Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 03 | March-2026
ISSN (O) 3107-6696

VEHICLE DIPPER LIGHT USING IoT

Navaneethakrishnan p

Department of Information Technology, Sri Krishna Adithya College of Arts and Science, Coimbatore, Tamil Nadu, India

ashwinsanthosh0705@gmail.com

Dr. S. Malathi

Department of Information Technology, Sri Krishna Adithya College of Arts and Science, Coimbatore, Tamil Nadu, India

malathis@skacas.ac.in

---***---

Abstract - Road safety during nighttime driving is often compromised due to improper usage of vehicle headlights, particularly the failure to dip high-beam lights when approaching oncoming traffic. Continuous exposure to high-beam glare can cause temporary blindness, leading to accidents and discomfort for drivers. This paper presents an IoT-based vehicle dipper light automation system that intelligently controls headlight intensity to ensure safe driving conditions. The system employs light sensors to detect the intensity of oncoming vehicle headlights and a microcontroller to process the sensor data. Using wireless communication, the microcontroller adjusts the vehicle's headlight beam automatically, switching between high and low beams as required. Additionally, the system can transmit data to a cloud platform for monitoring and analysis, enabling further enhancements in smart traffic management. By reducing manual intervention and ensuring timely beam adjustment, the proposed system enhances driver safety, minimizes road accidents, and promotes responsible driving behavior. This IoT-enabled solution provides a smart, reliable, and cost-effective approach suitable for modern vehicles and intelligent transportation systems.

Introduction

Nighttime driving is an essential aspect of modern transportation, but it often poses significant safety challenges due to improper usage of vehicle headlights. High-beam lights, when not dipped in the presence of oncoming traffic, cause glare that can temporarily blind drivers, leading to accidents and discomfort. Despite awareness campaigns and manual controls, negligence and delayed reactions continue to make this a recurring issue on roads. The lack of an automated mechanism to regulate headlight intensity contributes to unsafe driving conditions, especially on highways and poorly lit roads.

Recent advancements in Internet of Things (IoT) technology have enabled the development of intelligent automotive systems capable of real-time monitoring and automation. IoT-based solutions integrate sensors, microcontrollers, and communication modules to provide smart control and remote accessibility. An IoT-enabled vehicle dipper light system addresses the problem of glare by automatically detecting the intensity of oncoming headlights and adjusting the vehicle's beam accordingly. This reduces dependency on manual intervention, ensures timely response, and enhances overall road safety.

Literature Study

Numerous studies have been conducted on intelligent vehicle lighting systems and glare reduction using embedded technologies and wireless communication. Early research focused on manual dipper mechanisms and simple sensor-based systems that detect ambient light levels to switch between high and low beams. While effective in controlled environments, these systems lacked adaptability to real-world traffic conditions and did not account for the varying intensity of oncoming headlights.

Subsequent research introduced GSM-based and RF communication systems that allowed vehicles to exchange signals, enabling cooperative beam adjustment. These approaches improved driver response time but required additional infrastructure and were limited by communication range. Other studies explored the use of image processing techniques with cameras to detect oncoming vehicles and adjust headlights accordingly. Although accurate, such systems were computationally intensive and costly, making them less feasible for widespread adoption.

With the emergence of IoT, researchers began integrating light sensors, microcontrollers, and Wi-Fi-enabled modules to

Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 03 | March-2026
ISSN (O) 3107-6696

develop real-time, automated dipper systems. Cloud platforms and mobile applications were also introduced for monitoring and analysis, allowing data-driven improvements in smart transportation. However, most existing systems focus either on glare detection or beam adjustment. Only a few provide a fully automated, IoT-enabled solution that combines real-time sensing, intelligent control, and remote monitoring.

Significance of the Study

The primary significance of this study lies in its potential to reduce nighttime road accidents caused by high-beam glare. Improper use of headlights can temporarily blind oncoming drivers, leading to collisions and hazardous driving conditions. By automating the dipper light function using IoT-based sensors and controllers, the system ensures timely beam adjustment, thereby enhancing visibility and safety for all road users.

Manual control of dipper lights often depends on driver attentiveness, which can be inconsistent. This study introduces an intelligent, hands-free solution that detects oncoming traffic and adjusts headlight intensity automatically. The integration of IoT components allows for seamless operation without driver intervention, promoting responsible driving behavior and reducing human error.

Beyond immediate safety benefits, the system enables real-time data collection and cloud-based monitoring. This opens avenues for traffic analysis, performance optimization, and integration with broader smart transportation networks. The scalable nature of the design makes it suitable for both personal vehicles and public transport fleets, contributing to the evolution of intelligent mobility solutions.

Proposed System

The proposed system is designed to automate the dipper light functionality in vehicles using Internet of Things (IoT) technology. It consists of a light intensity sensor, a microcontroller (such as Arduino or NodeMCU), and a headlight control module. The light sensor detects the brightness of oncoming vehicle headlights, and the microcontroller processes this data to determine whether the vehicle's own headlights should be switched to low beam.

