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SENSORIZATION OF TWO-WHEELER HEADLIGHT FOR AUTO SWITCHING OF LOW/HIGH BEAM

MAZEDAN TRANSACTIONS ON ENGINEERING SYSTEMS DESIGN
e-ISSN: 2582-8061
Article id-MTESD0403001
Vol-4, Issue-3
Received: 1 Aug 2023
Revised: 15 Sep 2023
Accepted: 2 Dec 2023

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Citation: Wattamwar, A., Kasar, A., & Patil, M. (2023). Sensorization of Two-Wheeler Headlight for auto switching of Low/High Beam. *Mazedan Transactions on Engineering Systems Design*, 4(3), 1–6.

Abstract

In Today's fast world, due to immense work and fatigue it makes some circumstances under driving uneasy, as a result because of lack of attention while driving on the road is catastrophic leading to fatal crashes. There are several reasons in which a driver is not able to control the vehicle Moreover, person is more prone to accidents in a Two-wheeler as compared to Four-wheeler. For years it has been observed that the number of deaths and injuries due to Two-wheeler have been way higher than Four-wheeler, because a four-wheeler provides urgent breaking with extra wheels, Airbags and Seat belts. Thus, driving a Two-wheeler is riskier than Four-wheeler but steps can be taken to make Two-wheelers much more secure to ride on. Majority of road accidents happen due to not having a clear visibility or darkness.

While riding on a Two-wheeler, user may mislead and lose control by falling into blind spots due to sudden fluctuations in the intensity of light in the surrounding, therefore I developed much more adaptable feature Auto-Headlight system in Two-wheeler as a way to guide the user in critical driving situations. It will automatically turn on the headlight when in auto mode thus avoiding manual switching by the user and it will also automatically change itself from High beam to low beam overcoming sudden glare from headlamps of a proceeding vehicle using LDR. This paper brings in how we can focus on to make 2-wheelers safer, the methodology and outcome have been discussed in the later part.

Keywords: Automobile, Headlight, Two-wheeler, Visibility, LDR

1. INTRODUCTION

The sensorization of a two-wheeler headlight for auto-switching between low and high beams is a sophisticated process that involves the integration of sensors and control systems. These components work together to automatically adjust the headlight beam based on various factors, ultimately enhancing safety for both the rider and other road users by ensuring optimal visibility without causing glare. In terms of light sensors, these crucial components are typically crafted from semiconductor materials such as silicon. Photodiodes or phototransistors serve as common light-sensitive elements in these sensors. Despite their critical role, light sensors require minimal energy to operate. They generate a small electrical current in response to light, and this signal is utilized to control the switching between low and high beams, contributing to the energy efficiency of the system [1-6]. The microcontroller or processor acts as the brain of the system, playing a pivotal role in decision-making regarding when to switch between low and high beams. Constructed primarily from silicon using complementary metal-oxide-semiconductor (CMOS) technology, these components are designed to be energy-efficient and operate on low power [7-10]. Their seamless interaction with light sensors highlights the synergy between hardware and software in achieving optimal performance. Actuators responsible for adjusting the headlight beam can be composed of various materials, including metals and polymers. Common actuator types, such as motors or servos, are employed to physically adjust the position of the headlight. The energy consumption of these actuators depends on their type and design, underscoring the importance of efficient and well-designed mechanisms for optimal energy usage. The power supply, encompassing components like batteries or alternators, is a critical aspect of the system. Batteries, often crafted from materials like lithium-ion or lead-acid, provide the necessary energy for the system. This energy is supplied by the vehicle's electrical system, emphasizing the need for a robust power supply capable of supporting continuous operation and occasional adjustments of the headlight. Control algorithms, implemented in software and executed by the microcontroller or processor, play a central role in the functionality of the system. The programming involves the use of a programming language and may include algorithms for signal processing and decision-making. While control algorithms themselves do not consume physical materials, they require computational energy. The efficiency of these algorithms contributes to minimizing overall energy consumption. The enclosures and housing for sensors and electronic components are typically constructed from materials like plastics or

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metals. While the choice of materials for enclosures doesn't directly impact energy consumption, it plays a crucial role in providing durability and protection against environmental factors.

