International Journal of Emerging Technology and Innovative Engineering
Volume 2, Issue 12, December 2016 (ISSN: 2394 – 6598)
Date of Publication: 30.12.2016

DESIGN AND CONSTRUCTION OF VEHICLE ACCIDENT PREVENTION SYSTEM USING EYE BLINK SENSOR

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ABSTRACT

Vehicle accidents are recently increasing at a fast rate and diverse technologies are being introduced to minimized vehicular accidents. This paper relate to systems for determining a driver’s state of alertness and drowsiness, hence the need for design and construction of vehicle accident prevention system using eye blink sensor with an automatic braking system for alertness monitoring and drowsiness detection.This paper provide means of accident prevention system using eye blink sensor and automatic braking system to ensure that the vehicle gradually comes to a halt when drowsiness is detected and the driver fails to respond to the warning signal from the buzzer within the stipulated time. The hazard warning lights of the vehicle are also activated to alert other road users especially drivers behind during the stipulated time before the vehicle comes to a halt. Software package (Proteus) and programming language c + + were used to validate the model of the vehicle accidents prevention system using eye blink sensor and livewire software was used in the circuit design. Microsoft Excel was the statistical tool used in analyzing the experimental results. It was observed from the results that the vehicle accidents prevention system using eye blink sensor with automatic braking system is an effective technology for vehicle accidents prevention due to drowsiness. The design and construction of the vehicle accident prevention using eye blink sensor and automatic breaking system with the aim of solving the problem of inability of the existing system (technology) to come to a halt when drowsiness is detected was successfully implemented.

Keywords: Automatic Braking system, Eye Blink Sensor, Accident Prevention and Buzzer

1. INTRODUCTION

Road accident in Ghana is known to be the second major cause of death after malaria and it is reported that there is an average of 1,909 people who are killed through road accidents annually [1].Accident is an unintended event or unstabilized situation that produces injury or damage not directly resulting from a cataclysm of natural phenomenon or an event that cannot be managed [2]. However, many researchers also viewed accident as a random, rate and multifactor event often preceded by a situation in which one or more elements of the traffic stream have failed to cope with some conditions at the time and resulting in unintended injury, death or damage to property [3].It can be observed from the above explanation that road accidents are unexpected and undesirable events with negative consequences occurring without the intention of the victim, especially one resulting in damage or harm to human lives and properties causing burden on individuals, organizations and nations of the world. There are many factors that result to the numerous cases of road accidents in Ghana. Whilst others ascribe the causes to indiscipline and negligence on the part of authorities, drivers and pedestrians, others attribute it to superstition and misplace beliefs [4]. Also some other causes of most road accidents in Ghana include total indiscipline on our roads, that is driver receiving and making calls whilst driving, drunk driving and fatigue/drowsy driving. The term 'fatigue' and 'inattention' are sometime used interchangeable with sleepiness (drowsiness) [5].Fatigue has been estimated to be involved in 20% to 23% of all road accidents [6]. NHTSA conservatively estimated that 100,000 police reported crashes are caused by drowsy drivers each year. These crashes result in more than 1500 fatalities, 71,000 injuries and an estimated $12.5 billion in diminished productivity and property loss [7] Sleepiness leads to crashes because it impairs element of human performance that are critical to safe driving [8]. Also the morbidity and mortality associated with drowsy driving accidents are high, perhaps because of the higher speeds involved combined with delayed reaction time [9].Furthermore, NHTSA data shows that sleepy drivers are less likely than alert drivers to take corrective action before accidents [10].

2. THE STATE OF ROAD ACCIDENT

A research conducted indicates that 1.2 million people in the world lose their lives through road accidents annually [11]. World Health Organization (WHO) in its global status report on road safety reaffirmed that this number has risen to 1.3 million people who lose their lives globally each year and between 20 and 50 million people sustain various forms of non-fatal injuries every year as a result of road accident. Road accidents cost the world an amount of US$518 billion annually [12]. Predictions however indicates that road accidents as a cause of death will move to the fifth place by the year 2030, resulting in an estimated 2.4 million per annum if an immediate action is not taken globally to truncate the dominant nature of road accidents [12]. Media reports reveal that there is a high road accident rate in Ghana, when compared with other developing countries [1]. In 2001, Ghana was ranked as the second highest road accident-prone nation among six West African countries with 73 deaths per 1000 accidents [13]. Vehicular accidents claim many lives in Ghana daily and therefore have been the major concern of Ministry of Roads and Highways and its major stakeholders to combat it to the barest minimum. These major concerns in Ghana and the world at large propelled us to make conscious effort through research to come out with this paper that relate to systems for determining the driver's state of alertness and drowsiness. Hence the need for design and construction of vehicle accident prevention system using eye blink sensor with an automatic braking system for alertness, monitoring and drowsiness detection to reduce the rampant nature of drowsy related road accidents.

