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SED- SAFETY ENHANCED VEHICLE USING LabVIEW

Krithika Ramachandran[1], Lavanya Elangovan[2], Padma Pradha Thangaraj[3], Prathiba Sugumar[4], G.Vijayalakshmi[5]

UG Scholar, Department of ICE, Saranathan College of Engineering, Trichy, India[1,2,3,4]
Assistant Professor, Department of ICE, Saranathan College of Engineering, Trichy, India[5]

Abstract: This paper presents a method in developing safer automobiles. The safety parameters includes whether all the doors of the vehicle are closed, drunk and driving detection and headlight intensity control. The main aim of the safety Enhanced Device (SED) is to provide safer and ease driving. It is difficult for the drivers to actively control the headlight while driving, so for comfortable driving, in this work the surrounding brightness is measured automatically and according to that the Pulse Width Modulation (PWM) signals are generated to vary the intensity of the headlight. To avoid accidents due to drunk and driving, a gas sensor is used to measure the blood alcohol content of the driver. Another safety parameter is to check whether the doors of the vehicle are closed which is done by using an door latch sensor. All processing are done using LabVIEW and NI my RIO is used as the interface.

Keywords: Headlight intensity control, Drunk and driving, Alcohol detection Reed switch, Door, Gear motor, LabVIEW, NI myRIO

I INTRODUCTION

Driving style can characteristically be divided into two categories: “typical” (non-aggressive) and “aggressive”. Understanding and recognizing driving events that fall into these categories can aid in vehicle safety systems. Potentially Aggressive driving behavior is currently a leading cause of traffic fatalities. One of the causes of aggressive driving is Driving Under the Influence (DUI) of alcohol. According to latest data compiled by the National Crime Records Bureau (NCRB), drunk and driving was responsible for 7,061 road accidents in India in 2015. Accidents due to drunk and driving are the deadliest, there are more fatalities in accidents due to the DUI than in accidents due to other causes.

In this work to enhance the safety, the driver’s Breath Alcohol content(BAC) is checked before he gets into the driving and also while driving with the help of the MQ3 alcohol sensor.

Driving at night time is usually more dangerous than driving during daytime. According to the research most of the accidents occur during the night time. While driving at night, the headlight must be kept ON, otherwise it will be difficult to find the routes, other vehicles, turning points, etc., but if the intensity of the light is very high it will influence the vision of the opposite vehicle driver, which is the cause of many road accidents. This necessitates the importance of varying the intensity of the headlights, or else the glare from the headlight can blind the opposite driver which would lead to accidents. It will be difficult for the drivers to actively control the intensity while driving. To ensure comfort of the drivers and safety of the passengers this automatic headlight control system is helpful.

Generally speaking, a common approach to automate headlight is to detect potential light objects using some image processing algorithms, then apply certain heuristic rules to decide if high beam should be used or not. While such solution is relatively easier and quicker to develop, it usually suffers from the drawbacks such as difficulty of deployment in different geographical regions, lack of robustness to the change of weather and road conditions, as well as expensive system fine-tuning

The brightness of the surrounding is sensed using the Ambient Light Sensor (ALS). When the brightness in the surrounding is high, then the sensor value becomes high. Then according to the sensor values PWM signals are generated to lower the headlight intensity.

For a safe journey it is important to check all the doors of the vehicle are closed. When it is not closed, it leads to the loss of lives of the passengers. Unexpectedly if a car crash happens, the doors need to stay closed because they absorb the impact, keep you from being thrown out, and help keep the roof from crumpling like a soda can. It is checked by using the reed switch. Reed switches can be operated using a magnetic field generated by either a permanent magnet or current-carrying coil.

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In this project NI myRIO is used as the hardware interface between the real time system and LabVIEW software. The NI myRIO has

- myRIO Expansion Port (MXP)
- Breakouts (One Included in Kit)
- Power Input Cable
- USB Device Cable
- USB Host Cable (Not Included in Kit)
- LEDs
- Mini System Port (MSP) Screw-Terminal Connector

II AMBIENT LIGHT SENSOR

Ambient Light Sensor (ALS) shown in the Figure 1(a) consists of phototransistor which is connected to the supply voltage and ground. The output voltage varies according to the incident light on the phototransistor.

