VOL. 12, NO. 8, APRIL 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

BRAIN WAVE SENSOR SYSTEM FOR ACCIDENT PREVENTION IN VEHICLES

S. Pradeep Kumar and A. Wisemin Lins
Department of Electrical and Electronics Engineering, VELS University, Pallavaram, Chennai, Tamil Nadu, India
E-mail: pradeep88.se@velsuniv.ac.in

ABSTRACT

In the present day world there are a lot of vehicles used by the humans and there are no safety facilities in these vehicles but millions of consumers are using these vehicles to transport themselves from one place to another. Many accidents occur because of the brake failure, engine failure, driver whose drowsiness so the present day scientists are taking real hard steps to stop this kind of unwanted accidents which is mainly because of the human fault or error. Some of the reasons for causing accidents also include the driver's drowsiness when he is driving specially at the night time. A system is in need that should detect the condition of the driver whether he is suitable to drive. The system is safe and easy to use because though the system has more circuitry it defines a standard approach to prevent the accidents due to drowsiness and is concerned with the safety of the user so it is worth risk taking. In this system brain wave sensor is used to sense the drivers status whether he/she is conscious or unconscious. If driver become unconscious or become slept the buzzer will intimate the driver. Data acquisition system provides brain wave pulse ranges. If this brain wave pulses is mismatch with the reference pulse the system detect that driver become slept. After this the system will control the vehicle's engine. Due to this drowsiness of driver is detected and the accidents can avoid using this system.

Keywords: PIC 16F877A controller, brain wave sensor, buzzer.

1. INTRODUCTION

In this system brain wave sensor is used to sense the drivers status whether he/she is conscious or unconscious. If driver become unconscious or become slept the buzzer will intimate the driver. Data acquisition system provides brain wave pulse ranges. If this brain wave pulses is mismatch with the reference pulse the system detect that driver become slept. After this the system will control the vehicle's engine. Due to this drowsiness of driver is detected and the accidents can avoid using this system. In the present day world there are a lot of vehicles used by the humans and there are no safety facilities in these vehicles but millions of consumers are using these vehicles to transport themselves from one place to another. Many accidents occur because of the brake failure, engine failure, driver whose drowsiness so the present day scientists are taking real hard steps to stop this kind of unwanted accidents which is mainly because of the human fault or error. Brain Wave Sensor observes the Human brain, and NeuroSky provides Brainwave Headphone to feel it. Process and signs will be transmitted through Bluetooth found in the Brainwave headphone. The headphone can be charged using triple-A charger. The Brainwave headphone has a supply switch, a detector tip, flexible ear arm and a Earth Ear clip.

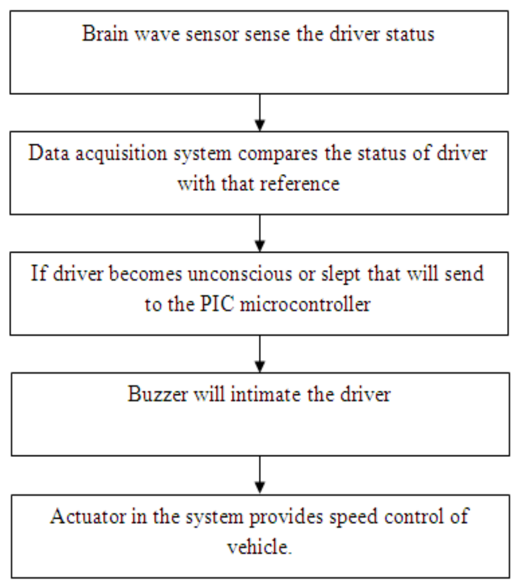


Figure-1. Flowchart of the module.

2. SYSTEM ARCHITECURE

In this designed system the Brain wave sensor sense the brain signal and the brain wave is analyzed by acquisition system, If the driver is in drowsy it can be identified and the speed is controlled and also an alarm is provided to the driver so that the driver can wake up and the accident can be prevented. The speed is controlled by the actuator in the system which encages the brake and maintains the minimum speed up to the driver wake up. The alarm may be the vibration provided in the seat of the driver.

