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Adaptive Headlight System in Vehicles Featured for Rainy Drive

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Abstract – *The glare of light from high intensity headlights has always been the major cause of accidents during night drive. Hence this paper aims to develop an adaptive headlight system for vehicles to control the intensity of headlamps. The prototype works to run a low beam headlight on detection of vehicles from the opposite direction. An additional feature is included to handle the same situation in a poor weather condition like rain. Automatic ON/OFF of headlamps in a rainy drive even during day time makes this work a multifeatured system. The Arduino board together with an assembly of Light Dependent Resistors (LDR) and rain sensor provides an inexpensive solution to ensure automotive safety.*

Key Words: Headlights, Vehicles, Night, Arduino, LDR, Rain sensor

1. INTRODUCTION

The number of private vehicles on road are increasing day by day. Whether it be day or night, people prefer to travel in their own vehicles. This has also increased the pace of human deaths due to road accidents. Carelessness and carefree attitude in driving leads to accidents during day time. But in the night drive, even when the number of vehicles are less, accidents are more due to the glare of vehicle head lights in the dark. As all the drivers prefer brightened headlights for night drives, situation become more vulnerable. It is a known fact that a sudden glare of bright light can darken human vision. So the case is when the light from the opposite vehicle blind the driver, he loses his control over the vehicle, leading to accident. This highly prevailing scenario in today's accident causes has thus given a platform for the researchers to find a solution for the same.

The solution been so far is to develop an adaptive headlight system for vehicles. Adaptive headlight systems can automatically control the intensity of the headlamps on detecting the presence of a vehicle from the opposite direction. Thus both the vehicles dim the beam brightness and hence can reduce glaring effect. The concept is not new for Volvo, BMW, Audi etc., but this paper focuses on providing a different and cheaper approach that can be applicable to low end vehicles also.

This paper presents a multi-featured headlight system that aids the driver in automatically switching ON/OFF the headlights depending on the requirement. Thus a manual switching of the lights during driving can be avoided. This requirement arises during driving in the late evening progressing towards dusk or a cloudy atmosphere leading to rain. Light glare also appears as a problem during rain. Thus activating a dim headlight during rain is also a requirement for an adaptive headlight system.

1.1 Literature review

A literature survey on various works pertaining to the development of an adaptive headlight system is pointing towards the use of LDR. Most of the papers present simple solutions using microcontrollers and LDRs to reduce the glare effect [1] [2]. In [3], an assembly of LDRs and Arduino is used to control intensity of vehicle beam. A mechanism for light control during fog is also incorporated using a humidity sensor.

This paper extends the application of adaptive headlight system to avoid manual control of headlamps during rain.

2. BLOCK DIAGRAM

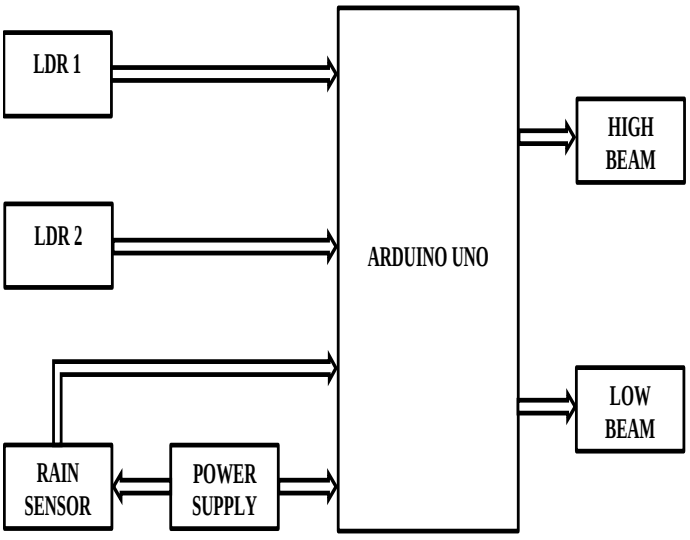

Fig -1: Block diagram

The block diagram depicts the working of the system with two LDRs and a rain sensor connected to the Arduino UNO board. LDR is used to measure the amount of intensity of light falling on the vehicle. LDR 2 measures the light intensity of

the environment and LDR 1 measures the intensity of light from opposite vehicles. Rain sensors sense the presence of rain. These measures are fed to the microcontroller. Based on these inputs Arduino decides switching of headlight beams.