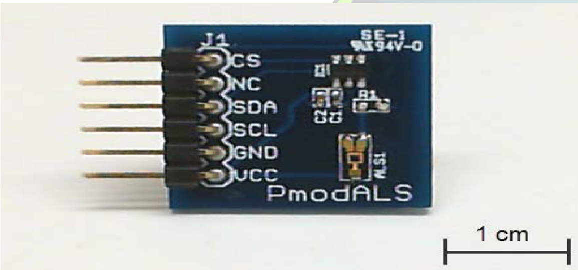

Figure1 (a)

AMBIENT LIGHT SENSOR

The pin connections of ALS are shown in the figure 1(b)

1. CS-Chip Select(active low signal)
2. NC-No Connect
3. SDA-Serial Data Out(to myRIO SPI MISO)
4. SCL- Serial Clock signal(from myRIO to SPI CLK)
5. GND-Ground
6. Vcc +3.3v

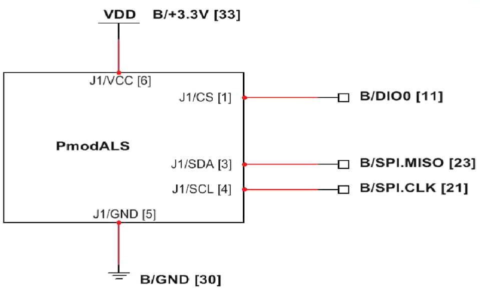

Figure 1(b)

The track and hold circuit is connected to analog to digital converter.As shown in the Figure 2 It produces a 8 bit sample. ALS also contains the SPI bus interface. The SPI is the ultimate point of contact back to the NI myRIO SPI input to either the port A or port B.

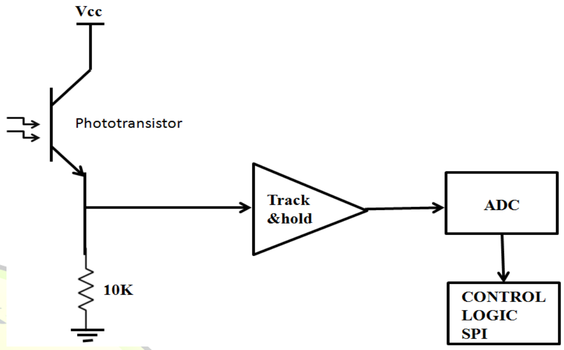

Figure 2

Analog converter has two modes

- Track mode
- Hold mode

It is initiated with the track mode. Chip select would be normally high; it was dropped to low to initiate a conversion cycle. This switches the converter to hold mode.

Serial clock should be normally high. When the chip select is dropped the serial clock pulses are initiated.

Serial data out is in the high impedance state. As soon as the chip select is dropped serial data becomes active.

The first data bit generated by the serial data out is the most significant bit. After the 8^{th} data bit is clocked out, the converter switches back to its track mode. The chip select will be made high to prepare the next conversion cycle.

Pulse Width Modulation (PWM) Signal is an analog signal generated using a digital source. For varying the light intensity, Pulse Width Modulation (PWM) seems to constitute the most effective means to accurately control the illumination. In PWM, the brightness is controlled by square pulse modulation of the driving current and by adjusting the duty cycle of the pulse train.

The behavior of the pulse width modulation is based on two components:

- Duty Cycle
- Frequency

The duty cycle describes the amount of time the signal is in a high (ON) state as a percentage of the total time of it takes to complete one cycle. Figure 3 represents the waveform having 25% Duty Cycle.

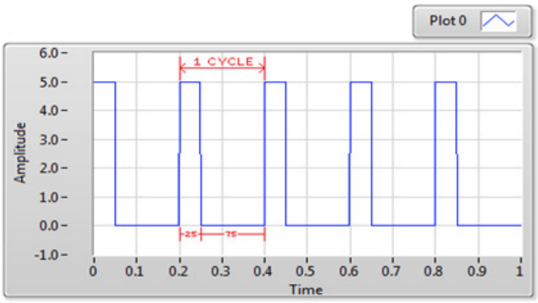

Figure 3

The frequency determines how fast the PWM completes a cycle (i.e. 1000 Hz would be 1000 cycles per second), and therefore how fast it switches between high and low states.

By cycling a digital signal OFF and ON at a fast enough rate, and with a certain duty cycle, the output will appear to behave like a constant voltage analog signal when powering the devices.