3. METHODOLOGY

This chapter as the name implies deals with a detailed description of the method used and explains the process of designing the logical model of the real – system. Computer – based experiment (simulation and programming) was used with the model to describe, explain and predict the behavior of the real – system under study. Computer software package (livewire) was also used in the circuit design of the vehicle accidents prevention system using eye blink sensor with an automatic braking system. Excel was the statistical tool used in analyzing the experimental results of this design.

4. BLOCK DIAGRAM OF THE SYSTEM

The block diagram of fig 1 depicts the total blue print of the proposed project. The total essence and the functioning of the project are represented in the block diagram. The block diagram mainly consists of 12 parts. They include

- LM324 Comparator
- Eye Blink Sensor

- LCD
- Microcontroller
- Buzzer
- Traffic indicator
- Brake controller
- DC motor 1
- DC motor 2
- Voltage regulator
- ignition Switch
- Battery

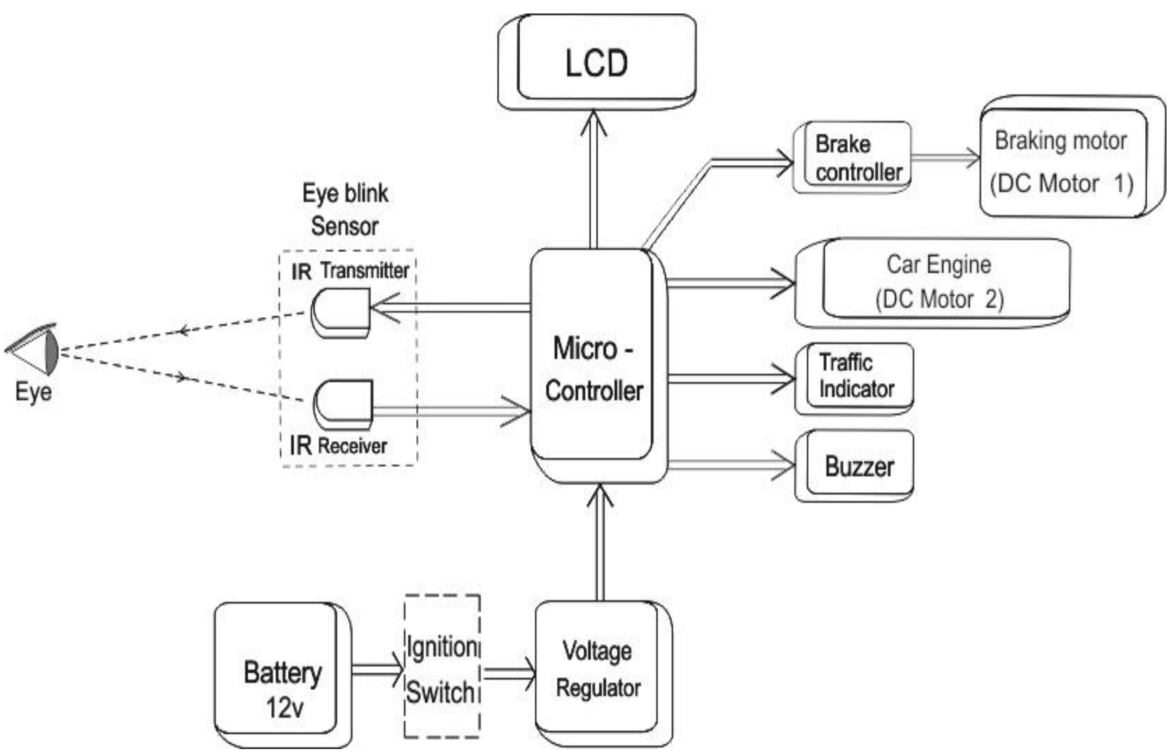


Figure 1 : Block diagram of the vehicle accident prevention system

The Purpose of such a model is to advance a system to detect fatigue symptoms in drivers and control the speed of vehicle to avoid accidents by means of an automatic braking system.