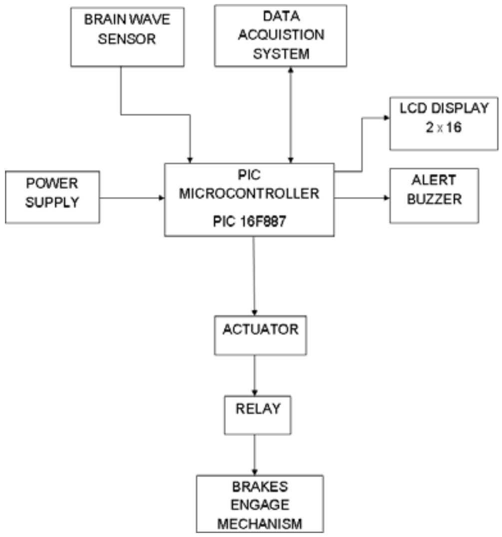


Figure-2. Block diagram of the module.

a) Hardware requirements

Microcontroller	: PIC 16F877A
Power supply	: 12V
Actuator	: Double axial cylinder.
LCD display	: 16x2
Brain wave sensor	: SM 630

b) Brain wave sensor

Figure-3. Brain wave sensor diagram.

Brain Wave Sensor is to recognize the Human brain, and NeuroSky provides Brainwave Headphone to feel it. Process and signs are carried away by Bluetooth which is present in the Brainwave headphone, and for this headphone we need to charge using triple-A charger. The Brainwave headphone has a supply switch, a detector tip, flexible ear arm and a Earth Ear clip. The Headphone has no harmful sensor that causes any pain to the User while wearing it. On inserting an triple-A charger on the Brainwave headphone with the supply switch, the LED detector will blink. The red color light blinks only when then the headphone is powered on but not linked with the computer's Bluetooth. Similarly the blue color light blinks which denotes the headphone is powered on and linked. Either red or blue color light blinks which denotes that the charger is charging low. Computer's Bluetooth Receiver receives the data broadcasted by the Brainwave headphone. Finally all these data's will be analyzed by the Level Analysis platform.

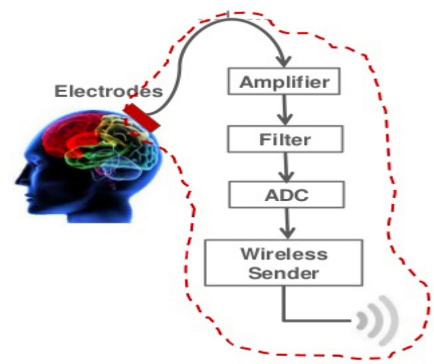


Figure-4. Working module diagram.

The Level Analysis platform will throw away the incomplete data. After analysis, data is carried to the module containing serial data transmission. The module has a receiver which receives the data which is carried out by the transmitter. Based on the data collected by the receiver the processor has control over the module. The processor is linked to a relay and a driver circuit.. All these data's are viewed on the LCD display.

c) Brain waves

- When the driver is unconsciousness, deep sleep or otherwise loss of sensation, delta wave emitting between 0.1 and 4 cycles per second.
- If the driver is in a state of strong desire for sleep, or sleeping for unusually long periods with reduced consciousness Theta wave emitting more or less 4 to 7 pulses
- when the driver are in a state of physical and mental relaxation and anxiety, although aware of what is happening in and around nearby vehicle, alpha waves emits and its frequency are in the range around 7 to 13 pulses per second

The below table displays the universally recognized frequency range which research scholar's travel behind. Most of them travel with their own identical range boundaries based on its frequencies.

Some research scholar's depends on bands having decimal values instead of round-off values. Rather some people divide bands into sub bands for data analysis.

VOL. 12, NO. 8, APRIL 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

Table-1. Types of brain waves.