Ambient Light Sensor detects the surrounding brightness. ALS is connected to the SPI bus on the connector B. SPI bus can be connected to connector A or connector B. The connector B also supplies 3.3 v to ALS. The conversion cycle begins by dropping the Chip Select (CS) value. Digital output block is set to 0 by giving a false constant so that the chip select is dropped to the low value. The SPI express VI block reads every single frame.

The frame length needed is 16 bits. The non-default values, clock phase and clock polarity are need to be selected. The output of the express VI is an array of 16 bit unsigned integers. The data direction is that the Most Significant Bit (MSB) first. So by using the index array the individual values are pulled off. The extraneous bits can be removed using the logical shift to the right. The values are converted to unsigned 8 bit integers. Then the values are displayed in the front panel. And the conversion cycle can be completed by switching the chip select to a high.

The sensor values are given into different cases of the case structure and for the different sensor values, PWM signals are generated and the headlight of the vehicle is controlled according to the surrounding brightness.

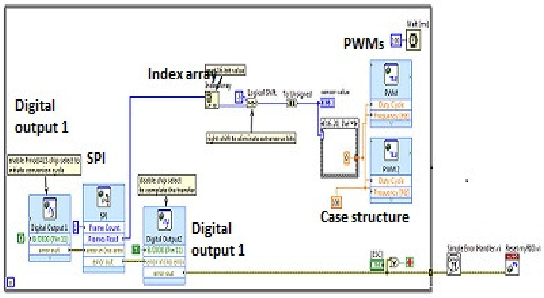

Figure 4(a)

As shown in the Figure 4(a) the digital output 1 changes the chip select to low to initiate the conversion cycle of the analog converter to switch it to hold mode from track mode. The SPI express VI counts a single frame and updates it to the application it is being used. The digital output 2 switches the chip select back to track mode. The index array function reads the 16 bit information from the SPI express VI. The 16 bit value is right shifted by 5 units and is converted to 8 bit value. The PWM shown in the Figure 4(b) is used to update the light intensity as specified in Pulse Width Modulation. A case structure is used to vary the duty cycle with respect to the 8 bit value.

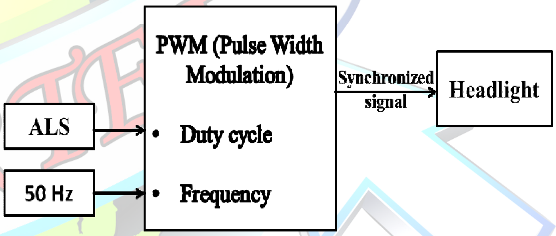

Figure 4(b)

III. REED SWITCH

A Reed Switch is similar to a standard switch. It makes or breaks an electrical connection. Unlike a push button switch though, a reed switch works via magnetic field. The reed switch has two contacts the contacts are made from ferromagnetic material, which sealed inside a thin glass which is filled with unreactive gases which keep them free from dirty or any other gases. The outer coverings are sometimes made up of plastic for better protection. The contacts are made up of nickel alloy for better magnetization. Figure 1(a) represents the reed switch at normally open mode.

There are two fundamental types of reed switches

- Normally closed

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- Normally open

Figure 5(a) is a normally closed switch. When no magnetic field is present the reeds are in contact and the electric circuit is complete. When a magnet is moved close to a switch, the reeds repel one another and split apart, the circuit is in open condition.

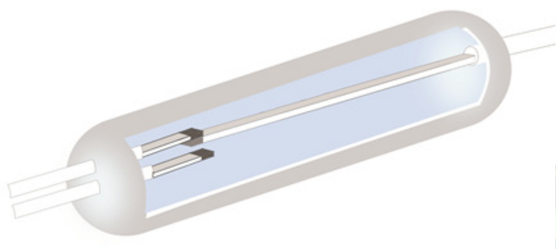

Figure 5(a)

Figure 5 is a normally open switch. It works in the opposite way, the two reed switch are made from ferrous material such as a nickel-iron alloy, are positioned so that they are not in contact. When a magnet is moved close to the switch, it pulls one of the reeds towards the other so that they are in contact, and therefore completing the circuit. When the magnets are removed the reeds return to their original position and the circuit is open.