The vehicle accident prevention system using eye blink sensor with an automatic breaking system is represented by the logical (flowchart) model in figure 2

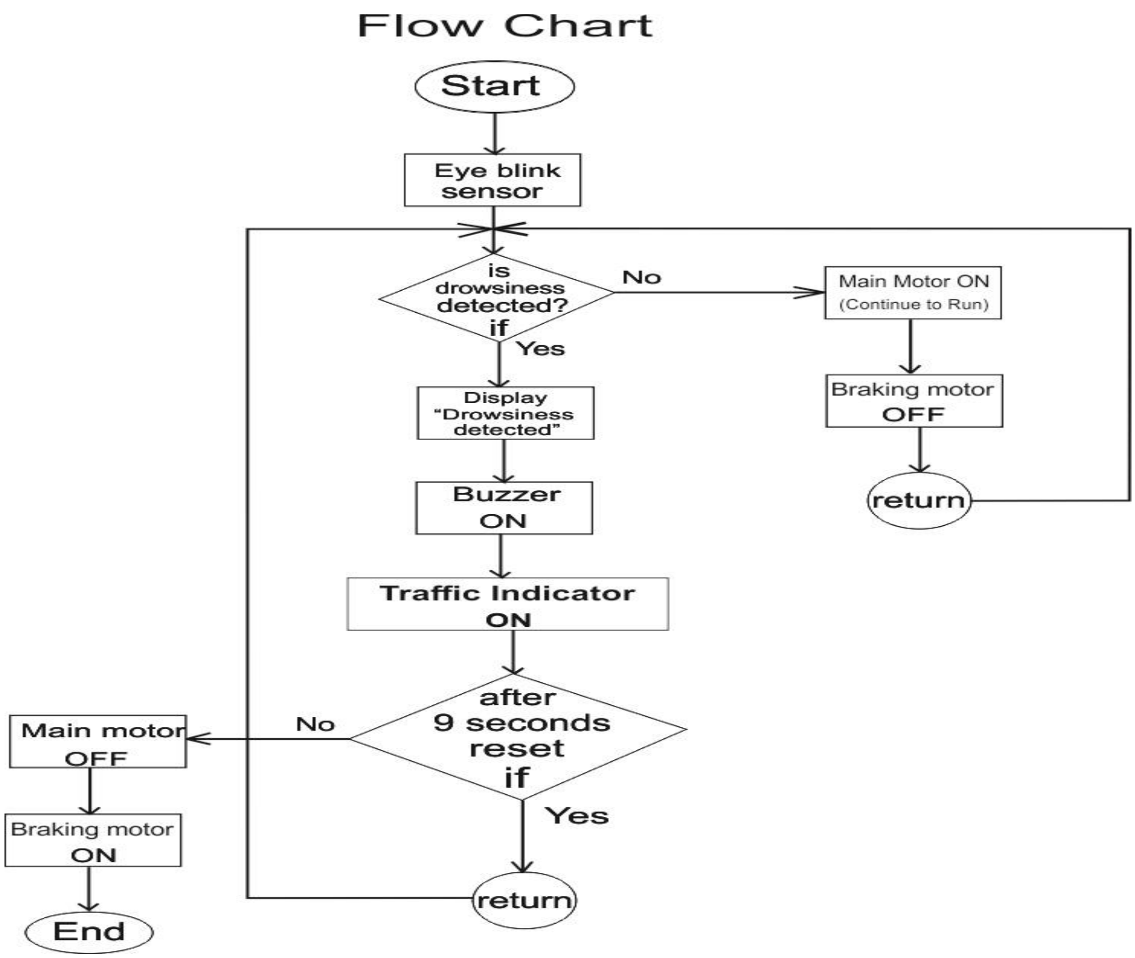


Figure 2 : The Logical Flow (Flow Chart) Model of Vehicle Accident prevention circuit Using Eye Blink Sensor

The detailed description of the components and connections of the logical (flowchart) model in figure 2 are shown by the circuit diagram of the vehicle accident prevention system in figure 3.