BRAINWAVE TYPES	FREQUENCY RANGE	MENTAL STATES AND CONDITIONS
DELTA	0.1 Hz to 3 Hz	Deep, Dreamless, Non-REM Sleep, Unconscious
THETA	4 Hz to 7 Hz	Intuitive, Recall, Fantasy, Imaginary, Dream
ALPHA	8 Hz to 12 Hz	Relaxed, but not drowsy, Tranquil, conscious
LOW BETA	13 Hz to 15 Hz	Formerly SMR, relaxed yet focused, Integrated
MIDRANGE BETA	16 Hz to 20 Hz	Thinking, aware of self & surroundings
HIGH BETA	21 Hz to 30 Hz	Alertness, Agitation

d) Wave patterns

i. Delta waves

Delta is the frequency range up to 4 Hz. Delta has the highest amplitude and the slowest waves. They are normally found in adults slow wave sleep and in babies. They exist with sub cortical lesions, in general distributed with diffuse lesions, metabolic encephalopathy hydrocephalus or deep midline lesions. For adults it is most important frontal e.g. FIRDA and for children posterior e.g. OIRDA.

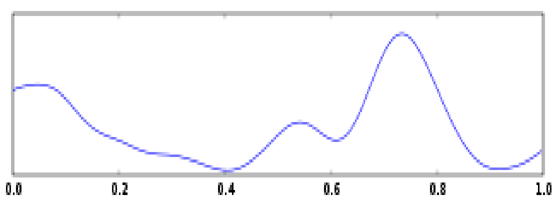


Figure-5. Delta waves.

ii. Theta waves

Theta is the frequency range between 4 - 7 Hz. Theta is generally found in young children and also found in drowsiness or arousal of adults. It can also be found in meditation.[5] Abnormal activity can be detected on excess theta for age. It is otherwise known as focal disturbance in focal sub-cortical lesions which is found in generalized distribution in diffuse disorder or metabolic encephalopathy or deep midline disorders or some instances of hydrocephalus. This range has been associated with reports of relaxed, meditative, and creative states on contradictory.

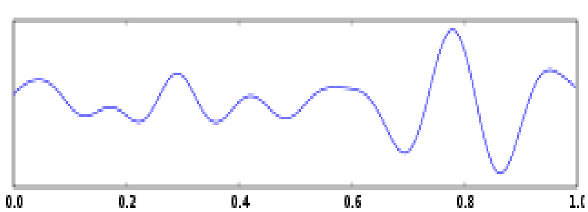


Figure-6. Theta waves.

iii. Alpha waves

Alpha is the frequency range between 7 - 14 Hz. Hans Berger named the first rhythmic EEG activity as the "alpha wave". Alpha wave is the "posterior basic rhythm" or "posterior dominant rhythm" or "posterior alpha rhythm", found in the posterior regions on both sides of the head. It is higher in amplitude on the superior side. They appear on closing of the eyes on rest, and diminished with eye opening or mental exertion. In youthful children the posterior basic rhythm is slower than 8 Hz (technically lies within theta range). Figure.7 shows the sensorimotor rhythm of aka mu rhythm.

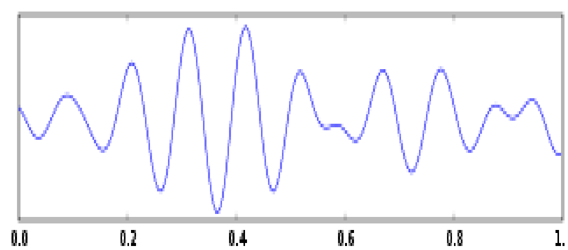


Figure-7. Alpha waves.

Other then the posterior basic rhythm, there are also general alpha mu rhythms which appears when the hands and arms are idle; and the "third rhythm" is the alpha activity in the temporal or frontal lobes. Alpha are unusual. Alpha coma is an EEG that has diffuse alpha occurring in coma and not responsive to external stimuli.

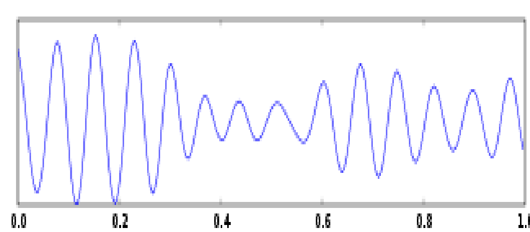


Figure-8. Alpha "coma" waves.

VOL. 12, NO. 8, APRIL 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

iv. Beta waves

Beta is the frequency range, between 15 - 30 Hz. It is found on two sides in regular spread and is visible at front. Beta activity is nearly related to motor character but reduced during brisk actions. Low angular distance beta with many changing frequencies associated with active, engaged or concerned sensing. Rhythmic beta and ascendant frequencies are combined with pathologies and drug effects, mainly benzodiazepines. They are unavailable in areas of cortical damage. The patients are aware of this rhythm.