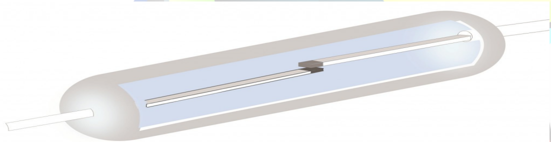

Figure 5(b)

In this project, normally open reed switch is used, to check whether the doors of the vehicle are closed. When the magnet is placed near the switch, the switch becomes close, that is the reed contact get attracted and form a closed circuit.

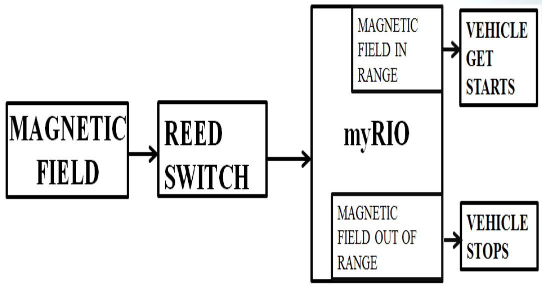

Figure 6

Figure 6 shows the block diagram of the Door locking system. As the reed switch works on the magnetic field, the magnet is placed on the doorways of the car and the reed switch is placed on the clamp of the car. When the door is not closed properly the digital out signal from the reed switch is sent to the myRIO. As per the signal the start and stop of the vehicle is decided. When the magnetic field is within the range then the vehicle starts, this indicates that the door is closed completely. When the magnetic field is out of range then the vehicle stops, this indicates that the door is not closed properly.

The sensor was tested at various conditions and its performance was studied. If the door is not closed properly, the driver is indicated with an LED. This makes the driver to alert the passengers to close the door.

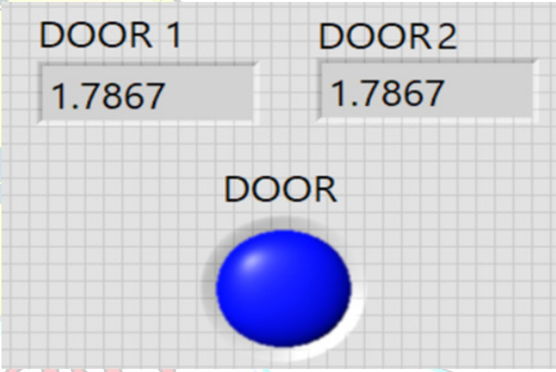

Figure 7(a)

In figure 7(a) & (b), when all the doors are closed, the circuit becomes closed and the output is compared with the standard value.

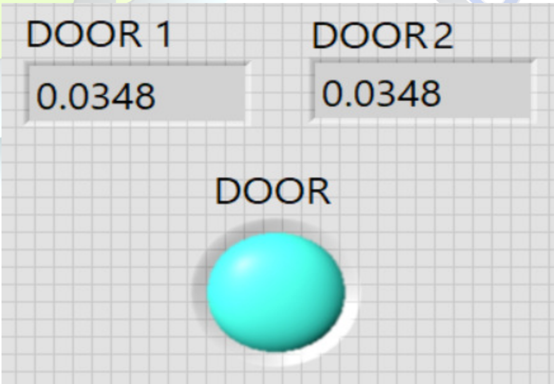

Figure 7(b)

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When any of the doors is not closed, the circuit becomes open and the output is read as 0. This indicates that some of the doors are not closed.

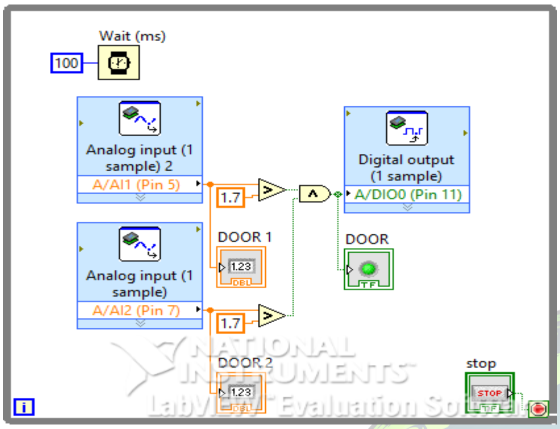

Figure 8

According to Figure 8, the magnetic field is the analog input and this signal is send to the myRIO. There the signal is compared. With respect to the compared signal the indications are made. If both the analog input are above the Threshold value, then door is closed completely. If both the analog input is below the threshold value, then is door is not closed properly.

