Smart vehicle headlights control system

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Smart Vehicle Headlights Control System

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Abstract. In this paper a designed smart vehicle headlight control system is proposed. The proposed scheme uses an Arduino to control the car headlight system automatically depending on the surrounding lighting conditions. Also a light dependent resistor (LDR) sensor and an ultrasonic sensor are used to sense the surrounding lighting condition as well as, the car approaching from the opposite direction of the street. This technology can integrate many embedded systems which control other complex systems such as car headlights control system, street lighting system, general park lighting system, house lighting system and many more. There are many research papers, about lighting systems which are controlled by wireless GSM/GUI, networks, a light depending resistor (LDR) depending on analogous circuits and timers. Some of the research papers are based on a passive infrared receiver. In this project, the target is to implement an advanced vehicle headlights control system using the Arduino which will receive data from the light dependent resistor, affected by the surrounding lighting intensity levels and the ultrasonic sensor to sense the availability of a vehicle coming from the opposite direction of the street. Therefore, depending on the surrounding lighting intensity and availability of a vehicle coming from the opposite direction, the system will automatically control the vehicle headlights intensity and sets an appropriate vehicle headlights intensity level during the night time.

INTRODUCTION

The health and safety of people are the most significant issues around the world. However, vehicle accidents which are related to high beam vehicle headlights have led to massive human and financial losses over the years. When the problem is critical and more related to the issue of the health and safety of people cannot be considering it for granted because health and safety is a vital measurement level taken by world safety and health organizations to protect human life and reduce financial losses.

Nowadays, highly developments in technology are an active factor in human life. Therefore, people require this technology to develop smart vehicle headlights to protect human life and prevent dangers during night driving.

Most of headlights control systems in the recent cars are designed to control the headlight intensity manually in On and Off modes, and there is no moderate level to control the car headlights intensity according to the surrounding lighting conditions. They do not effectively use the advantages of employing recent technologies which are available nowadays in several applications. There are two effective ways to implement this technology in the car headlights control system. The first one by using a passive infrared (PIR) sensor or ultrasonic sensor to control the car light intensity based on the availability of cars coming toward from an opposite direction. This technology can use in desert streets where there is darkness as well as highway streets. The second one is using smart car headlights control system which used a light depending resistor (LDR), ultrasonic sensor controlled by Arduino Uno to adjust and manage the light intensity depending on the surrounding lighting conditions [1-4].

In designing of this project, the critical focal point is the effect of high headlights beam from the vehicle into human eyes during the night driving, which results as vehicle accidents, human life and public properties losses. Moreover, reducing the energy consumption by adjusting the vehicle headlights intensity automatically depending on the surrounding lighting conditions.

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SYSTEM DESIGN

A smart vehicle headlights control system consists of several electrical and electronic components as the following:

Arduino Uno

Arduino Uno is an open embedded source system as shown in figure 1. It is a small computer system integrated on the minute chip. Arduino is an essential part of this system which used to control the whole process of the system by reading and manipulating the input from sensors. It has six analogue inputs pins which used sine wave signal. Also, 16 input/output pins used for the digital signal. Six digital output pins from the 16 digital input/output pins which used for pulse width modulation (PWM) which used digital pulse signal. It can be powered up by using a USB cable, battery or DC-AC adapter. The operating voltage of Arduino Uno is 5 volts with a current of 20 milli-Amper [2]. In this project idea, Arduino is used for regulating the entire processes of the project and execute all inputs from the ultrasonic sensor and light dependent resistor. The Arduino (Uno) software can operate on Macintosh and Windows preferably than microcontroller which only operates on Windows. Arduino Uno uses in this paper because of its features such as:

- The performance quality
- Small size.
- Cheaper than other microcontroller platforms [5].

FIGURE 1. Arduino (Uno)

Ultrasonic sensor

An ultrasonic sensor is an electronic sensor which used to measure the distance between two or more objects as shown in Figure 2. It uses sonar to send ultrasonic pulses to hit into a surface of the nearest objects. Then the reflected pulses returned to the ultrasonic sensor which receives the reflected echo to determine the distance separated between the sensor and a particular object. The distance is measured by specifying the time difference of incidences and reflected echoes. Furthermore, the ultrasonic sensor has a feature of long-range detection so it can determine the target position from a long distance via stable and accurate readings.