This highlights the holistic approach taken in the design and implementation of the system, considering both functionality and the physical integrity of the components. Every year automobile companies come up with frequent innovative ideas to improve ride quality and overall performance in different areas. Safety is one of the crucial factors that need to be focused on, with today's rush on the road it is difficult to reach destinations sooner than expected due to several elements such as poor vision, blind spots etc. It is not strange enough to have millions of people becoming a victim of road accidents in a year with all the chaotic pressure and occurrence of distraction that is displayed at any moment on motorways at the time of driving leading to human error but measures can be taken to improve the safety on the road through slight advancement in technology. Driving a vehicle irrespective of the number of wheels is highly a visual task as most of the information that is carried out by the driver is through their own vision. Peripheral vision at the time of driving is very important to observe and recognize the objects in the surrounding approaching from the corners while looking straight ahead, with all of these parameters are been processed in order to make an ideal response.

Studies reveal that majority of accidents happen at night time than at day time. Approximately 37% of the accidents occur between 9:00 pm to 6:00 am indicating the darkness that affects the vision while driving a vehicle. Even though in order to drive at night time or in the dark, lighting system is been used but at a certain point a typical conventional lighting system cannot give a quicker response to the driver as it is completely manual operation that is executed, thus the necessary action needs to be implemented by the driver itself, even to switch on the headlights. Automatic Headlamps were firstly observed in premium segment vehicles such as Volkswagen, BMW, Mercedes-Benz etc., and this system has been eventually passed on the economical top-end variant vehicles, thus it has its presence in the market of 4-wheeler hence this research aims to implement the idea of Automatic Headlight system in a 2-wheeler.

This very system can give out a quicker response as compared to the normal Lighting systems used in a 2-wheeler. Unlike the system used for lighting in a standard 2-wheeeler where switches are manually operated every time, in the auto-headlight lighting system in auto mode the driver does not have to look after the headlight as it is controlled automatically based upon the onboard conditions nearby the vehicle. For example, if we are travelling even in day time and suddenly enter into a tunnel it will automatically illuminate the headlight with no user involvement, this system will be able to measure the amount of darkness and will give out the necessary output.

In addition to that the system can automatically switch itself from High beam to low beam based upon the intensity of light detected at the moment from object such as a vehicle approaching in opposite direction preventing the cause of temporary blindness that can affect the vision, moreover in order to make the rear end of the vehicle much more noticeable in bad weather conditions, use of Auto-laser beam is been implemented having higher red intensity of light that can be observed from a far distance avoiding collisions behind the back end as well. O. Akinsanmi (2015) proposed design of automatic Automobile headlight system that initiates in a way that when vehicle headlight is been operated in high beam it will switch to low beam when the system senses glare from vehicle in opposite direction and will turn back to high beam when vehicle passes by [11]. Bala Krishnan T (2017) made use of LDR and PIC microcontroller to automatically turn from upper to dimmer light of vehicle headlight overcoming glare of other light source or light emitted by approaching vehicle [12]. Lakshmi K (2019) implemented Automatic Vehicle Headlight Management system avoiding headlight glare, which manages to overcome temporary blindness while driving by making use of LDR and Arduino uno to control the light intensity from other sources, reducing the work of driver to switch between mode of lighting operation [13]. Fadil Muhammad (2020) designed Automatic headlight system based on road contour and beam from other headlights which consists of accelerometer sensor to adjust the reflector light uphill as well as downhill and lux meter sensor to change the mode of light [14]. B. kalaimathi (2021) designed a prototype of Automatic Headlight dimmer using Arduino (atmega 328) and LDR sensor to prevent accidents happening at night times by resolving the glare issue of headlamps of another vehicle at night [15]. Yi-shun chen (2018) gave an advanced new method of automatic control of vehicle headlights in which vehicle speed sensor and electronic level monitor controls the vehicle state thus automatically changing the projection angle of headlamp as per road conditions [16]. Kazi Muhammad Fahim Shahriar proposed much more durable method to handle the intensity of headlights while driving using ambient light sensor. By using the following sensor, it gives quicker response to the driver hence making the system adaptable [17-19]. However, in advanced systems, such as Human-Computer Interaction or health devices, these sensors may be integrated to create a more adaptive and personalized user experience by considering external conditions and the user's emotional state or well-being [20-25].