IV. ALCOHOL GAS SENSOR

Driving under the influences of alcohol will cause:

1) Longer reaction time, which may lead to higher risk of crash, particularly at high speeds;

2) Vigilance reduction including no responses or delaying responding where performance on attention-demanding tasks declines with drowsiness;

3) Deficits in information processing, which may reduce the accuracy and correctness in decision-making. This causes aggressive driving and will be the major cause for accidents.

This paper proposes the detection of intoxicated person and also doesn't allow the vehicle to start in the same case.

Blood Alcohol Content (BAC) is usually expressed as a percentage of ethanol in the blood in units of mass of alcohol per volume of blood. It is expressed as mg/L (milligrams per liter). It is most commonly used as a metric of alcohol intoxication. BAC can be calculated by using a formula

% BAC = breath mg/L * 0.21. Alcohol content in a volume of breath or blood. A 1% blood alcohol content is 10g/L or 10,000mg/L, this level would almost certainly be fatal.

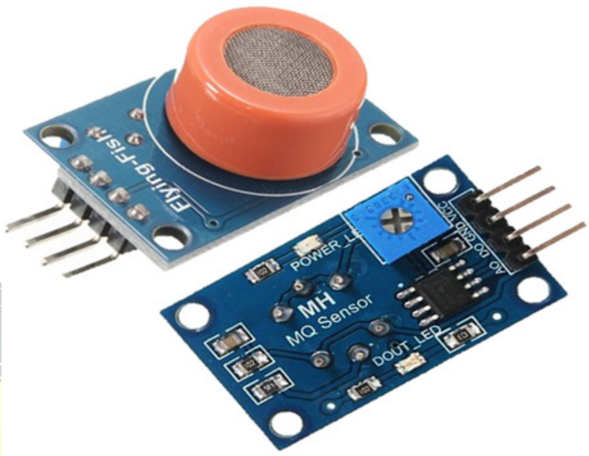

Figure 9

MQ3 alcohol gas sensor module is used to sense the concentration of alcohol present in the breath of the driver. It has high sensitivity to alcohol and small sensitivity to Benzine. It has high sensitivity and fast response time. The drive circuit is very simple, all it needs is one resistor. Here LabVIEW is used as the platform and myRIO as the interface. Figure 9 shows the myRIO pin connections in the MQ3 sensor.

1. Vcc
2. Ground
3. Digital input
4. Digital output.

When the user exhales into the MQ3 sensor, any ethanol present in their breath is oxidized to acetic acid at the anode:

$$CH_2CH_2OH_{(g)} + H_2O_{(l)} \rightarrow CH_3CO_2H_{(l)} + 4H^+_{(aq)} + 4e^-$$

At the cathode, atmospheric oxygen is reduced:

$$O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightarrow 2H_2O_{(l)}$$

The overall reaction is the oxidation of ethanol to acetic acid and water.

$$CH_3CH_2OH_{(l)} + O_{2(g)} \rightarrow CH_3COOH_{(aq)} + H_2O_{(l)}$$

The electric current produced by this reaction is measured by a myRIO, and displayed as an approximation of overall blood alcohol content (BAC) by the Alcohol sensor.

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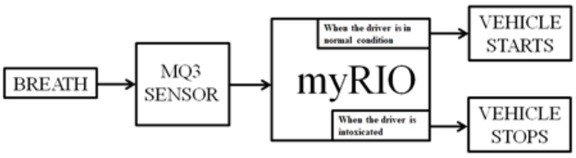

Figure 10(a)

Figure 10(a) describes the process of detecting alcohol in our work. Input of MQ3 sensor is the driver's breath which is the analog input. MQ3 sensor senses the amount of alcohol present in the breath and the analog output is given to the myRIO. If the driver has not consumed alcohol, the vehicle starts and then if the driver is intoxicated, the vehicle does not start.