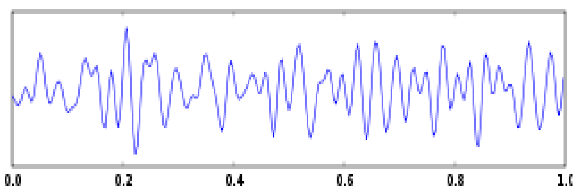


Figure-9. Beta waves.

v. Gamma waves

Gamma is the frequency range around 30 – 100 Hz. This frequency denotes combining of different populations of neurons together into a network to carry out cognitive or motor function. Mu ranges 8–13 Hz., sometimes extend over to other frequencies. This leads to the continuous firing of motoneurons in sleep state. Mu extinction reflects motor reflector neuron systems. The patterns differ in standard neuron system and the reflector neuron system interfere with each other.

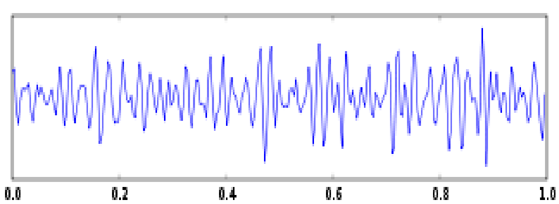
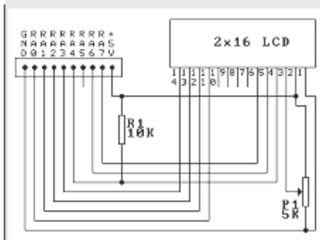


Figure-10. Gamma waves.

e) LCD display

Using an LCD display, the microcontroller displays the required information. The liquid Crystal display is ready to utilize module based on the regular IC SED1278.The module has 14 pins as input. A liquid crystal display (LCD) is a thin, flat electronic visual display that utilizes the light adjusting behavior of liquid crystals (LCs). LCDs don't allow light to pass it directly. Liquid crystal displays (LCDs) are a passive display technology which doesn't allow light instead they use the ambient light in the surroundings. On controlling this light, it visualizes images with less power. This is because LCDs are the preferred technology with low power consumption and compact size. They are used in a wide range of exercises, which includes computer monitors, TV, instrument panels, aircraft cockpit displays, signage, etc. LCDs are common in appliance such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have replaced cathode ray tube (CRT) and visualize in the majority exercise. They are usually tampered, flimsy, mobile, cheaper, authentic, and comfortable to the eyes.

LCD Pin Functions



Pin	Function	Description
1	Vss	Ground
2	Vdd	+ve supply
3	Vee	Contrast
4	RS	Register Select
5	R/W	Read/Write
6	E	Enable
7	D0	Data bit 0 (8 bit)
8	D1	Data bit 1 (8 bit)
9	D2	Data bit 2 (8 bit)
10	D3	Data bit 3 (8 bit)
11	D4	Data bit 4
12	D5	Data bit 5
13	D6	Data bit 6
14	D7	Data bit 7

Figure-11. LCD display unit.

f) Buzzer

A buzzer or beeper is an sound signaling device, which may be mechanical, electromechanical, or electronic. Some applications of buzzers and beepers are alarms, timers, etc. Some other applications are verification of user input such as a mouse click or keystroke. Earlier the machines were working on electromechanical principle. The word "buzzer" means rasping noise that electromechanical buzzers actually made. A piezoelectric component is constructed by an oscillating electronic circuit or other sound signal source. Sounds commonly used to show that a switch has been pressed on, a ring or a beep. Electronic buzzers find many applications in recent days.

Figure-12. Buzzer.