2. PROPOSED SYSTEM

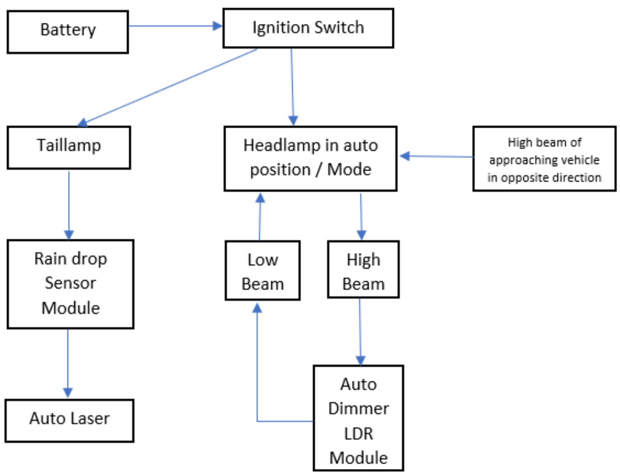

Figure 1 Block Diagram of the Auto Headlight system

As Majority of Accidents occur at the time of night when there is no clear visibility or when someone immediately comes in to a risky spot where chances of collision are immense. Due to the sudden flash of other vehicle's lights which is of high light intensity, the human eyes are not only blinded by it but it can also last up to few minutes and has an effect on the reaction time which is reduced by approx. 1.4 seconds.

In such cases manual switching can be really difficult for the user as it needs to be done with quick instinct which can be fulfilled by using LDR sensor thus making the system automized, in addition to that to have better visibility at the rear as well, rain sensor module is been taken under operation whose output is been transmitted to the auto laser which comes in handy in foggy/mist areas.

Light Dependent Resistor (LDR)

Figure 2 LDR Sensor of light sensitive Relay module

LDR is a type of a sensor that changes its resistance according to the amount of intensity of light falling on it. If the light intensity increases, the resistance value will ultimately decrease and will increase the conductivity of LDR and vice versa. The output of LDR is an analog output. It is a passive sensor which means it does not require any external voltage supply to run. Thus, LDR exhibits photoconductivity, normally resistance of LDR is very high, sometimes as high as 1MΩ. but when illuminated with light, resistance will drop dramatically.