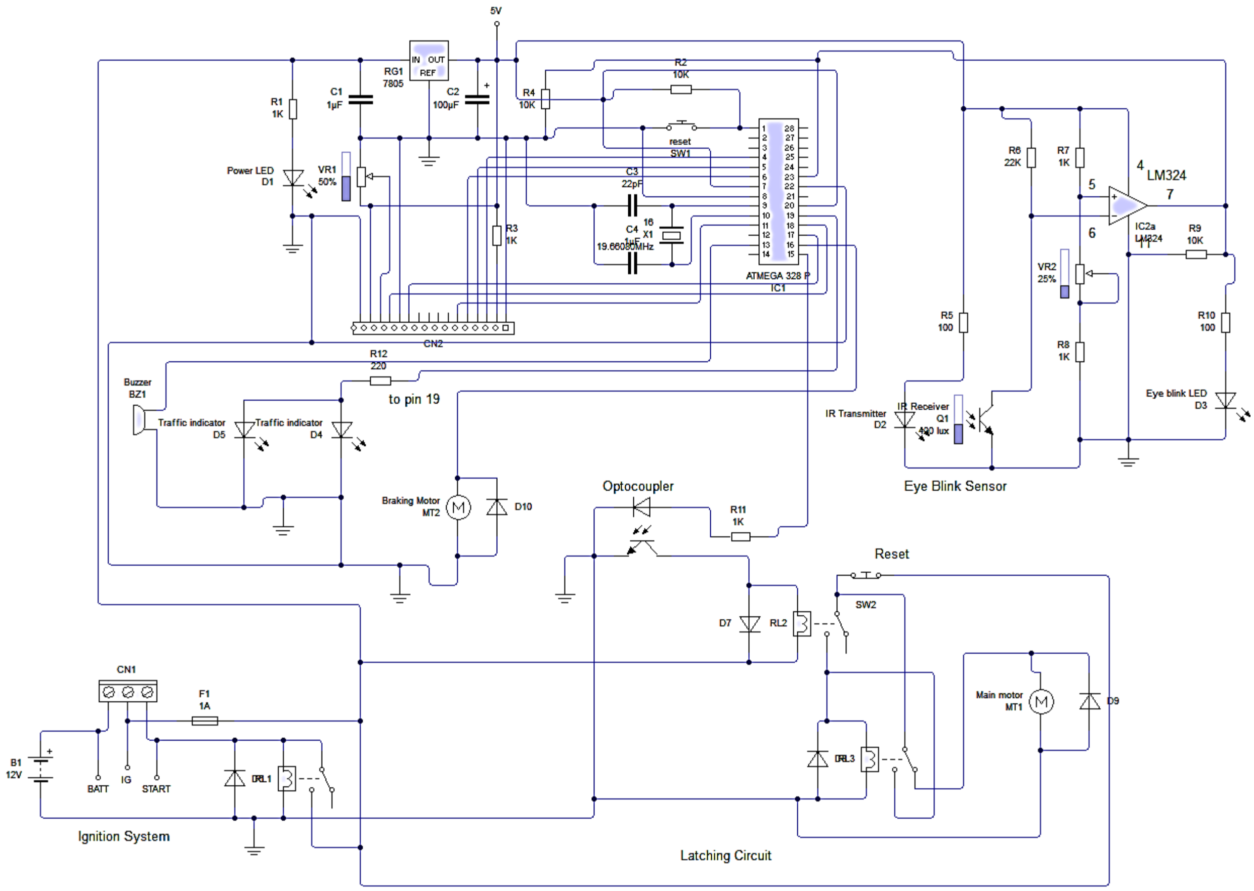


Figure 3 : Circuit Diagram for Vehicle Accident prevention system

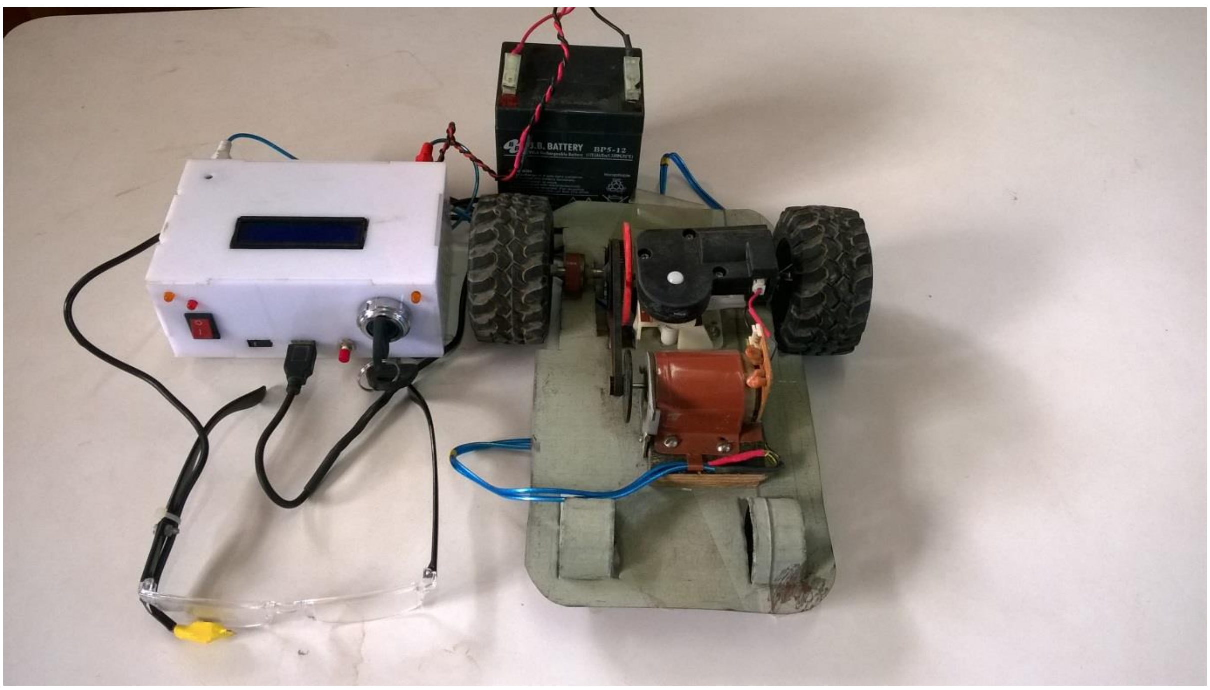
5. MODE OF OPERATION

The system consists of a microcontroller and an eye blink sensor for driver blink acquisition and an adaptive braking system designed using dc motor for providing precise positioning of the brake pad to control the speed of the vehicle. It operates by means of switching on the ignition system thus allowing current to flow through the circuit. When drowsiness is detected by the rate at which the driver blinks his or her eyes, the microcontroller receives signal from the eye blink sensor through the comparator circuit and then start its process by switching off the engine and activates the buzzer for nine(9) seconds, and if not being reset, continue its process by activating the traffic indicator of the vehicle to alert the nearby vehicle and then starts its braking process gradually by allowing current to flow through the brake motor to limit the speed of the vehicle in a gradual manner until it comes to a halt. It then displays on the LCD that drowsiness is detected when the driver is feeling drowsy, and also displays drowsiness not detected when the driver is in normal state (not drowsy).

6. RESULTS AND DISCUSSION

This chapter deals with the detailed analysis of the experimental results of this design, using excel as the statistical tool. The results of the experiment are however, presented analytically in the form of tables and graphs

7. RESULTS



The picture above shows the final construction of the vehicle accident prevention system using eye blink sensor with an automatic braking system.

Table 1 : Experimental results on rheostat readings (the eye) against the level of drowsiness

Number of Experiment	Rheostat Readings in Percentage (The Eye) %	Drowsiness Level in Millivolt mV	LCD Display
1	0	0	Drowsiness not detected
2	22	212	Drowsiness detected
3	44	227	Drowsiness detected
4	65	246	Drowsiness detected
5	100	858	Drowsiness detected

The graphical representation of the drowsiness level against the rheostat (the eye) readings in percentage of Table 1 of the vehicle accident prevention system using eye blink sensor is shown in figure 4.