A buzzer is an electronic signal device used in automobiles, microwave oven etc. Buzzer consists of numerous switches or sensors connected to control unit that checks for which switch was pressed or preset time has lapsed. This sounds warning in continuous form or beeping sound. This device is based on an electromechanical principle which is similar to an electric

VOL. 12, NO. 8, APRIL 2017 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

bell without the metal gong with the ringing noise. This device is mounted on the wall or ceiling and used as a sounding board. Another implementation with AC-connected devices is to execute a circuit to make the AC current into noise loud which can drive a loudspeaker and hook up to cheap 8-ohm speaker. Currently, it is trendy to use a ceramic-based piezoelectric sounder like a Sonar alert which produces high-pitched tone. They are grouped up to "driver" circuits which differs the pitch of the sound or pulsed the sound on and off. The term "buzzer" comes from the rasping noise that buzzer, functions as of stepped-down AC line voltage at 50 or 60 cycles. Other sounds frequently used to point out that a button has been pushed are a ring or a beep. Some system used in Jeopardy, are noiseless, in its place using light.

3. 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;

  TRISC=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++;
     }
   }
 }
}
```

ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

a) Algorithm

- **Pre-processor data**

Step: 1 Initialize LCD, Brain wave sensor and get the header files.
Step: 2 Assign the registers (both unidirectional and bidirectional).
Step: 3 Get the address of the A to D Convertor.
Step: 4 assign the USART address for both transmitter and receiver.
Step: 5 assign the bits of the Keys.

- **Main menu**

Step: 6 Get analogue and digital values.
Step: 7 Get the Input for all the waves used.
Step: 8 Initialize LCD.
