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## IDOI: 10.15680/IJIRSET.2025.1404264 Speed Adaptive Lighting and Alert System for Vehicle Safety

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**ABSTRACT**: Nowadays in India, we face many road accidents, in which many people suffer permanent damage and some even lose their lives. The key factors that cause these accidents are poor light conditions, inability to predict the speed of the vehicle, and upcoming drivers may be distracted by vehicle high beam lights. So it is necessary to address this issue. This paper discusses how vehicle safety is critically impacted by inadequate lighting and insufficient driver awareness of speed, often leading to accidents due to traditional fixed headlight intensity. That is not adaptable to vary according to the conditions. This paper seeks to address these issues by developing an innovative adaptive lighting and alert system designed to enhance vehicle safety both during the day and at night. The system is divided into two modes of operation, manual and automatic. The system utilizes an LDR to detect the lighting of vehicles. The LDR detects the upcoming vehicle light intensity hence automatically adjusting light intensity in the acceptable beam. LEDs are used as a headlamp illumination, due to its efficient illumination capability. By applying the stages of illumination of the headlamp, it can reduce the waste of illumination as well as charge of battery.

**KEYWORDS**: Speed Adaptive Lighting; Alert system; Light Intensity; LDR; Automatic Headlamp.

#### I. INTRODUCTION

Road accidents in India have become a serious and growing concern, leading to a significant number of injuries, disabilities, and fatalities each year. Among the many factors contributing to these accidents, poor visibility conditions, especially at night, play a crucial role. Inadequate street lighting, the inability to judge the speed of oncoming vehicles, and the excessive glare from high-beam headlights all contribute to unsafe driving environments. When high-intensity beams from an approaching vehicle hit a driver's eyes, it can cause momentary blindness, reducing their reaction time and increasing the risk of accidents. Additionally, conventional fixed-intensity headlights are unable to adjust based on real-time speed and road conditions, further exacerbating the problem. These challenges highlight the urgent need for an intelligent, adaptive solution that can improve night-time driving safety while minimizing the risks posed by improper vehicle lighting.

To address these issues, this paper introduces an Adaptive Lighting and Smart Alert System, a technology-driven approach aimed at optimizing vehicle illumination for safer driving conditions. The system is designed to dynamically regulate headlamp brightness based on real-time speed and road conditions, ensuring improved visibility without causing discomfort to other road users. The core of this system lies in its ability to detect the intensity of incoming vehicle lights through a Light Dependent Resistor (LDR), which automatically adjusts the brightness of the vehicle's headlights. This prevents excessive glare while maintaining sufficient illumination for the driver. Unlike traditional headlight systems that operate at a fixed intensity regardless of road conditions, this adaptive system enhances road safety by adjusting light output to suit the surrounding environment.

The proposed system operates in two modes: manual and automatic, allowing drivers to choose their preferred level of control over the headlight adjustments. In automatic mode, the system autonomously detects incoming headlights and modifies the illumination intensity in real-time, eliminating the need for driver intervention. In manual mode, the driver retains the ability to adjust the brightness settings based on personal preference and external lighting conditions. By





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incorporating LED technology as the primary headlamp illumination source, the system benefits from enhanced energy efficiency, longevity, and superior brightness control. LED headlights not only provide better illumination compared to traditional halogen lamps but also consume significantly less power, making them an ideal choice for modern adaptive lighting systems.

One of the key features of this system is its multi-stage illumination approach, which intelligently regulates light output based on necessity. This staged illumination mechanism ensures that only the required amount of light is emitted, reducing unnecessary energy consumption and prolonging battery life. This feature is particularly beneficial for electric and hybrid vehicles, where energy conservation plays a vital role in overall vehicle performance. Additionally, by preventing excessive headlight usage, the system helps reduce light pollution, contributing to a more sustainable and eco-friendly driving experience. Beyond adaptive lighting, the system also incorporates a smart alert mechanism designed to enhance driver awareness. Many accidents occur due to drivers failing to notice oncoming vehicles in time, particularly in low-visibility conditions. By integrating an intelligent alert system, the proposed solution provides real-time notifications to drivers, helping them respond proactively to potential hazards. This feature is especially useful on highways and rural roads, where visibility can be significantly reduced due to the absence of street lighting.

