IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, May 2026
Impact Factor: 8.2

Smart Automatic Vehicle Headlight Dipper Circuit

Shraddha Walke[1], Shejal Patil[2], Gayatri Dhanokar[3], Gayatri Ghogare[4]
Electronics and Telecommunications Department[1-4]
Mauli College of Engineering, Shegaon, India

Abstract: *The Smart Automatic Headlight Dipper Circuit is a simple but useful safety system designed to reduce the problem of glare from high-beam headlights during night driving. Glare from oncoming vehicles can temporarily affect a driver's vision and increase the chances of accidents. This project offers an automatic solution that adjusts the headlight brightness without the driver needing to manually switch it.The system uses a Light Dependent Resistor (LDR) to sense the intensity of light coming from other vehicles. When strong light is detected, the circuit automatically switches the headlight from high beam to low beam. Once the incoming light reduces, it switches back to high beam again. The circuit is built using basic and low-cost components like resistors, transistors, operational amplifiers, and relays, making it easy to design and affordable to implement..*

Keywords: IoT based smart headlight system

I. INTRODUCTION

A smart automatic vehicle headlight dipper circuit is an electronic system that automatically switches a vehicle's headlights between high beam and low beam depending on the surrounding light conditions and the presence of oncoming vehicles. The main purpose of this system is to improve road safety, reduce the driver's workload, and avoid glare that can temporarily disturb or blind other drivers at night. In normal driving conditions, the driver has to manually switch between high beam and low beam. This can sometimes be inconvenient or simply forgotten, which may lead to discomfort for others or even increase the risk of accidents. To solve this problem, the smart dipper circuit uses light-sensing components such as Light Dependent Resistors (LDRs) or photodiodes to detect the intensity of incoming light from opposite vehicles as well as changes in ambient lighting. Based on this input, the system automatically controls the headlights, ensuring safe and smooth switching without needing manual intervention.

II. SYSTEM ARCHITECTURE

The system architecture of a smart automatic vehicle headlight dipper circuit is made up of several connected units that work together to sense light and control the vehicle's headlights automatically. It starts with the sensing unit, which uses a Light Dependent Resistor (LDR) or a photodiode to detect the intensity of light coming from oncoming vehicles or the surrounding environment. This sensor converts the detected light into a corresponding electrical signal. After this, the signal is sent to the signal conditioning unit, where it is processed using components like comparators or operational amplifiers. Here, the system compares the incoming signal with a preset reference value to decide whether the detected light intensity is high or low. Based on this decision, the system prepares the appropriate control action for switching between high beam and low beam headlights.

System architecture is the overall design or blueprint of a software system that shows how different components work together to make the system function. It explains how the frontend (what users see), backend (where the main processing happens), database (where data is stored), servers, and APIs are connected and interact with each other. You can think of it like the plan of a building that ensures every part has a role and fits properly. A well-designed system architecture helps the application run smoothly, stay fast, handle more users when needed, remain reliable, and be easier to maintain and improve over time.

DOI: 10.48175/IJARSCT-34763

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, May 2026
Impact Factor: 8.2

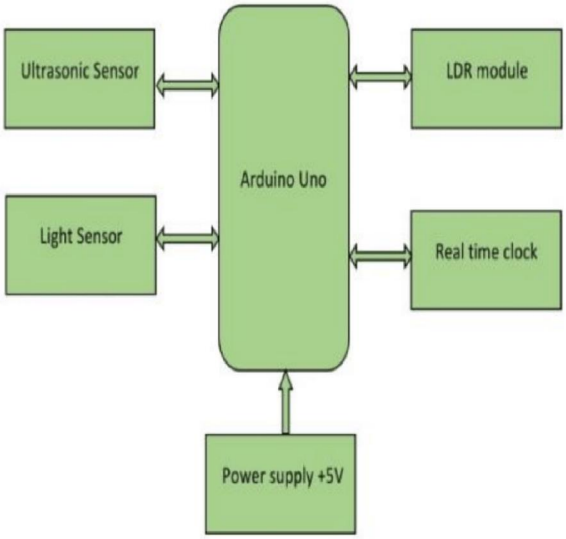

Fig. 1 WORKFLOW MODEL

III. METHODOLOGY

The methodology of the smart automatic vehicle headlight dipper circuit explains the step-by-step process used to design, build, and operate the system. It starts with system design and component selection, where essential parts such as a Light Dependent Resistor (LDR), comparator or operational amplifier, transistors or a microcontroller, and a relay module are selected. These components are chosen because they can reliably detect changes in light intensity and control the switching of vehicle headlights.