2.1 Light Dependent Resistor (LDR)

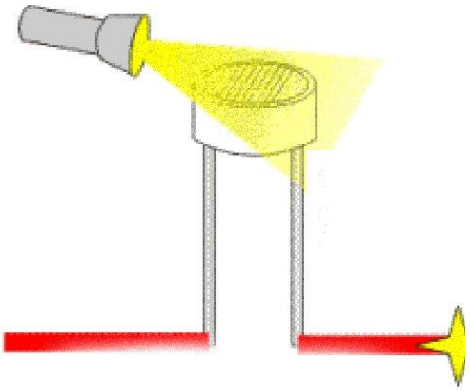

Fig -2: Working principle of LDR

An LDR [5] is a sensor that has a resistance which varies depending on the amount of light falling on its surface. Therefore it can be used in a variety of light sensing circuits. It works on the principle of photoconductivity. LDR has a very high resistance which decreases as it is illuminated. Thus conductivity is increased when light is absorbed.

Due to its high sensitivity, easy employment and low cost, LDR proves to be the best component for the adaptive headlight system. The analog output from the LDRs are fed to the microcontroller which then decides on switching the headlamps.

2.2 Rain sensor

Rain sensor is a switching device used to detect rainfall. The sensing pad with series of exposed copper traces, together acts as a variable resistor whose resistance varies according to the amount of water on its surface. This resistance is inversely proportional to the amount of water. The sensor produces an output voltage according to the resistance, which is measured to determine the presence of rain [6].

The sensor also contains an electronic module that connects the sensing pad to the Arduino. The module produces an output voltage according to the resistance of the sensing pad and is made available at an Analog Output (AO) pin. The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at a Digital Output (DO) pin. The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO). A threshold can be set by using a potentiometer, so that when the amount of water exceeds the threshold value, the module will output LOW otherwise HIGH.

Fig -3: Rain Sensor

2.3 Arduino UNO

Arduino is the most commonly used physical computing platform. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output.

3. ALGORITHM AND FLOWCHART

Algorithm:

STEP 1: Start.

STEP 2: Read the sensor values.

STEP 3: If LDR 2 or Rain Sensor is low go to STEP 4 else go to STEP 7.

STEP 4: If LDR 1 is low go to STEP 5 else go to STEP 6.

STEP 5: Switch on high beam, go to STEP 2.

STEP 6: Switch on low beam, go to STEP 2.

STEP 7: Switch off high beam and low beam, go to STEP 2.

Flowchart:

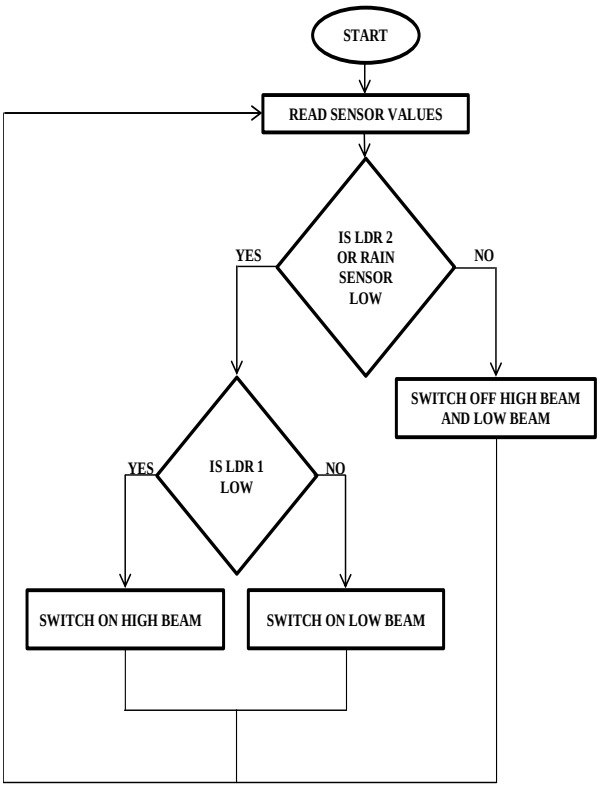

Fig -4: Flowchart

Working:

The basic system works with the LDRs which detect the amount of light outside. LDR 2 should be mounted on the vehicle in a way to detect light intensity outside. LDR 1 should be fitted on the fronteal region of the vehicle to measure the light from opposite vehicles. If the light intensity is low, LDR offers high resistance decreasing the current.

The headlights have to turn ON when the sensors detect a level of darkness or rain. Headlights need to be turned ON under either of the two conditions:

1. If LDR 2 outputs a low voltage that is less than a preset thershold value or
2. The rain sensor produces a digital LOW output.

Otherwies it implies a normal day time. But the decsion as to which beam should be activated for the drive is made based on the output of LDR 1. Thus if LDR 1 detects the brightness of vehicle from opposite direction , outputs a high value. This makes the low beam to be turned ON.

Thus the system performs three functions:

- Automatically switch ON & OFF the headlamps while driving
- Based on light intensity from opposite vehicle, switch between low beam amd high beam.
- An automatic control of headlights during rainy drive.

4. CIRCUIT DIAGRAM

- The analog outputs from LDRs are connected to analog inputs of Arduino (A3, A4)
- Digital output of rain sensor is given to digital input pin 5
- Two LEDs are used to indicate a high beam and low beam. They are connected to digital output pins of Arduino.
- A working voltage of 5 V is supplied .

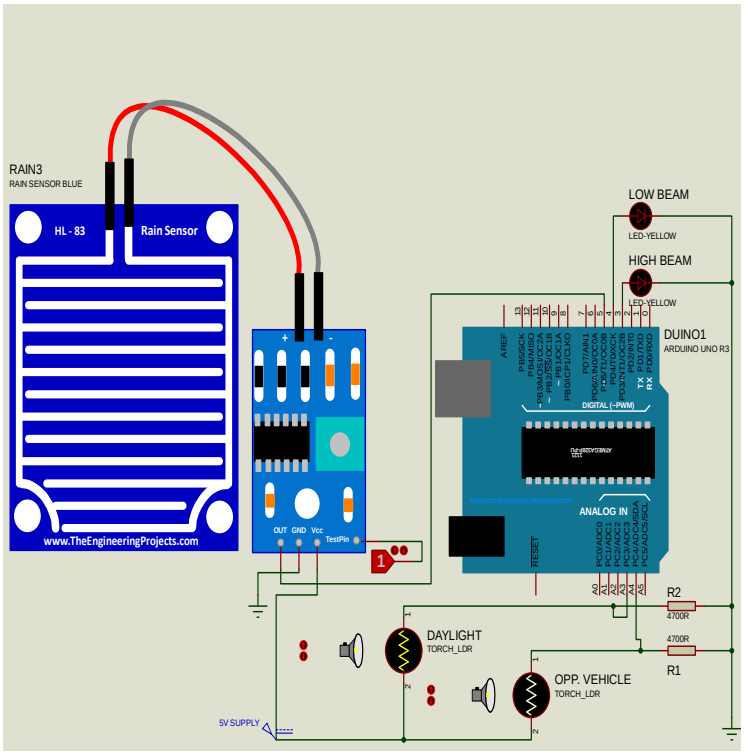

Fig -5: Circuit diagram

3. CONCLUSION

This paper suggests the development of a simple and inexpensive system for low end vehicles. It aims to meet the automatic ON/OFF of the headlights based on requirements and thus can help the driver on a manual control of the same. The highlighting feature is the additional consideration of rainy drive. The system can work with much efficiency consuming less time and effort. More features can be added by incorporating an ultrasonic sensor that can detect the distance of the vehicle from the opposite direction.

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