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Automatic Vehicle Headlights by Light Conditions Using STM32

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Abstract: *This paper proposes an efficient method to control the headlight intensity of the vehicle using ambient light sensor (ALS) based on light dependent resistor (LDR) with the principle of pulse width modulation. We propose the new system titled "AUTOMATIC VEHICLE HEADLIGHTS BY LIGHT CONDITIONS USING STM32". The main responsibility of this automatic headlight control is to control the intensity of the headlight based on the ambient light. The intensity of the headlight will be low when the ambient light intensity is high and vice versa. This system employs external light sensors to continuously monitor ambient light levels. 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. The LDR sensor is used to sense the surrounding lighting condition. By utilizing a light sensor, microcontroller, and control mechanism, this system dynamically adjusts the intensity of vehicle headlights based on the surrounding ambient light*

Keywords: light sensor(LDR), microcontroller (STM32), headlight, Embedded 'C'

I. INTRODUCTION

Vehicle headlights are a key part of vehicle that serve the purpose of lighting up the road ahead of the vehicle. While there have been several modifications in smart cars, the headlights have not seen much technological changes. We here develop smart vehicle headlights that not just start automatically as soon as sun goes down but also adjust light intensity as per required brightness to save power. By doing this project we can save power, no manual switching ON/ OFF lights, lights operated as per outer intensity to save power and many more. This paper aims at designing and executing the advanced development in embedded systems for energy saving. Nowadays, human has become too busy, and is unable to find time even to switch the headlights wherever not necessary. The present system is like, the headlights will be switched ON in the night and they will be switched OFF during day time and the headlights intensity is low during afternoon. This paper gives the best solution for electrical power wastage. Also, the manual operation of the lighting system is completely eliminated. In this project LDR sensor (Light Dependent Resistor) is used to indicate day/night time. Energy efficient technologies and design mechanism can reduce cost of this system drastically.

Manual control is prone to errors and leads to energy wastages. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control headlight of vehicle. The problems with headlights are: Sometimes users forget to switch ON the lights before starting the car at night, which can lead to accidents and also,vehicle headlights usually glow at full intensity then turned ON consuming max power.The only aim of this research paper is to describe an automated lighting framework which focuses on the energy saving and reducing human intervention, and also to construct a smart vehicle headlighting system with sensors and controllers, to outline an automated lighting system with particular methodology plan, which makes the system more user friendly and that requires less involvement of manpower.

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II. SYSTEM OVERVIEW

The system makes use of a light sensor, ignition key, LED panel (to demonstrate led panel headlight) all controller by an Arduino based controller to achieve the desired output. We first need to start the ignition to start the system. On ignition start the system starts up and the controller monitors the light sensor to monitor environmental light conditions. If the lighting is below certain threshold, the system starts the LED panel. Once started the system continuously monitors the external lighting level and adjusts the brightness of while saving unnecessary energy.The controller automatically handles lighting as per environmental conditions as long as ignition is on. When the ignition is turned off, the controller waits for 5 minutes and automatically turns off the headlights to avoid battery drain, in case user forgot to turn them off.

III. PROBLEM STATEMENT

Nowadays, human has become too busy, and is unable to find time even to switch the headlights wherever not necessary. At times users forget to turn OFF headlights during day times consuming unnecessary battery. Also, users sometimes forget to turn OFF headlights before leaving cars which drains the entire car battery. Vehicle headlights usually glow at full intensity then turned on consuming max power. Therefore, we design and develop an automatic vehicle headlight control system using STM32 microcontroller that adjusts headlight intensity based on ambient light conditions, ensuring optimal visibility and safety. Here,we developed smart vehicle headlights which are automatically adjusted by using LDR.

IV. PROPOSED SYSTEM MODEL

This system continuously monitors the external lighting level and adjusts the brightness of headlights for saving unnecessary energy. The controller automatically turns off the headlights as soon as external lighting conditions. If light source is present then the headlights are OFF and headlight are ON when light is absent. The controller automatically handles lighting as per environmental conditions as long as ignition is on. When the ignition is turned off, the controller waits for 5 minutes and automatically turns off the headlights to avoid battery drain, in case user forgot to turn them off.

V. BLOCK DIAGRAM

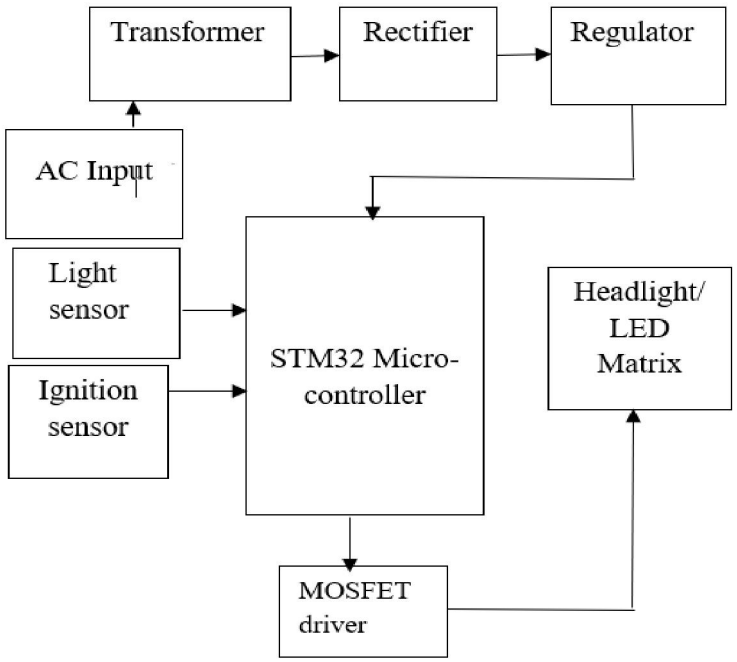

Fig. Block diagram of automatic vehicle headlight control by light conditions using STM32

