delay(1000);
p++;
RE1=0;
}
}
```

```
void main()
{
int a,b,c,count=0;
ADCON1=0x82;
ADCON0=0xc5;
TRISA=0x3f;
TRISE=0x00;
PORTE=0x00;
PORTC=0x00;

TRISD=0x00;
PORTD=0x00;

CCP1CON=0x0c;
CCP2CON=0x0c;
PR2=128;
TMR2=0;
T2CON=0x04;
CCPR1L=0;
CCPR2L=0;

lcd_cmd(0x01);
lcd_cmd(0x38);
lcd_cmd(0x06);
lcd_cmd(0x0c);

lcd_cmd(0x80);
lcd_data(" DROWSINESS ");
lcd_cmd(0xc0);
lcd_data(" SYSTEM ");
delay(20000);
lcd_cmd(0x01);
while(1)
{
GO=1;
while(GO==1);
a=ADRESL;
b=ADRESH;
```

```
b=b*256;
c=a+b;

if(c>0 && c<500)
{
CCPR1L=255;
lcd_cmd(0x80);
lcd_data(" NORMAL ");
}

If(c>500 && c<1023) { lcd_cmd(0x80); lcd_data(" ABNORMAL ");
if(count==0)
{
for(int j=255;j>=0;j--)
{
CCPR1L=j;
delay(600);
}
count++;
}
}
}
}
```

RESULTS :

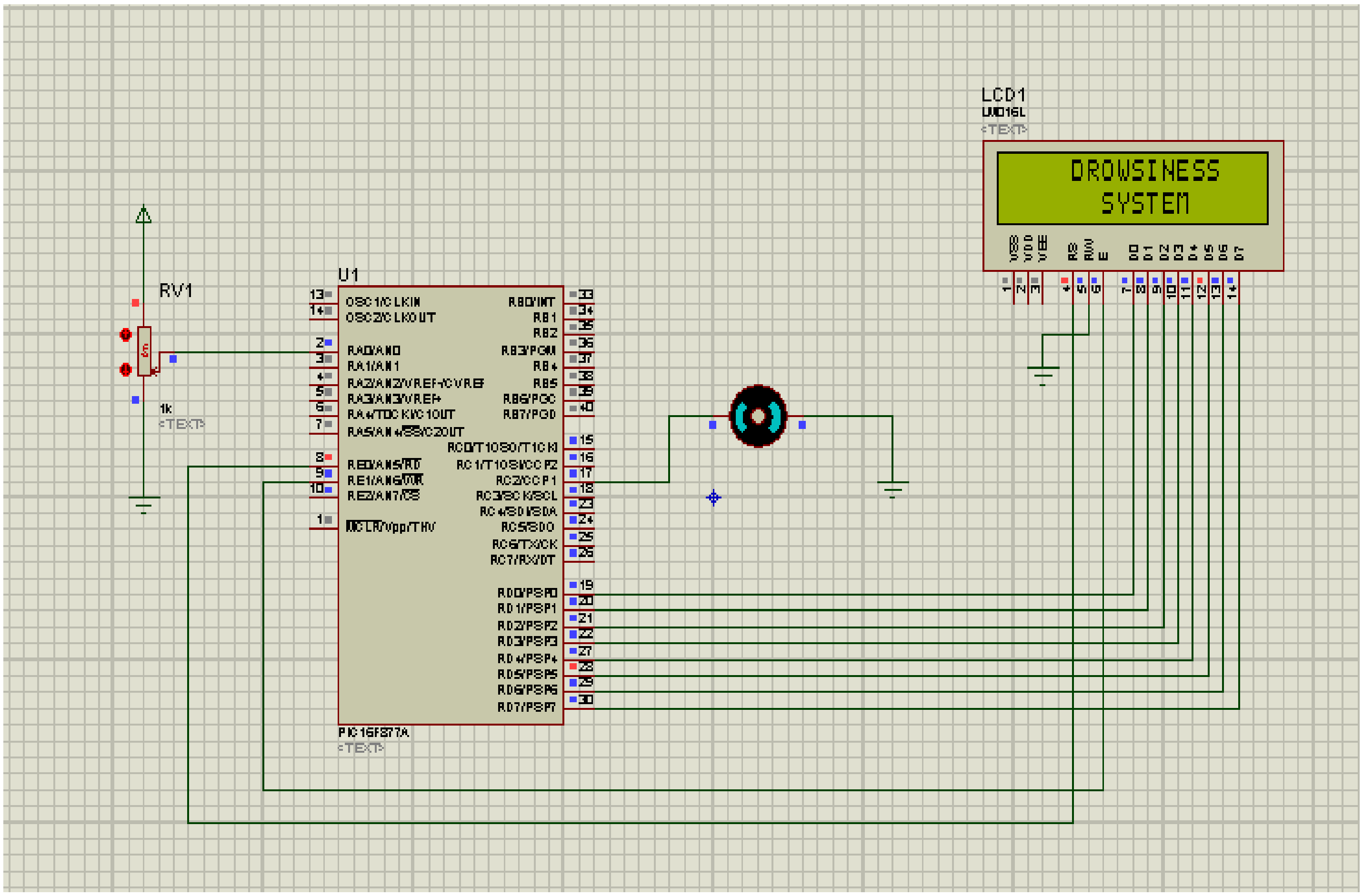

Figure-2. Simulation output when the driver is in drowsy condition

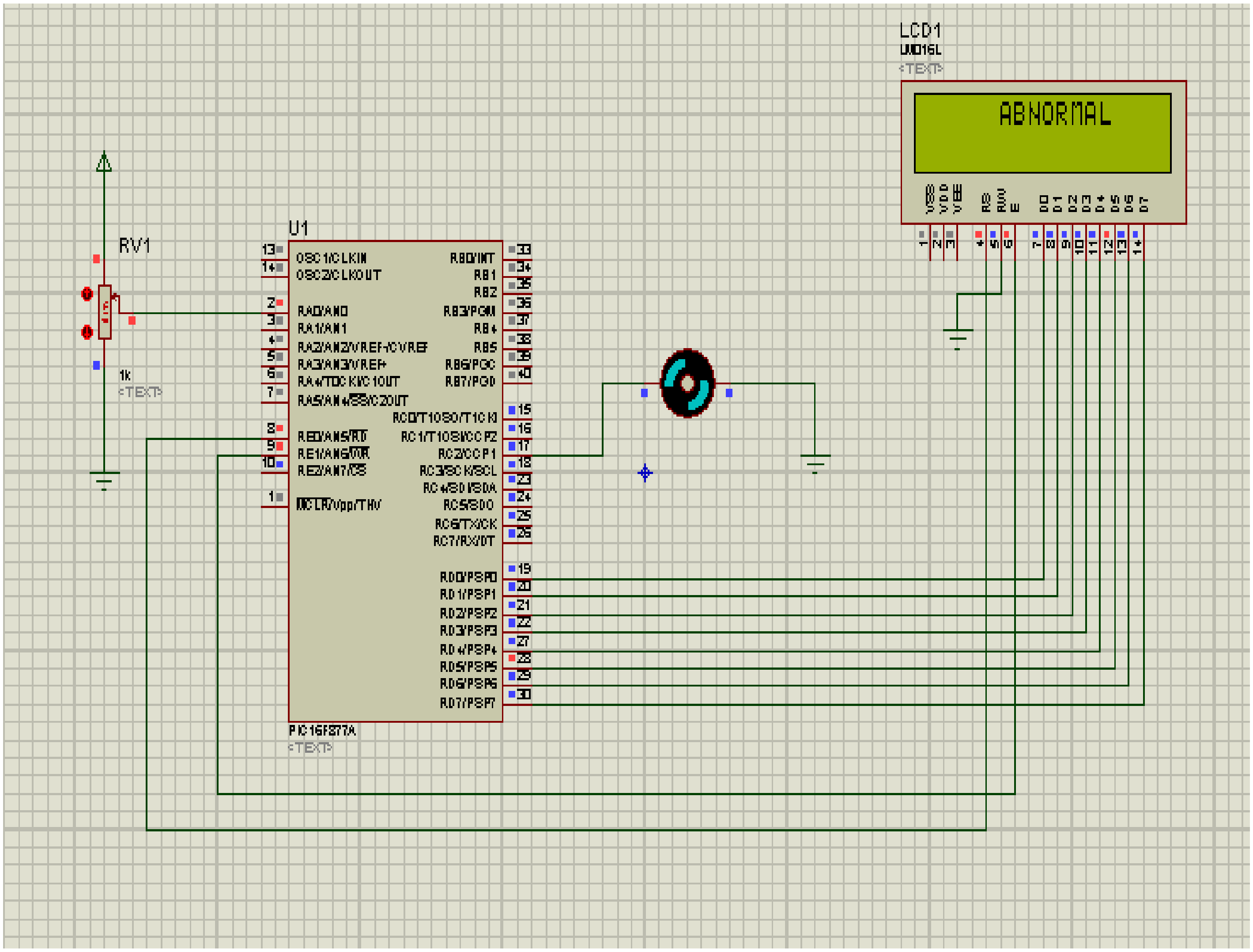

Figure-3. Simulation output when the driver is in abnormal condition.

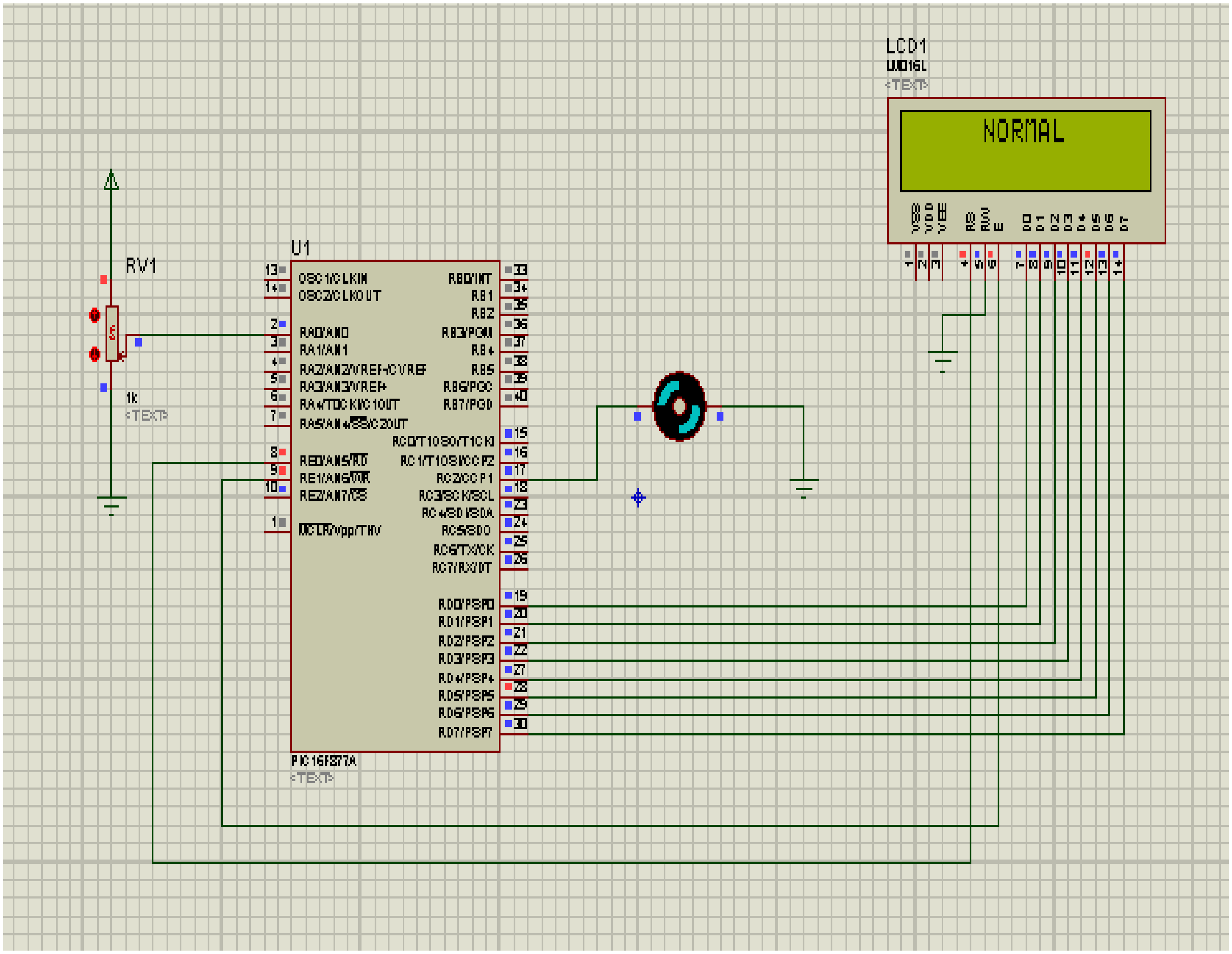

Figure-4. Simulation output when the driver is in normal condition.