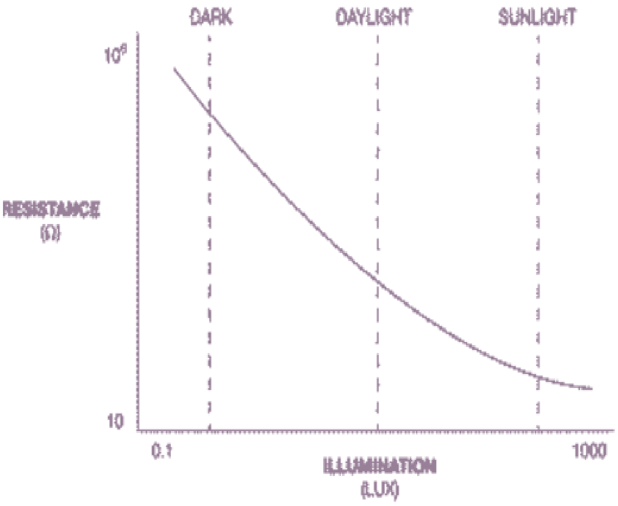

Figure 3 Relation between Resistance & illuminance of LDR

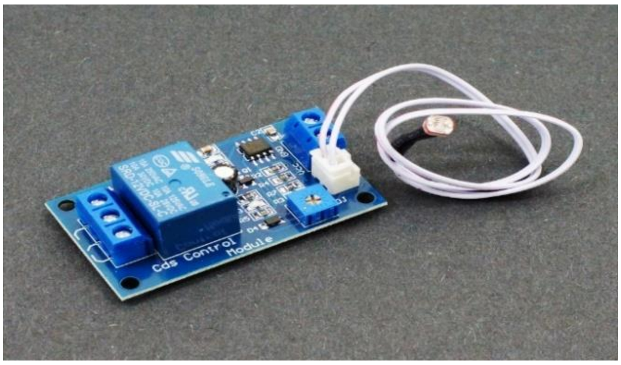

Figure 4 12v Light Sensitive LDR Relay Module

The module requires 12V power and ground to operate. There is a red LED that is lit when power is applied to the module. When the relay is de-energized it draws approximately 10mA. When energized, the module draws about 40mA from the Vcc pin, the output is SPDT type with both NO (Normally open) terminal and a NC (normally closed) terminal relative to COM terminal. When the relay is de-energized blue LED turns OFF which means that load is connected to normally closed relay contact when switched on, on the other hand when load is connected with the normally open relay contact terminal and if it switches on, the relay is energized thus Blue LED glows up.

Headlamps

Headlamp is crucial part of two-wheeler as it provides visibility while riding on the road, which is located at the front of the two-wheeler, based upon the functions of headlamp there are two major beams used in city or at highways or as per the requirement of the user on the road, which are low beam and high beam.

Figure 5 Halogen lamp at low Beam

In other words, low beam is also called as dipped beam, it focusses more towards the road surface but at a closer range to the vehicle, it is beneficial in the cities, downtown areas where traffic is involved.

Figure 6 Halogen lamp at High Beam

High beam is also known as main beam and it mostly comes in to picture when we are dealing with pitch darkness, regions where there is lack of light to illuminate the road surface but it is ideal only when there are no other vehicle users on the road whether in same or opposite direction as the vehicle with high beam at a close distance can glaze up a person's vision which can be riskier at night time road conditions.

Rain sensor Module

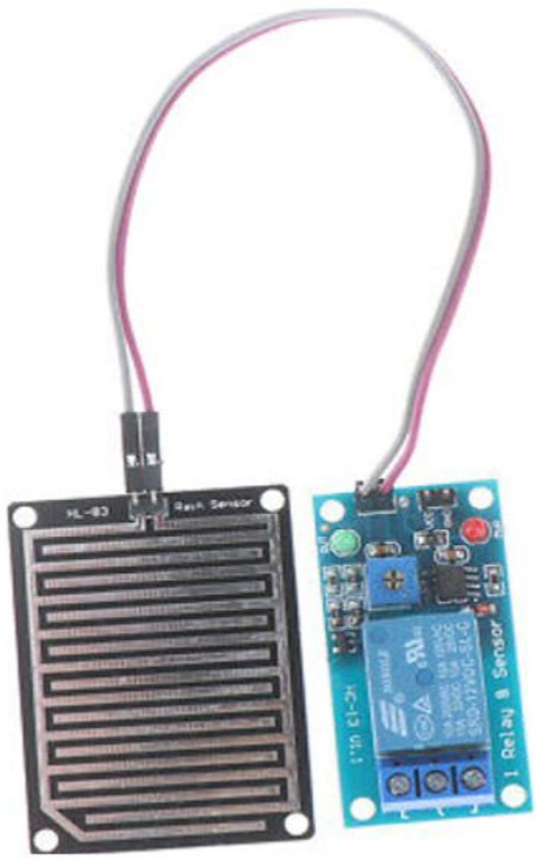

Figure 7 Rain sensor relay module

It acts as a switching device when it detects water droplets, it is activated so that the signals are uses as input by the module which in turn operates the relay to deliver the signal to turn on the laser beam.

Laser Beam

Figure 8 safety distance warning line fog red color LED laser light

The output of the rain sensor is been given to the laser beam which will emit much more concentrated beam of red intensity, that too at a far distance.