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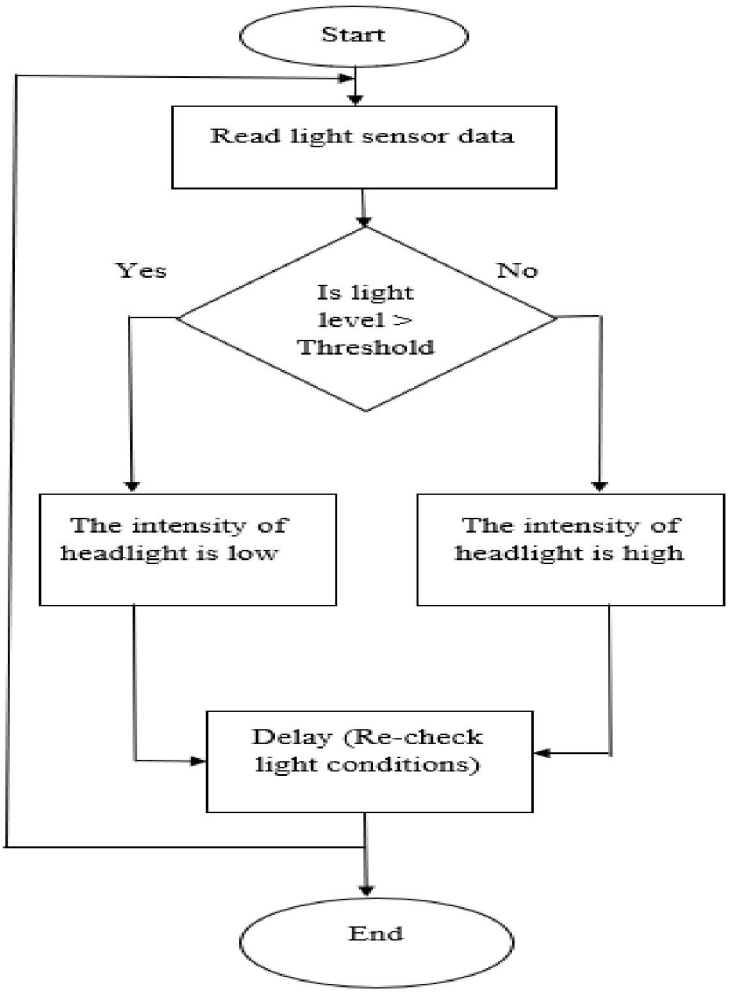
VI. FLOW CHART



VII. HARDWARE COMPONENT

STM32 Controller:

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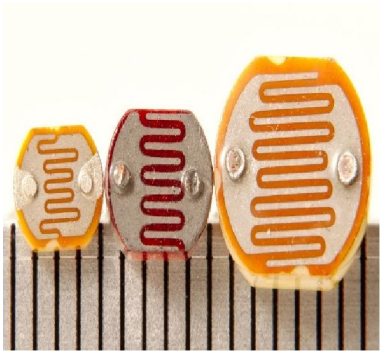
STM32 microcontrollers play a vital role in various industries. In the automotiveindustry, they are used for engine control, safety systems, infotainment systems, and more. In consumer electronics, STM microcontrollers power devices such as smartphones, tablets, smartwatches, and home automation systems.

Light Dependent Resistor:

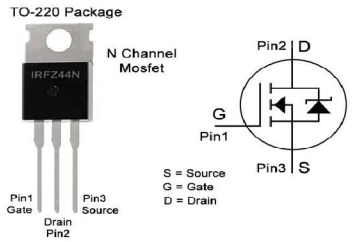


Light dependent resistor, aptly describes its function as a sensor that changes resistance based on light intensity. The LDR sensor working in the automated lightning system efficiently adjust the brightness based on the ambient light conditions.

Ignition Sensor:

Ignition sensor is a monostable ignition module with pair of keys. It is triggered when a key is put in and turned right. After releasing the key, the module goes back to the original position. These sensors monitor the rotational speed and position of the camshaft and the crankshaft components and send this data to the engine control module.

MOSFET Driver:



The MOSFET driver switches the headlights ON or OFF by controlling the flow of electrical current. In some systems, the MOSFET driver may also regulate the headlight intensity inresponse to changing light conditions. MOSFET drivers provide robust control and protection against electrical transients. They are used to minimize power losses and heat generation.

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VIII. ADVANTAGES

- No manual switching ON/OFF lights.
- Light operated as per outer intensity.
- Flexibility in programming.
- Its size is compact.
- Lights turn OFF automatically if engine is off but lights ON for over 5 minutes.

IX. APPLICATIONS

- In commercial applications.
- Passengers vehicles (bus, taxi).
- Agriculture vehicles.
- Autonomous vehicles.

X. CONCLUSION

This paper aims to find the solution of power consumption and manual working of the current system. This system promotes energy efficiency by optimizing light usage, conserving power, and extending the lifespan of lighting components. By automating headlight adjustments, we can save energy.

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