The ultrasonic sensor can measure the distance unto 400 cm or 13 feet. The operating voltage of ultrasonic HC-SR04 is 5 volts with a current of 15 milli-amper. The effectual angle of this ultrasonic sensor is greater 15 degrees and measuring an angle is up to 30 degrees. Several applications used an ultrasonic sensor such as water level detection, distance measurement and obstacle detection [6].

In this proposed paper, the ultrasonic sensor is used to determine the distance between one vehicle and another vehicle is coming toward from the opposite direction. Hence, the ultrasonic sensor will send pulses in the direction of driving. Then the pulses will hit the surface of the nearest car, and the reflected pulses will return to the sensor. A system will measure the difference between the time of the incidences and reflected pulses to measure the distance.

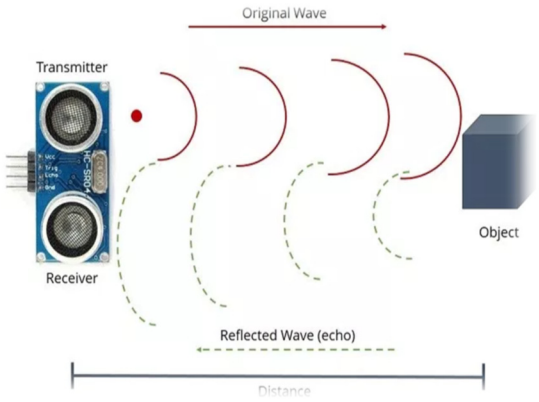

FIGURE 2. The working principle of Ultrasonic sensor

Light Emitting Diode (LED)

A light emitting diode (LED) is a type of semiconductor light source as shown in figure 3. It forms by two type semiconductors such as P-type semiconductor and an N-type semiconductor. When an electrical current flow into those semiconductors, there will be PN-junction area is formed between P-type and N-type semiconductor material. It always emits limited light which depends on a signal wavelength. The output of the light emitting diode range is approximately red at wavelength 700 nanometers to blue at wavelength 400 nanometers [7]. The light emitting diode is using in this project to indicate vehicle's headlights which will be controlled automatically depending on the surrounding lighting conditions.

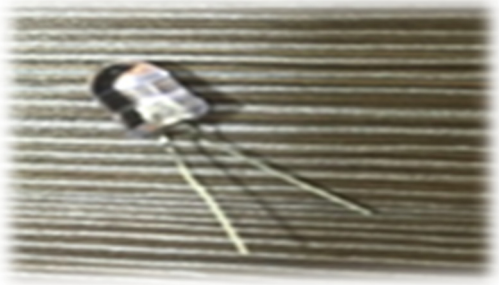

FIGURE 3. 10 milli LED

Light Dependent Resistor

The light dependent resistor (LDR) sensor, also called a photoresistor, photoconductor, and photocell as shown in figure 4. It is a light sensitive device and a good conductor. Almost this type of photoconductor is using to indicate the absence or presence of light as well as measuring the intensity of the light signal in a particular area. Consequently, its resistance is varying depending on light intensity falling on it. The resistance of the light dependent resistor (LDR) is high at normal state when there is no light signal focus on its surface. However, its resistance will decrease when there is a light signal that falls on its surface.

Light-dependent resistor (LDR) will use in this project in the purpose of sensing the amount of light depending on the surrounding lighting condition to control the vehicle's headlight beam level.

FIGURE 4: Light dependent resistor

12 volts DC Power Supply (Battery)

A power supply is an indispensable part of any electronic, electromagnetic and mechanical system as shown in figure 5. There are two types of power supply such as direct power (DC) and alternating power (AC) supply. A direct current (DC) power supply provides an immediate and constant current flow into electronic devices. Moreover, DC power supply is producing as well as, simulate a permanent flowing of voltage to all nodes in an electric or electronic circuit. This steady current output is fundamental in electrical and electromagnetic systems which demanding DC power or conversion AC power into DC power. Therefore, DC power supply assemblies typically used in a diversity of industries and the most energetic alternative energy in recent time. In this project 12 volts DC power battery used for powering up the vehicle headlights control system.

FIGURE 5: Battery 12 volts

HARDWARE IMPLEMENTATION

The practical implementation is an important and extensive stage that will give a clear and precise idea about the hardware installation process of the project. It is a productive stage of the project through which students can be earned various skills and obtained practical experience by practically interacting with several components of different features and specifications.