The next step is the sensor setup, where the LDR is placed in a suitable position so that it can properly detect light from oncoming vehicles as well as the surrounding environment. The LDR is connected in a voltage divider circuit, which helps convert changes in light intensity into a corresponding voltage signal. This signal is then used by the system to make decisions about switching between high beam and low beam automatically.

Methodology refers to the systematic way or approach used to complete a task, solve a problem, or carry out a study. It is like a step-by-step plan that explains how something is done in an organized manner. Instead of working randomly, methodology provides a clear structure so that the process becomes more efficient, repeatable, and easy to understand. It is commonly used in research, software development, and projects to ensure that every step is properly followed and leads to accurate and reliable results.

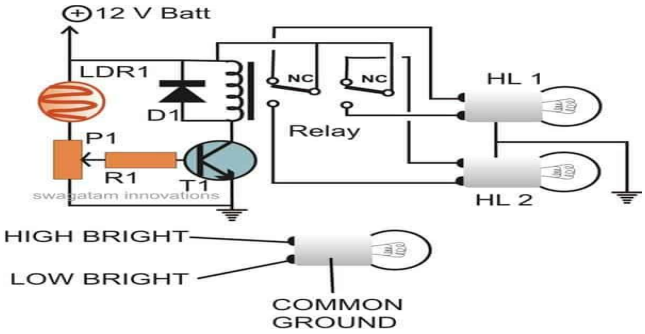

Fig. 2. CIRCUIT DIAGRAM OF SMART VEHICLE DIPPER

DOI: 10.48175/IJARSCT-34763

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, May 2026
Impact Factor: 8.2

Below figure is of the output of Smart Vehicle Headlight Dipper

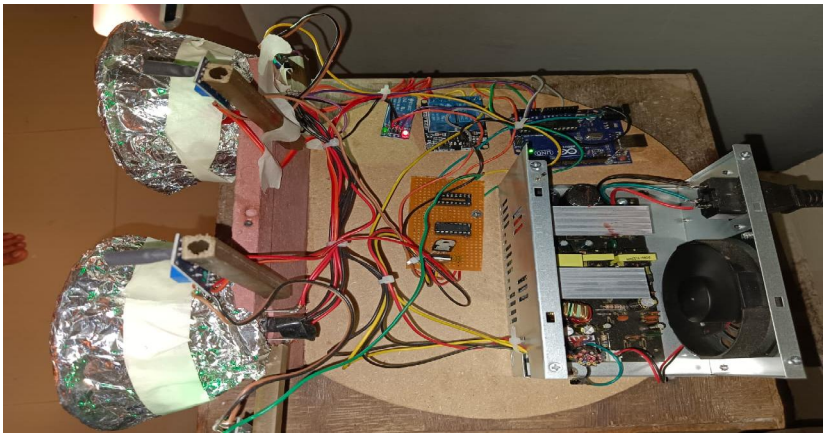

Fig. 3. OUTPUT OF HEADLIGHT DIPPER

3.1 Automatic High/Low Beam Switching

The system automatically changes the headlights depending on the traffic around the vehicle. When it detects an oncoming vehicle or a vehicle in front in the same lane, it switches from high beam to low beam so that other drivers are not disturbed by glare. When the road becomes clear and there are no vehicles ahead, it switches back to high beam to help the driver see farther and drive more safely at night.

3.2 Adaptive Light Intensity Control

The system automatically adjusts the headlight brightness based on driving conditions. It increases or decreases the light depending on the vehicle's speed and the surrounding environment. For example, it provides stronger lighting during fast driving or in dark areas, while reducing brightness in places like fog, tunnels, or well-lit streets. This helps the driver see clearly while also making sure other road users are not disturbed or uncomfortable.

3.3 Beam Direction Adjustment (Advanced Systems)

In advanced smart lighting systems, the headlights automatically adjust their direction based on how the vehicle is moving. When the vehicle turns, the lights slightly move left or right to better illuminate the curved road ahead. They also adjust up or down when the road goes uphill or downhill. This helps the driver see bends, slopes, and uneven roads more clearly, making night driving safer and more comfortable.

IV. IMPLEMENTATION

The implementation of a smart vehicle headlight dipper system starts with designing the overall system by combining sensors, a controller, and headlight actuators so that the lighting can be automatically controlled based on road conditions. After this, the sensors are integrated into the system. Devices like LDRs or photodiodes are used to detect surrounding light levels, while cameras or IR sensors are used to identify oncoming vehicles or vehicles ahead. These sensors continuously send real-time information to the control unit, which helps the system decide how the headlights should operate.