CHAPTER 4 FUTURE SCOPE

4.1 CONCLUSION AND FUTURE ENHANCEMENT: -

The traditional vehicle based and vision based drowsy detection is apparent only when the driver fell asleep. This is often too late to prevent accident. Therefore the existing systems have been proven not so effective till date. The vast possibilities of mind machine interface (MMI) have been utilized to overcome the above mentioned drawbacks of drowsy detection system in this project. A low power consumption alarm system along with a EEG sensor system is employed. The sensors are set with high sensitivity aided with low cost and high reliability. This has a real time application in day to day life as the number of accidents that are fatal as well as not, are increasing in an alarming rate. The activity of the brain is taken as the input and fed to comparator circuit, processed with microcontroller. The normal and abnormal rate is set according to the authentic and preferred standards available. Software module is employed in microcontroller to control the motor, LCD and buzzer. A high frequency alarm is used to wake up the sleeping driver which is placed near his seat. Number of speakers is varied according to the requirements. This experiment varies from the previously implemented projects as the sensitivity and range is successfully increased. In this module we integrated the drowsy detection and alerting system with car automation. As the driver is still unconscious even after the alarm set off, the car will halt in the leftmost side. To make this happen, we used some essential alteration in steering system of the car. As the driver will be unconscious when the car is getting halted by it, making the system aware of the nearby cars and will help to take a safe distance. When it accidentally collides with any vehicle, the vibration sensors will get noticed and will help to change the course accordingly. Steering and braking system is always connected to navigate the car with less collision.

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