In conclusion, the Adaptive Lighting and Smart Alert System represents a significant advancement in vehicular safety technology. By dynamically adjusting headlamp brightness based on real-time road conditions and minimizing the adverse effects of high-beam glare, this system ensures a safer and more comfortable driving experience for all road users. The incorporation of LED-based adaptive lighting, multi-stage illumination, and a smart alert mechanism not only enhances visibility but also optimizes energy consumption, making it a practical and sustainable solution for modern vehicles. With further advancements in sensor technology and artificial intelligence, this system has the potential to be seamlessly integrated into future automotive designs, contributing to a smarter and safer transportation ecosystem.

#### **II. PROBLEM STATEMENT**

The vehicle drivers normally face the issue of temporary blindness due to high beams during the night. This temporary disruption in vision, often described as "glare" or "seeing spots," can significantly impair a driver's ability to see clearly, especially when facing oncoming traffic. This results in severe road accidents. The automatic headlight technology enhances road safety and driver comfort. However, there are still some challenges that need to be addressed. One main challenge is the cost of the technology, which may limit its adoption by some drivers or automobile manufacturers. The primary objective of this paper is to create a system that dynamically adjusts vehicle lighting based on speed and ambient light, while also offering alert-based cues for speed awareness on paper research.

#### **III. LITERATURE SURVEY**

The current automation discussed in the prior paper employs a traditional method for detecting vehicle speed, but this paper suggests utilizing an isolated system that incorporates an IR sensor, which offers greater efficiency and precision. This component is essential for the seamless operation of the vehicle from the control system's performance perspective. Headlamps are vital for enhancing the driver's visibility and ensuring safe driving. However, conventional headlights often fail to operate effectively and require manual operation. The goal of this paper is to design and create a headlight system that is automatically controlled to enhance safety while driving at night.

[1] "Design And Implementation Of Automatic Headlight Dimmer For Vehicles Using Light Dependent Resistor (LDR) Sensor" described that the paper outlines an automatic headlight dimmer that utilizes a Light Dependent Resistor (LDR) sensor to lower the brightness of headlights from oncoming cars, thereby minimizing impact on human vision. The system automatically transitions from high beam to low beam, reducing glare by detecting the light intensity from approaching vehicles and removing the need for the driver to manually adjust the headlights, which may be overlooked at times.

[2] "Development of Adaptive Front Light Systems" described that adaptive front light systems are designed to automatically modify the vehicle's headlamp beam in order to provide optimal illumination of the road ahead while minimizing discomfort for other drivers. The system proposed focuses on creating a prototype of an adaptive front lighting system that enhances nighttime visibility on curved roads for the driver. In this innovative approach, instead of





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relying on the steering wheel for horizontal adjustments of the headlamps, a camera is utilized as a sensor to facilitate the horizontal rotation of the headlamps. The camera acts as an image sensor to identify and capture the details of the curved road that lies ahead of the vehicle. Consequently, a more suitable light beam is generated, leading to improved illumination for curved roads. This advancement will enhance visibility and safety when navigating curved roadways.

[3] "Development of an Adaptive Headlamp Systems" described that the highest rate of fatal traffic accidents takes place on curved roads during nighttime. To improve safety while driving at night, this paper focuses on creating a prototype for steerable headlights by modifying a standard static headlamp with both cost efficiency and reliability. Various components that are readily accessible in the market and suitable for building a steerable headlight system were evaluated.

[4] "Automatic Headlight Dimmer a Prototype for Vehicles" explained that Glare at night while driving is a significant issue for motorists. The presence of glare can lead to a temporary loss of vision known as the Troxler effect. This paper focuses on designing and developing a prototype circuit referred to as the automatic headlight dimmer. This system allows drivers to utilize high beam lights when needed, but it automatically shifts to low beam when it detects an oncoming vehicle. In the end, glare plays a major role in causing accidents during nighttime.