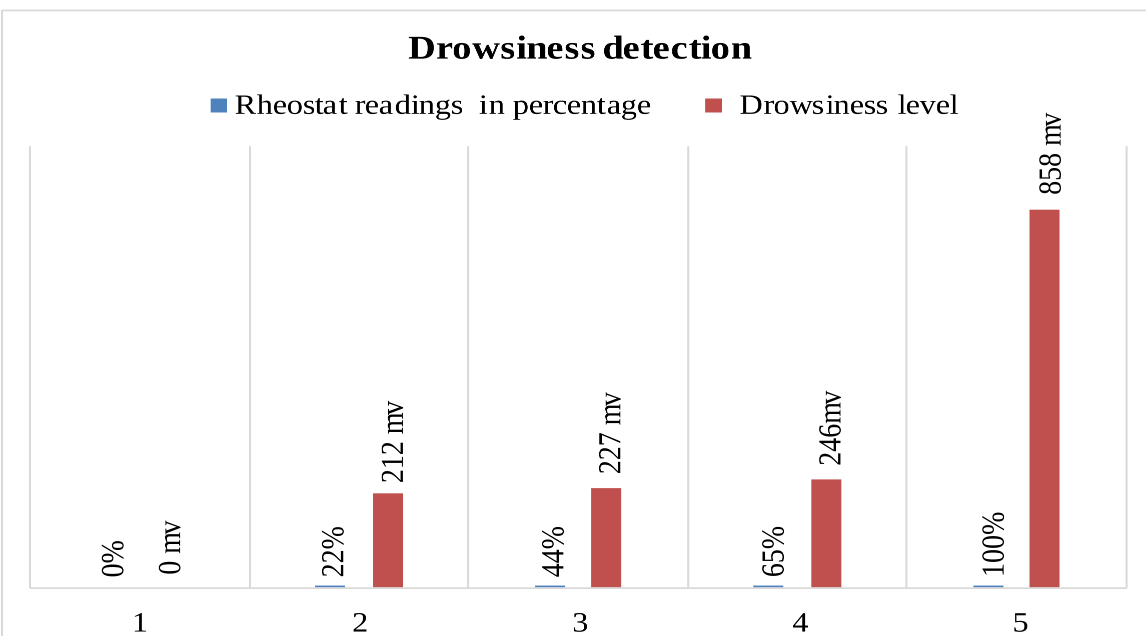


Figure 4: Graph of Rheostat Reading (the EYE) Against Drowsiness Level

The experiment conducted on the sensitivity of the eye blink sensor in rheostat readings in percentage against voltage are tabulated in Table 2.

Table 2 : Experimental results of the sensitivity of the eye blink sensor

Rheostat Readings in percentage (%)	Voltage (V)
0 → 80	1.30
80 → 100	1.29

The graphical representation of the experimental results of the sensitivity of the eye blink sensor tabulated in Table 2 is shown in figure 5.