Step: 9 Data displayed in LCD. (Downiness, Unconscious, Normal)
Step: 10 Get the value of the key.(Data obtained from input waves)
Step: 11 Assign the keys in keypad.
Step: 12 Display the result.

4. RESULTS

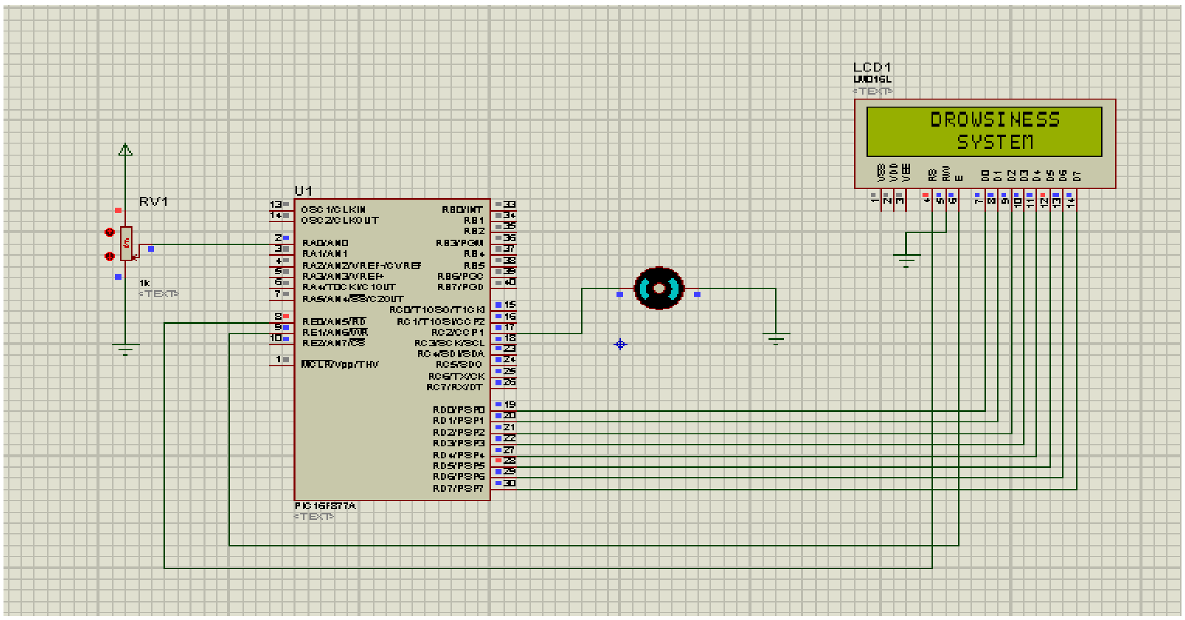


Figure-13. Simulation output when the driver is in drowsy condition.

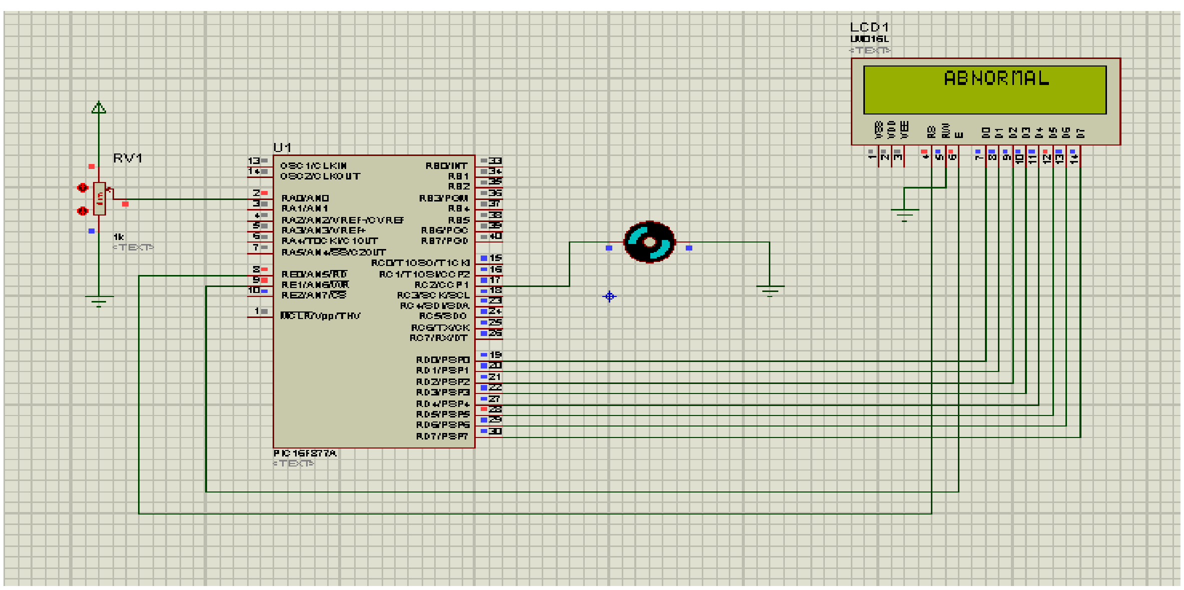


Figure-14. Simulation output when the driver is in abnormal condition.

ARPN Journal of Engineering and Applied Sciences

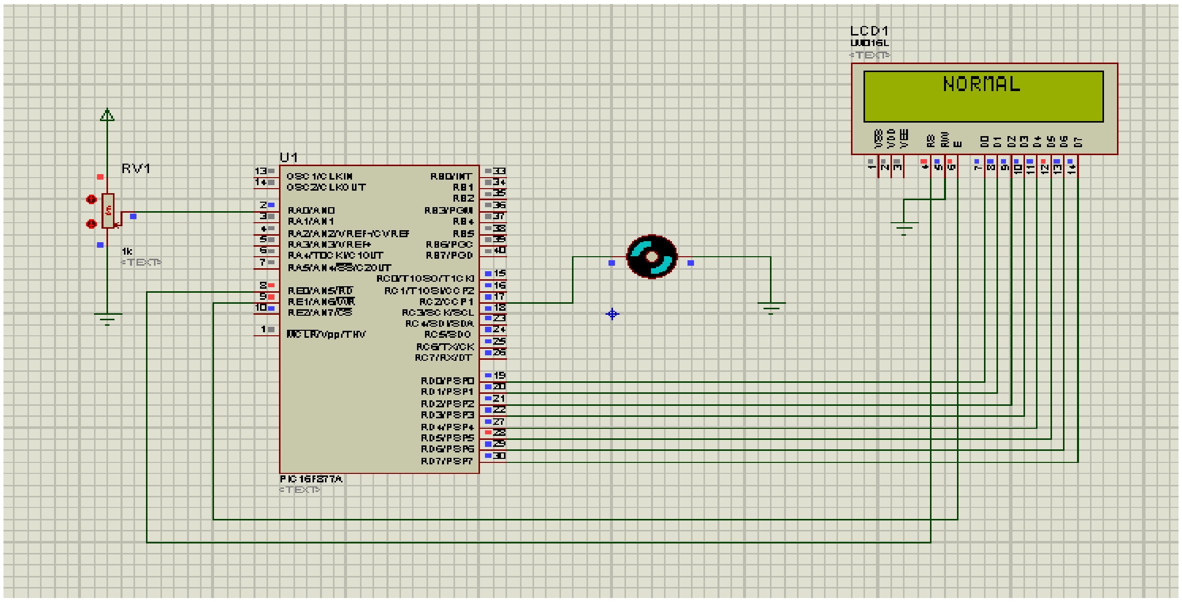


Figure-15. Simulation output when the driver is in normal condition.

5. DISCUSSIONS AND CONCLUSIONS

This is because of the reality that the driver is not able to manage his vehicle when he is snoozing and by the time he realizes it, there is an accident. The vehicle is at a very high pace on highways due to which managing is hard and getting the vehicle to bring to an end is complicated. So only many car companies are studying on how an accident occurs due to driver fatigue and prohibited. Our paper generates a model to avoid such an incident. The Purpose is to move forward a device to identify fatigue symptoms in drivers and manage the pace of vehicle to avoid accidents. The major components of the system consist of a “BRAIN WAVE SENSOR” sensor for driver and an adaptive speed controller. In this paper New innovative technology of “BRAIN WAVE SENSOR” is used for identifying the drowsiness of the driver but by the use of brain waves many physical activities can be identified in future the whole control of vehicle come under by sensing the brain waves. By using such a system in vehicles higher safety precautions were Integrated.

REFERENCES

[1] Maki, Y. Sano, G. Kobashi, Y. Nakamura,“Estimating Subjective Assessments Using a Simple Biosignal Sensor”, In IEEE 13th ACIS International Conference on 2012,pages325 – 330