[5] "Nighttime Vehicle Light Detection on a Moving Vehicle using Image Segmentation and Analysis Techniques" described A vehicle detection system is designed to recognize vehicles by detecting their headlights and taillights in a nighttime roadway setting. The suggested system consists of two phases for recognizing vehicles in front of a camera-equipped car. Initially, the system differentiates bright objects on the road, after which these bright objects undergo the proposed knowledge-based connected-component analysis method to locate the vehicle lights and estimate the distance from the camera-equipped car to the identified oncoming vehicles.

[6] "Automatic Headlight Beam Control System" proposed a system that offers advantages over traditional front lighting systems by conserving battery usage and automatically managing beam switching, thereby reducing the effort required from drivers. The Automatic Headlight Beam Control System (AHBCS) improves safety and convenience while driving by automatically turning headlights on and off and adjusting beam intensity. It includes two sensors: one oriented forward and another positioned perpendicular to the road's surface. This emphasizes the advancements and innovative characteristics of the AHBCS, along with its benefits for drivers.

[7] "Universal Adaptive Headlight System" explained that the accidents primarily occur at night due to the inadequacies of traditional headlight systems. This proposed solution addresses the issues with standard headlight systems by incorporating LEDs into the headlamps. Conventional headlight systems typically offer only two lighting options: low beam and high beam. The innovative design proposed regulates the headlight beams using LEDs. In this system, the angle of the beams is adjusted based on the position of the steering wheel. A relay circuit is employed to power the LEDs. LEDs are chosen for their efficiency in power usage. Additionally, this system is straightforward to implement.

[8] "Adaptive Headlight System For Accident Prevention" described that Automobiles are designed with headlights that illuminate the road ahead but often fail to adequately light turns. This limitation can result in inadequate visibility and difficulty seeing objects on curved roads, particularly during late-night driving. Therefore, the primary objective of this system is to provide a cost-effective solution for illuminating blind spots during nighttime travel and in conditions of significantly reduced visibility, enhancing safety in these dark areas and helping to prevent accidents.

[9] "Adaptive Lighting System For Automobiles" described that When driving at night on the highway, a high-intensity light beam is essential for illuminating the road ahead. However, this can create glare for drivers of oncoming vehicles, leading to temporary blindness and a dazzling effect that poses significant challenges for nighttime driving. To mitigate this issue, dual-filament bulbs are used, which incorporate a separate filament positioned to deflect the light beam both downward and sideways, thereby reducing the risk of blinding drivers in approaching cars.

[10] "Development of Vehicle Lighting System Using LED Application" examines the progress made in LED lighting systems for vehicles. Enhancements in LED technology have established them as a more efficient alternative to incandescent and halogen bulbs, resulting in reduced power usage while providing high levels of brightness. Researchers have integrated LED lighting with control systems such as Pulse Width Modulation and DC-DC converters





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to effectively regulate brightness levels. Additionally, research on Buck and Boost converters has focused on optimizing LED power efficiency across various battery voltage conditions.

[11] "Automatic Dipper Light Control For Vehicles" proposed that "Automatic Dipper". In this method during nighttime, when driving through urban areas, abundant lights can impact the device's performance; therefore, the mode can switch to manual to prevent headlight flickering. When both vehicles are equipped with the "Automatic Dipper," they effectively lower their headlight beams towards each other.

#### **IV. PROPOSED METHODOLOGY**

The first crucial step in implementing the research paper on Speed-Adaptive Lighting and Alert System for enhanced vehicle safety is information searching. This step involves collecting knowledge on existing adaptive lighting systems, sensor technologies, speed indicators, and safety data related to vehicle accidents. A key focus is on how adaptive lighting can improve visibility under varying conditions, such as day and night, and how auditory cues for speed can support driver awareness and safety. This paper reviews the aims to reduce accidents by improving visibility and ensuring drivers maintain appropriate speeds through auditory signals.

The proposed methodology starts by identifying the problem: the need for an adaptive system that enhances safety by adjusting lighting based on the vehicle's speed and surrounding light levels. The solution involves designing a system that dynamically adjusts headlight intensity and uses auditory feedback to alert the driver about their speed. The system's design concept in controlling LED Headlight brightness is shown in Fig(4.1) The system consists of three main parts which are the LED Controller circuit, Sensing circuits, and Transmission Unit. These parts are used to build up the system of adaptive lighting for vehicles.