Firstly, fixation the several hardware components inside the body of the vehicle. Proving the battery, Arduino UNO, breadboard, Ultrasonic sensor and LEDs into the inside surface by using glue. Moreover, prove the light dependent resistor (LDR) into the top outside surface of the vehicle using glue. Then, solder the battery wires with the switch button and DC power jack wire of the Arduino as shown in figure 6.

FIGURE 6. System implementation process

Secondly, making connections between two sides of the breadboard by using normal wires and fixing resistor (10 kilo-ohms) into the breadboard of the project. Furthermore, uploading the principle code into the Arduino board.

Finally, connecting the Ultrasonic sensor, Light dependent resistor, LEDs with the arduino pins using jumper wires and breadboard as shown in figure 7.

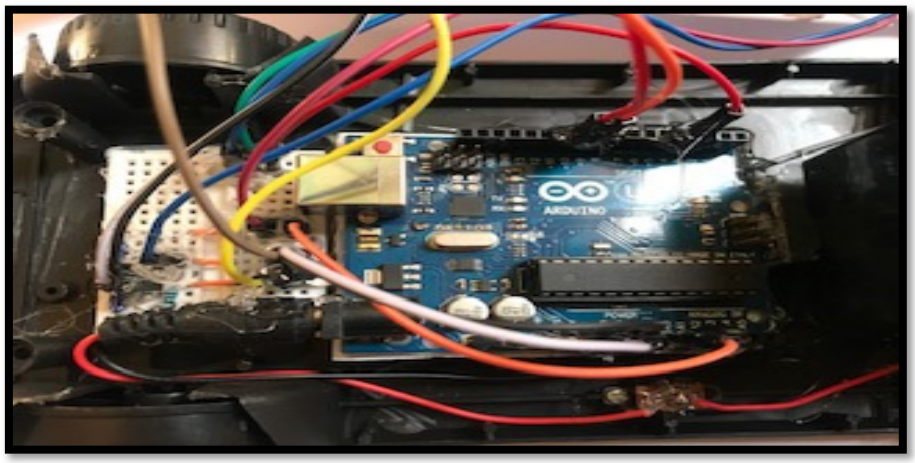

FIGURE 7. System connections

SOFTWARE SIMULATION

Proteus is a software program is using for microprocessor modelling, simulation and circuit design of any system. This program can simulate a designed system to make sure that the developed system can be practically implemented. Proteus program requires the system block diagram and software programming code to simulate the designed system. Furthermore, this software program is useful for evaluating the quantitative and qualitative values of the system. Besides, it is manageable and straightforward to use by everyone because it supports Arduino and microcontroller components and programming codes. Consequently, the Proteus program is used to simulate the vehicle headlights control system as shown in the figure below.

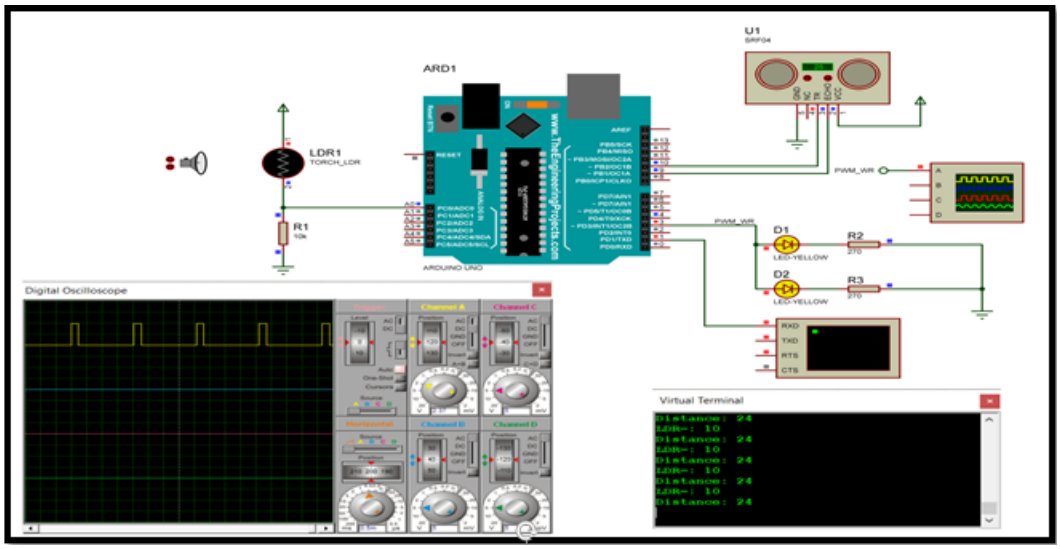

FIGURE 8. Software Simulation

PERFORMANCE ANALYSIS

Smart vehicle headlights control system is tested ten times respectively and the results of the ultrasonic sensor and light dependent resistor are shown in the table 1 below:

TABLE 1. Tests applied on ultrasonic sensor and light dependent resistor

Test Module	Ultrasonic Sensor	Light Dependent resistor (LDR)
No. of tests applied	10	10
No. of tests passed	8	9
No. of tests failed	2	1
% of tests passed	80%	90%
% of tests failed	20%	10%

The testing table shows that ten tests applied using vehicle headlights control system. The purpose of applying ten tests into the system is to check and ensure that the ultrasonic sensor and light dependent resistor are working properly within the comprehensive vehicle headlights system. In case of testing ultrasonic sensor to sense the availability of a vehicle is coming from an opposite direction, the system is responding eight times out of ten times however, it failed for two times only out of total attempts. These numbers mean ultrasonic sensor achieves good performance with 80 percentage of passing score.

In all real systems, each integrated device has its performance which consists of time response and its technical effective. The ultrasonic sensor is operating within the comprehensive vehicle headlights system. It is continuously sending ultrasonic waves to sense the incoming vehicles from an opposite direction of the street by measuring the distance of reflected echoes. Therefore ultrasonic sensor has different time response values at several intervals. The system tested many times at several distances (Centimeters) to observe and analyze the time response of the ultrasonic sensor as shown in the figure below.

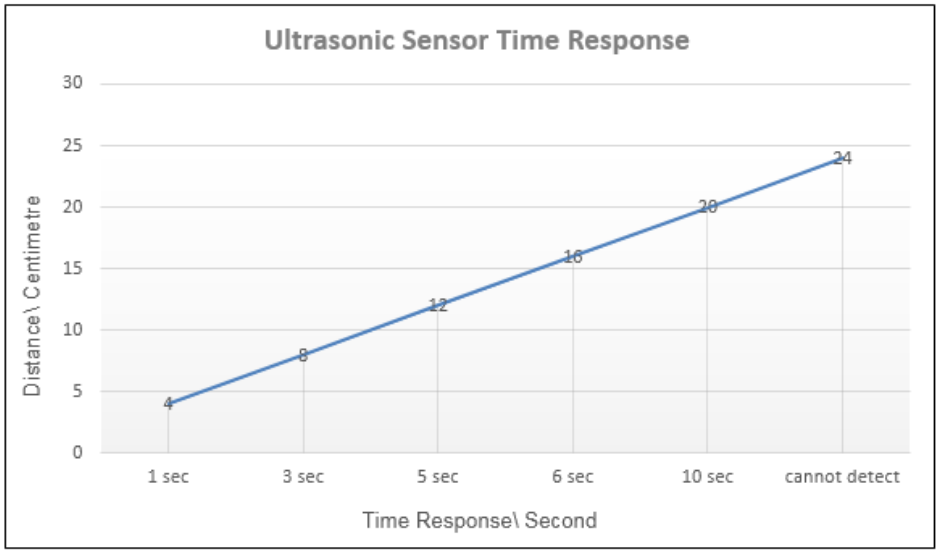

FIGURE 9. Ultrasonic Sensor Time Response Based on Distance

Worth mention light dependent resistor is a passive component whereas phototransistor and photodiode are true active devices. Therefore the sensitivity of the light dependent resistor is lower than the sensitivity of phototransistor and photodiode. Because of the light dependent resistor does not have PN junction, so its sensitivity does not depend on the flow of electrons. Consequently, when the intensity of light is remaining constant, the resistance may vary based on the temperature degree.

The light dependent resistor was tested many times at different angles of a light source. Time response of the light dependent resistor varies according to the angle of the light source. The maximum response time of LDR is nine seconds at an angle of 150 degrees whereas the minimum response time of LDR is one second at an angle of 90 degrees as shown in the figure 10. Accordingly, due to this property light dependent resistors inappropriate for accurate light intensity measurements.