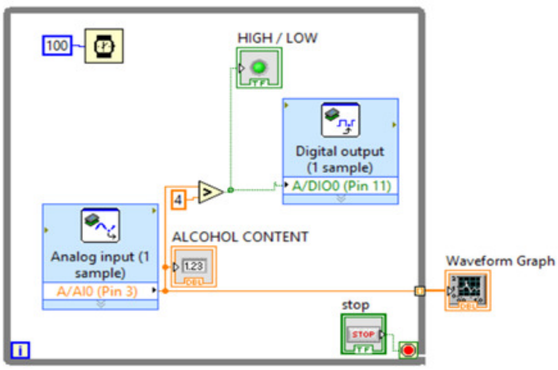

Figure 10(b)

MQ3 sensor senses the alcohol content in the driver's breath. Analog output of the MQ3 sensor is given to the analog input of the myRIO. The analog value is compared with the calibrated value which is done according to the acceptable limit for driving. If the analog value is above the acceptable limit, it means the driver is intoxicated. Hence the vehicle will not start. If the analog value is below the acceptable limit, it means the driver is in normal condition. Hence the vehicle will start. This is shown in the Figure 10(b).

Figure 11(a) shows the output obtained when the driver is in normal condition. Figure 11(b) shows the output obtained when the driver is intoxicated. When the driver is intoxicated it is programed as such the vehicle does not start

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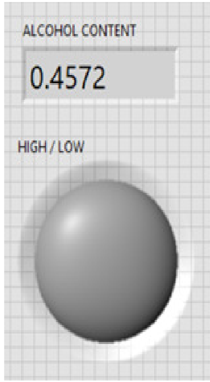

Figure 11(a)

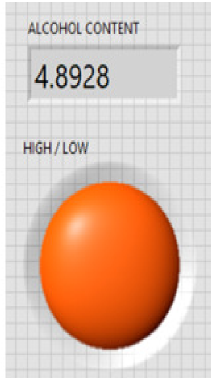

Figure 11(b)

V. SAFETY ENHANCED DEVICE

As discussed in the sections [II], [III], [IV], all the parameters are combined and interfaced with myRIO to obtain the Safety Enhanced Vehicle.

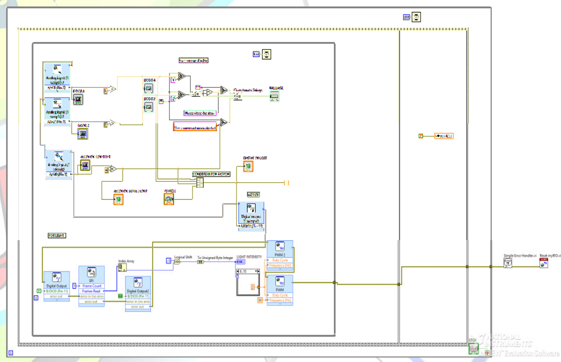

Figure 12

Figure 12 depicts the overall design of SED. Analog input 2 and Analog input 3 are the values obtained by the reed switches which informs the driver whether the doors are closed. Analog input gives the value of the alcohol content present in the breath of the driver. If the doors are closed and the driver is not intoxicated, TRUE condition is generated which allows the vehicle to start. The head light intensity varies automatically according to the ambient brightness. This project is designed as such even while driving if the driver consumes alcohol, an alert message is displayed and the vehicle stops.

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Figure 13

As shown in Figure 13, IC L293D is the driver IC which is used in this project, common DC gearhead motors need current above 250mA. There are many integrated circuits like ATmega16 Microcontroller, 555 timer IC. But, IC 74 series cannot supply this amount of current. When the motor is directly connected to the output of the above ICs then, they might damage. To overcome this problem, a motor control circuit is required, which can act as a bridge between the above motors and ICs (integrated circuits). There are various ways of making H-bridge motor control circuit such as using transistor, relays and using L293D/L298.

Geared DC motor as shown in Figure 14, can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The motor runs at 1200 RPM.

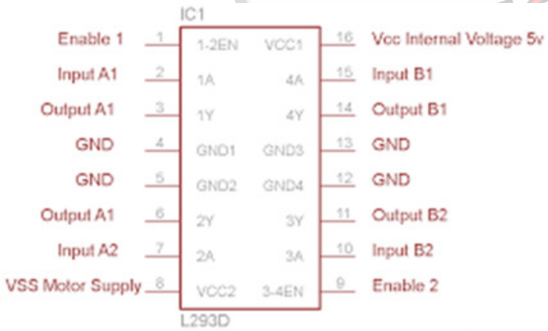

Figure 14

In this project two gear motors are used. The connections are given as per the above circuit diagram. 5V power supply for IC is given from the myRIO first pin which generates 5V in default. 9V DC supply is given as the power supply for the gear motors. The safety and the efficient parameters are given as per the above mentioned connections in the section [II], [III], [IV]. The setup is implemented on a prototype which is made up of acrylic sheet. Figure 15 shows the pin configuration of IC L293D.