4.1 The proposed Block Diagram of the system is shown in the below figure.



Fig. 4.1: Basic Block Diagram of System





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The proposed Flow Chart Diagram of the system is shown in the figure below.



Fig. 4.2 : Flow Chart of the System

#### **Expected Results**

- A. Enhanced visibility for drivers during both daytime and nighttime conditions, thereby reducing the probability of accidents.
- B. Improved driver awareness of vehicle speed through the implementation of auditory alerts.
- C. Elevated overall safety and comfort levels during driving, contributing to a more secure driving experience.

#### **V. CONCLUSION**

This paper shows the aims to significantly enhance vehicle safety by implementing advanced adaptive lighting systems that adjust according to the vehicle's speed, measured in kilometres per hour (km/h). In addition to improved visibility, the system will also incorporate speed-indicating tones that vary based on the time of day, ensuring that drivers receive appropriate auditory cues during both daytime and nighttime driving conditions. By optimizing lighting conditions to match speed and surrounding environments, this technology helps drivers maintain high levels of awareness and visibility, thereby decreasing the likelihood of accidents. Furthermore, this paper underscores the critical importance of safety features in the automotive sector, where the effective application of these technologies can play a pivotal role in enhancing overall vehicle safety.

#### REFERENCES

[1] Okrah. S. K., Williams. E. A., Kumassah. F., "Design And Implementation Of Automatic Headlight Dimmer For Vehicles Using Light Dependent Resistor (LDR) Sensor," International Journal of Emerging Technology and Innovative Engineering Volume 2, Issue 4, April 2016 (ISSN: 2394 – 6598)

[2] Snehal G. Magar, "Development of Adaptive Front Light Systems," International Journal of Engineering Research & Technology (IJERT) IJERTIJERT ISSN: 2278-0181 IJERTV3IS111186 www.ijert.org Vol. 3 Issue 11, November-2014.

[3] Meftah Hrairi and Anwar B. Abu Bakar, "Development of an Adaptive Headlamp Systems," International Conference on Computer and Communication Engineering (ICCCE 2010), 11-13 May 2010, Kuala Lumpur, Malaysia.

[4] Muralikrishnan.R<sup>1</sup>, "Automatic Headlight Dimmer A Prototype For Vehicles," International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321-7308 Volume: 03 Issue: 02 | Feb-2014 p.85-90.

[5] Yen-Lin Chen, "Nighttime Vehicle Light Detection on a Moving Vehicle using Image Segmentation and Analysis Techniques," Wseas transactions ON computers ISSN: 1109-2750 Issue 3, Volume 8, March 2009.

[6] Vithalkar Akshay Ganesh, Khavare Vinayak Vittal, Maitshaphrang Syiemlieh, "Automatic Headlight Beam Control System," International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 3, Issue-7, July-2015





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#### Volume 14, Issue 4, April 2025

#### |DOI: 10.15680/IJIRSET.2025.1404264|

[7] Jyotiraman De, "Universal Adaptive Headlight System". IEEE International Conference on Vehicular Electronics and Safety (ICVES) December 16-17, 2014. Hyderabad, India.

[8] Shreyas S, Kirthanaa Raghuraman, Padmavathy AP, S Arun Prasad, G.Devaradjane, "Adaptive Headlight System for Accident Prevention". International Conference on Recent Trends in Information Technology. 29 December 2014

[9] Abhinandan Suryawanshi<sup>1</sup>, Shashank Sawane<sup>2</sup>, Nikhil Walsane<sup>3</sup>, Prof. C. K. Bhange, "Adaptive Lighting System For Automobiles," International Journal of Advance Scientific Research & Engineering Trends, Volume 5 || Issue 12 || April 2021 || ISSN (Online) 2456-0774

[10] Asmarashid Ponniran<sup>1</sup>, Azila Nor Azrani Mat Sor<sup>1</sup>, Ariffuddin Joret<sup>1</sup> and Handy Ali Munir<sup>2</sup>, "Development of Vehicle Lighting System Using LED Application," International Journal of Integrated Engineering, Vol. 3 No. 2 (2011) p. 11-15.

[11] Tejas Vijay Narkar, "Automatic Dipper Light Control For Vehicles," International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308 | Volume: 05 Issue: 03 | Mar-2016









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