Figure 9 laser beam adjusted at rear of bike below the tail lamp

This beam will help in ensuring a safer distance at poor visibility conditions not only in dark areas but hilly, foggy areas as well where tail lamps intensity cannot be seen clearly thus it acts a rear fog light which is present in 4-wheeler.

Battery

Figure 10 VRLA Battery

The battery used up in the system is a valve regulated lead acid battery which is a type of maintenance free battery been used, which will provied the necessary 12v power supply which is distributed to all the lighting components of the system through the ignition switch.

3. RESULT AND DISCUSSION

The System that is built for two-wheeler works successfully, the 12v supply from the battery goes to the entire system, in the system we made use of two identical 12v LDR modules yet there overall functionality was different as compared to each other. The system gives the user the choice of manual as well as auto mode for the operation of headlamps.

Figure 11 Complete system Setup

Automatic headlight switch if in OFF state then it will act as an AHO system (Automatic Headlight ON) in this case the halogen will be illuminated and when put in ON state then it can turn the headlamps OFF and ON as per the measure of darkness, hence when in AUTO mode it will emit light only when required.

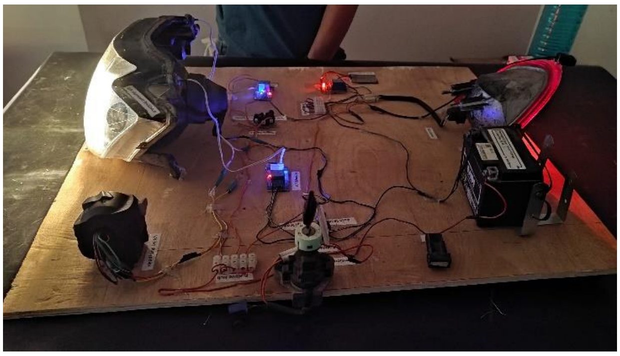

Figure 12 Prototype under operation

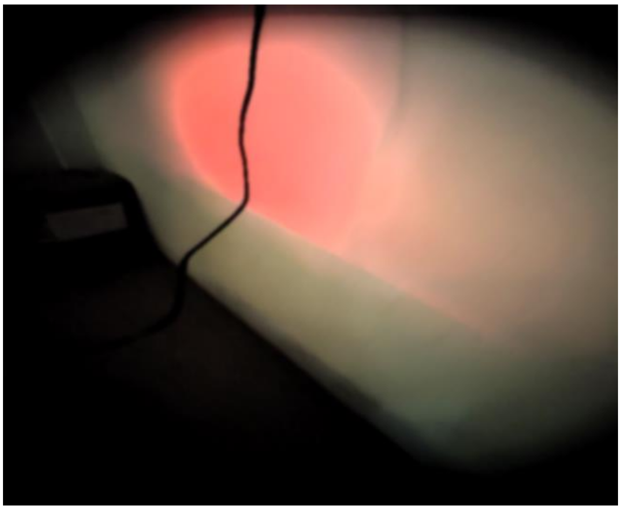

Figure 13 Activation of laser beam

If the user switch ON the Auto Dimmer LDR module then the system will switch itself automatically from High beam to low beam whenever the system detects rapid increase in light intensity at a certain range providing up a quick response ensuring safety. As it helps riding on with sufficient amount of lighting in the front.

The laser beam is activated automtically after rain sensor detects droplets of water, so practically it can enhance visibility at the back of the vehicle, keeping up a safe distance between us and other vehicles in bad weather conditions where tail lamp intensity is not enough to identify or to know the presence of vehicle ahead.

4. CONCLUSION

While riding on the road, one needs to be concern about the position of light beam of headlight especially at night times, The Proposed system is able to adapt to the fluctuations of light intensity, when user puts each module in Auto mode it will help in eleiminating the visibility issues moreover it gives a choice to the user to use either manual mode or Auto mode, the system is capable of turning on the headlamps when it is dark and switching from High to low beam when the system is in high beam initiallly and it detects vehicle with bright headlamps approaching towards. Hence, the system improves safety by tackling the troxler effect faced by human eye.

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