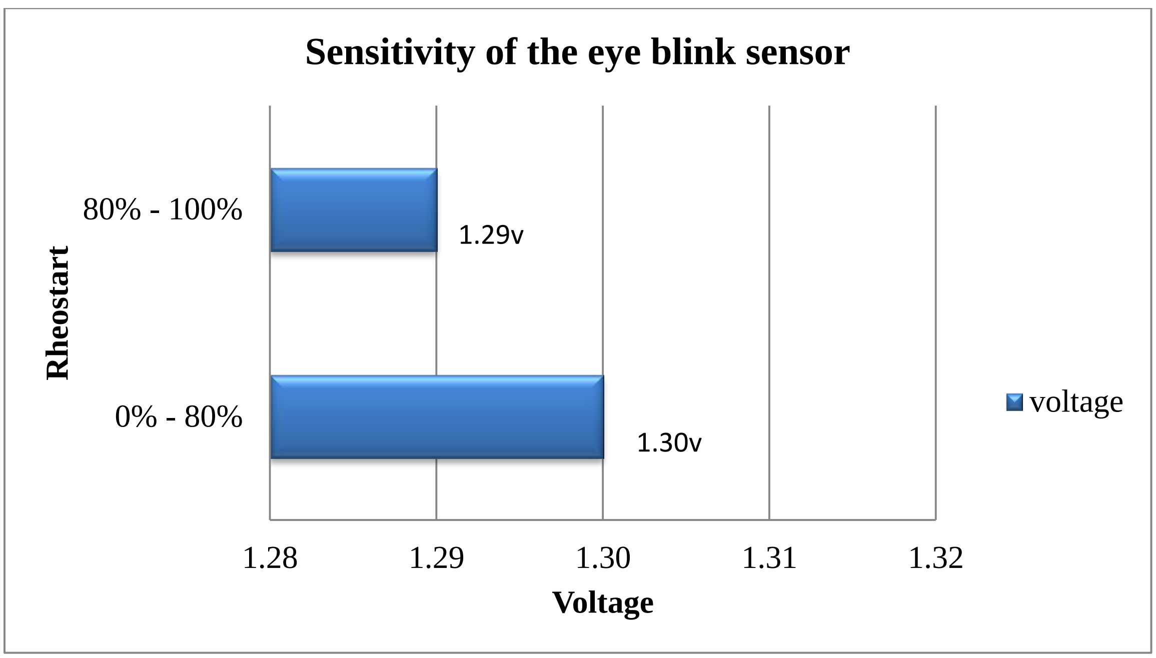


Figure 5 : Graph of sensitivity of the eye blink sensor

8. DISCUSSION OF RESULTS

Table 1 shows the detailed result of a prototype vehicle accident prevention system, using eye blink sensor with an automatic breaking system. For each test the rheostat (eye) levels were set and the drowsiness level were detected by the virtual terminal of the screen of the microcontroller. In all, five experiments were conducted at different ranges of the rheostat (eye) levels and the ranges are as follows: 0% → 0mv, 22% → 212mv, 44% → 227mv, 65% → 246mv and 100% → 858mv.The 0% → 0mv indicate the normal eye blinking condition of the driver which shows that drowsiness is not detected. This happens when the rheostat representing the eye is set to 0% which then gives an out of 0mv reading of the digital multimeter.The 22% → 212mv indicate the minimum level at which drowsiness is detected and this happen when the rheostat representing the eye is set to 22%, the corresponding output 212mv is then fed to the comparator through the eye blink sensor. This compared signal is fed to a microcontroller, the microcontroller is programmed such that if the difference value exceeds the normal blinking state of the driver it sends information about the fault to particular part of the system as programmed in other to achieve goal of the project. The 100% → 858mv indicate the maximum level at which drowsiness is detected. The eye blink sensor is an infrared (I R) based and therefore at the normal vision where the eyes are opened, the IR output signal falls below the threshold value (22%). At the instant the eyes are closed for a time greater than threshold value (22% of rheostat level), drowsiness is detected which causes the output of the IR signal to rise above the set or the threshold value as shown in figure 4. Figure 4 shows the minimum and maximum levels within which drowsiness are detected. Table 2 shows the detailed result of the sensitivity of eye blink sensor. The sensitivity (rheostat) against voltage readings of the eye blink sensor are as follows: 0% - 80% → 1.3V and 80% - 100% → 1.29V. The above rheostat readings in percentage against voltage readings shows that, when the sensitivity (rheostat) was varied from 0% to 80% a constant voltage of 1.3volts was recorded by the digital multimeter and when it was varied from 80% to 100%, the digital multimeter displayed a constant reading of 1.29volts.thus giving a voltage deviation of 0.01volt.

This gives an indication of a good sensitivity in that sensitivity of a system or circuit is the smallest unit of a given parameter that can be meaningfully detected by the instrument when used under reasonable condition. Hence the eye blink sensor used in this project work can detect 0.01volt change in the input voltage.Figure 5 shows the variation of the sensitivity of the eye blink sensor. The time delayed for the eye blink sensor to respond to drowsiness is 2.5 seconds, and this was due to the integrated circuit (IC) of the microcontroller used in this project work. The time delayed by the eye blink sensor can be changed depending upon the integrated circuit (IC) of the microcontroller and also through the programming.The above results are a clear indication that the logical flow (flow chart) model of vehicle accident prevention system using eye blink sensor with automatic breaking system in figure 2 is achieved. Excel was the statistical tool used in analyzing these experimental results.

10.CONCLUSION

The verification and validation of the logical (flow chart) model was successfully achieved by a simulation software package (proteus) and a programming language c + +.The experimental device build by the simulation software was found to behave exactly as the real – system under study after the practical construction of the prototype was tested.The design and construction of the vehicle accident prevention using eye blink sensor with automatic breaking system with the aim of solving the problem of inability of the existing system (technology) to come to a halt when drowsiness is detected was successfully implemented. In view of this positive results of this project work, it is feasible to venture in mass production of vehicle accident prevention by the used of eye blink sensor with automatic breaking system in other to replace the existing technology without the automatic breaking system. Implementing this technology in vehicles will help reduce drowsy related road accidents and hence this project work has relevance.

ACKNOWLEDGEMENT

Our sincerest appreciation to Professor Willie K. Ofosu, who read, scrutinized and provided the necessary support, encouragement and guidance which propel us to complete the project work successfully.

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