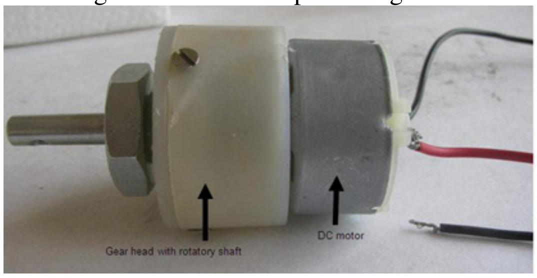

Figure 15

VI RESULT

The sensor was tested at different ambient conditions and its performance is evaluated. The sequences were acquired and the PWM signal is generated accordingly. For the variations in the ambient light intensity the headlight intensity of the vehicle is varied. It will be helpful for the driver to automatically control the headlight intensity whenever it is necessary.

Figure 16(a), Figure 16(b), Figure 16(c) represents the headlight of the vehicle under different environmental brightness.

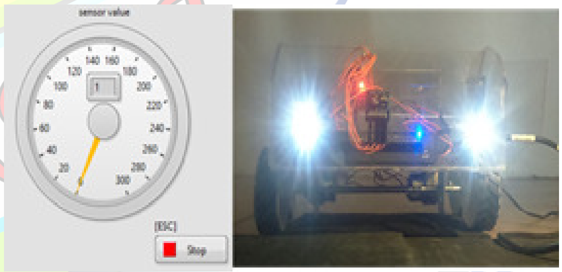

Figure 16(a)

When the surrounding is dark, then the headlight will glow in its full brightness.

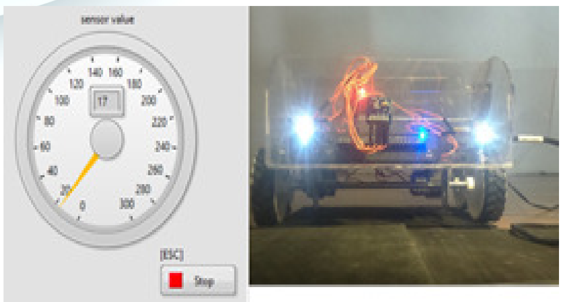

Figure 16(b)

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In this condition, ambient brightness is neither too dark nor too bright. So the headlight will glow with medium intensity.

Figure 16(c)

When the surrounding is bright enough to drive the car the headlights are turned off automatically.

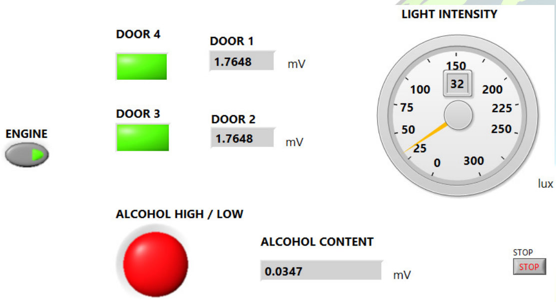

Figure 17

Figure 17 describes the overall result of this project. Boolean indicators are used to indicate the driver in case of emergencies and also when any one of the parameter is not satisfied.

VII CONCLUSION

The automated headlight control system is focused upon building a comfortable driving experience for the driver and a safe travel experience for the passengers. We have achieved it through varying the headlight intensity corresponding to the environmental light intensity. This is useful to drivers who don't concentrate over the headlight intensity. The safety is enhanced at the same time when the battery power consumption is also optimized. This can be most efficient during night times and in regions with varying light intensity.

For a comfortable drive it is necessary to check the doors. In this safety enhanced device, the doors are checked first. The signal from the doors through the reed switch is taken to the myRIO. It checks for the doors. If any of the doors is not closed properly ,then the vehicle won't be started and at the same time while driving if the door gets opened up the driver gets a indication about it and vehicle stops.

On a larger scale this can yield a greater efficiency when interfaced through IOT.

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