To enable remote monitoring and data logging, the system is equipped with a Wi-Fi module that connects to a cloud platform. This allows real-time transmission of sensor data and system status, which can be accessed through a mobile application or web dashboard. The IoT integration not only enhances transparency but also supports future scalability for smart traffic systems and fleet management.

The core logic of the system is based on threshold comparison. When the sensor detects incoming light intensity above a predefined level, the microcontroller triggers the dipper mechanism to switch from high beam to low beam. Once the oncoming vehicle passes and the light intensity drops, the system automatically restores the high beam. This ensures timely and accurate beam adjustment without driver intervention.

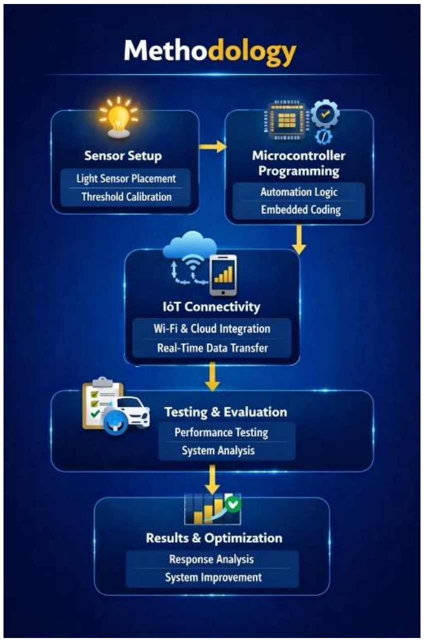
By automating the dipper light function, the system significantly improves nighttime driving safety and reduces the risk of glare-induced accidents. It also promotes energy efficiency by optimizing headlight usage. The compact design and low-cost components make it suitable for integration into both new and existing vehicles, offering a practical solution for enhancing road safety through smart technology.

Methodology

The methodology begins with the design of the IoT-based dipper light system, which integrates a light intensity sensor, a microcontroller, and a headlight control circuit. The sensor is positioned to detect the brightness of oncoming vehicle headlights, while the microcontroller processes this input data. Based on predefined threshold values, the microcontroller decides whether to switch the headlights between high and low beams, ensuring accurate and timely response.

The system incorporates a Wi-Fi module to enable IoT connectivity. Sensor readings and system status are transmitted to a cloud platform, where data can be stored and analyzed. A mobile application or web dashboard provides users with real-time monitoring and insights into system performance. This connectivity ensures transparency, supports remote diagnostics, and allows for future integration with smart traffic management systems. The proposed methodology involves the automation logic into the microcontroller using programming.

Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 03 | March-2026
ISSN (O) 3107-6696



Limitations

The accuracy of the light intensity sensor can be affected by environmental conditions such as fog, rain, or dust, which may distort the detection of oncoming headlights. Additionally, variations in headlight brightness across different vehicle models can lead to inconsistent responses. These factors may reduce the system's reliability in certain real-world scenarios.

The system relies on stable internet connectivity for real-time data transmission and cloud integration. In remote or low-network areas, the IoT functionality may be limited, affecting monitoring and data logging capabilities. This constraint can hinder the system's performance in rural or underdeveloped regions where internet access is inconsistent.

Implementing the system in existing vehicles may require modifications to the headlight circuitry, which could be complex or incompatible with certain models. Moreover, the lack of standardized interfaces across vehicle manufacturers poses a challenge for universal adoption. These integration issues may limit the scalability of the solution without further customization.

Conclusion

The proposed IoT-based vehicle dipper light system effectively addresses the issue of high-beam glare during nighttime driving. By automating the headlight adjustment process using real-time sensor data, the system enhances road safety and reduces the risk of accidents caused by temporary blindness. The integration of microcontrollers and wireless communication ensures intelligent, hands-free operation.

This study demonstrates the potential of IoT in transforming conventional automotive systems into smart, responsive solutions. The use of cloud connectivity and mobile interfaces allows for real-time monitoring and data analysis, paving the way for future enhancements in intelligent transportation networks. The system's low-cost design and scalability make it suitable for widespread adoption across various vehicle types.

While the system shows promising results, further improvements can be made to enhance sensor accuracy and compatibility across diverse driving environments. Future research may explore integration with vehicle-to-vehicle (V2V) communication and adaptive lighting technologies. Overall, this study contributes to the advancement of smart mobility and promotes safer, more efficient driving experiences.

References

1. Srikanth, G., Sanjay Kumar, J., Manisha, K., & Shiva Shankar, B. "Smart Vehicle Headlight Auto Switching and Intensity Control." *JETIR Research Journal*.
2. Narasimha Reddy, B., Veera Sankara Reddy, G., Poornesh, P., Sanjeevini, P., & Pallavi, V. "Smart Vehicle Head Light Auto Switching and Intensity Control." *IJCRT*.
3. Patel, S., & Mehta, R. "Internet of Things Applications in Intelligent Transportation Systems." *International Journal of Computer Applications*.
4. Kumar, R., & Singh, A. "Adaptive Headlight Systems Using IoT for Smart Vehicles." *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*.