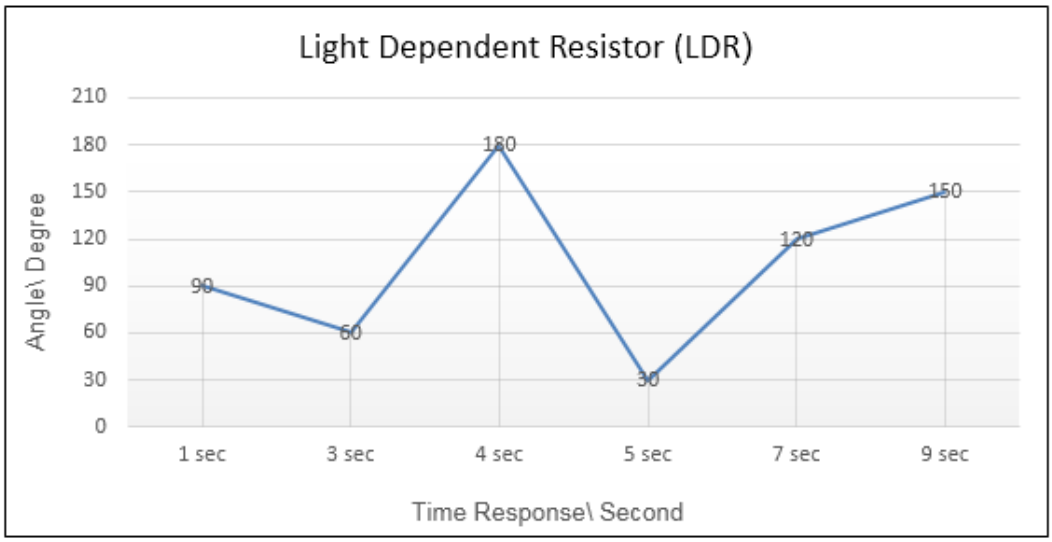

FIGURE 10. Ultrasonic Sensor Time Response Based on Angle

From the observed results, the response time of the light dependent resistor is varied based on the focusing angle of the light source. At a morning time when the sun rises (relative angle is 40 degree), there will be slightly lighting into the surrounding environment the vehicle headlights will be switched into low mode. At midday, the sun lighting will be approximately at ninety degrees and it focuses directly to the LDR so that the vehicle headlights will be switched OFF. Finally, in the evening the sun lighting will be approximately at the range (180-360 degree), so the vehicle headlights will be switches to moderate mode until the surrounding environment becoming dark. When the surrounding environment becomes dark, the vehicle headlights will be switches into a high mode with respecting to the condition of the ultrasonic sensor status.

CONCLUSION

This paper is aimed to design and perform a smart vehicle headlights control system to adjust vehicle headlights automatically according to the surrounding lighting condition moreover, based on the availability of a vehicle is coming toward from the opposite direction of the street. This system is effective in reducing the number of vehicles accidents occurring at night time. Furthermore, protecting the vehicle driver's eyes from high headlights beam that able to damage the internal parts of the human eyes.

There are numerous practical and effective components are used to implement this vehicle headlights control system such as Arduino Uno which acts as brain of the project, ultrasonic sensor to adjust vehicle headlights based on the vehicle approaching from an opposite direction, light dependent resistor to adjust the vehicle headlights according to the surrounding lighting condition, LEDs which act as vehicle headlights and others. There are various research papers are studied as well as they critically analyze to fanned this technical project idea. Moreover, these research papers help to gain enough fundamental knowledge related to the project idea and its main components to know how can interface the main components of the project into the Arduino Uno. Consequently, these research papers mainly applied as a cornerstone to accomplish the objectives of the project idea. The project idea was realised by interfacing the functional components and uploading programming code to the Arduino Uno to achieve the working efficiency and get the expected ideal outcomes. Consequently, this system can be implemented in recent vehicles models. Ultimately, there are many achieved advantages by this vehicle headlights control system such as decrease the occurrence of daily accidents and reduce energy consumption. Also, reduce the effects of high headlights beam into driver's eyes. In fact, this system will depreciate the manually controlling the vehicle headlights of the system because will automatically control vehicle headlights without manually adjusting headlights switch.

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