4.1 System Design

The system design of a smart vehicle headlight dipper involves carefully planning and combining all the necessary parts needed for automatic headlight control. It starts with selecting suitable sensors like LDRs, photodiodes, cameras, or IR sensors that can detect surrounding light levels and identify oncoming or leading vehicles. A microcontroller or vehicle ECU is used as the main control unit to process the sensor data and make quick decisions in real time.The

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 1, May 2026 Impact Factor: 8.2

headlight system, usually based on LED or matrix LED technology, is designed to control beam switching, brightness, and direction in a precise way. Along with this, other supporting parts such as relays, LED drivers, power supply units, and communication interfaces are added to make the system work smoothly and reliably. Overall, the design focuses on building a system that is efficient, responsive, and able to automatically adjust headlights according to changing road and traffic conditions, improving both safety and driving comfort

4.2 Sensor Integration

Sensor integration in a smart vehicle headlight dipper system involves selecting and combining different sensors to monitor environmental and traffic conditions in real time. Light-dependent resistors (LDRs) or photodiodes are used to detect ambient light intensity, helping the system understand whether it is day, night, or low-visibility conditions such as tunnels or fog. For vehicle detection, infrared sensors, cameras, or radar sensors are integrated to identify oncoming vehicles as well as vehicles traveling ahead in the same lane. These sensors are carefully placed on the vehicle, usually near the windshield or headlight assembly, to ensure accurate sensing of the road environment.

V. RESULTS AND DISCUSSION

5.1 Automatic switching between high beam and low beam

The system continuously monitors road conditions and automatically switches the headlights between high beam and low beam. When a vehicle is detected, it immediately switches to low beam, and when the road is clear, it returns to high beam. This ensures smooth and safe lighting control without driver involvement.

5.2 Accurate detection of vehicles using sensors

Sensors such as LDRs, IR sensors, or cameras help the system identify oncoming vehicles or vehicles ahead. These sensors detect changes in light intensity or object presence, allowing the system to react appropriately and maintain safe driving conditions.

5.3 Improved safety compared to manual systems

Traditional headlight systems rely on the driver to switch beams manually, which can sometimes be delayed or forgotten. The automatic system eliminates this issue by reacting instantly, improving safety for all road users.

VI. CONCLUSION

The smart vehicle headlight dipper system is a useful automation solution that improves road safety and makes driving more comfortable. By using sensors, control units, and adaptive lighting technology, it removes the need for the driver to manually switch the headlights. This helps ensure the road is always properly lit while also reducing glare for other drivers on the road.The system shows how important automation is becoming in modern vehicles and also acts as a basic step toward future intelligent and self-driving vehicle lighting systems. Overall, it offers a safer, more energy-efficient, and easier way to manage vehicle headlights.

VII. ACKNOWLEDGE

I would like to sincerely thank everyone who supported me during the completion of my project on the Smart Vehicle Headlight Dipper System. This project would not have been possible without their guidance and encouragement. First, I express my heartfelt gratitude to my project guide for their constant support, valuable suggestions, and patient guidance throughout the development of this work. Their advice helped me understand the concepts clearly and improve my project step by step.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, May 2026
Impact Factor: 8.2

REFERENCES

[1]. Rajesh Singh, Automotive Electronics and Control Systems, McGraw Hill.
[2]. William B. Ribbens, Understanding Automotive Electronics, Elsevier.
[3]. Bosch Automotive Handbook, Robert Bosch GmbH.
[4]. IEEE Papers on Adaptive Front Lighting Systems (AFS).
[5]. SAE International Technical Papers on Intelligent Vehicle Lighting Systems.
[6]. IoT-based Smart Vehicle Lighting System research articles (IEEE Xplore / Springer).
[7]. ISO 26262: Road Vehicles – Functional Safety Standard, International Organization for Standardization.
[8]. N. K. Gupta, Automotive Sensors and Actuators, Tata McGraw-Hill, 2015.
[9]. Springer Link, Studies on Smart Automotive Lighting and Driver Assistance Systems.
[10]. A. K. Talwar, Embedded Systems in Automotive Applications, CRC Press, 2020.
[11]. International Journal of Automotive Engineering, Research on Adaptive Headlight Control Using Sensors and Microcontrollers.
[12]. Conference Papers on IoT-based Smart Vehicle Lighting Systems and Automation