[2] Hachisuka, S. Res. Labs, DENSO Corp, Nisshin, Japan “Human and Vehicle-Driver Drowsiness Detection by Facial Expression”, In IEEE Biometrics and Kansei Engineering (ICBAKE), 2013 International Conference on 2013, pages 320 – 326.

[3] Tadesse. E, Weihua Sheng, Meiqin Liu “Driver drowsiness detection through HMM based dynamic modeling” in Robotics and Automation (ICRA), 2014 IEEE International Conference on 2014,Pages 4003 – 4008

[4] Awais, Muhammad, Badruddin, Nasreen, Drieberg, Micheal “Driver drowsiness detection using EEG power spectrum analysis” Region 10 Symposium, 2014 IEEE Pages: 244 – 247.

[5] B. Praveenkumar, K. Mahendrakan, “Prevention of Accident Due To Drowsy By Using Eye Blink” in International Journal of Innovative Research in Science, Engineering and Technology at Vol. 3, Issue 5, May 2014

[6] Mr. Gummarekula Sattibabu, Mr. B.V.V. Satyanarayana,” Design and Implementation of Wireless Brainwave Stimulated Accident Prevention System” international journal of innovative technology and research Volume No. 1, Issue No. 1, December-January 2013

[7] Shao-Hang Hung, Che-Jui Chang, Chih-Feng Chao, Chin-Teng Lin, “Development of Real-time Wireless Brain Computer Interface for Drowsiness Detection” IEEE ,pp 1380-1383,2010.

[8] Mohammed Ayaz. R, Sadaf Zabeen, R. Rajkumar “Changing Everything: Cloud Patients Health Monitoring & 24-Hour Care Over Body Sensor Network” Int J Pharm Bio Sci 2016 July; 7(3): (B) 653 – 659.

[9] Darwish, A. & Hassanien, A. E. 'Wearable and Implantable Wireless Sensor Network Solutions for Healthcare Monitoring', Sensors 2011:11(6), 55-61.

[10] Alemdar, H. & Ersoy, C., 'Wireless sensor networks for healthcare: A survey ', Computer Networks 201054(15): 2688 - 2710.

[11] Chunming Rong, Hongbing Cheng" Authenticated Health Monitoring Scheme for Wireless Body Sensor Networks", ICST, 2012:31-35.

[12] Mohammed Hayyan Alsobai, Sulastri Abdul Manap, "A Study on Driver Fatigue Notification Systems" ARPN Journal of Engineering and Applied Sciences at Vol. 11, No.18, September 2016.