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THE IMPORTANCE OF SMART LIGHTING AND SENSOR SYSTEMS FOR IMPROVING VEHICLE VISIBILITY (IN THE CONTEXT OF DARKNESS AND ADVERSE WEATHER CONDITIONS)

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ANNOTATION:

This article analyzes innovative solutions aimed at improving the visibility of vehicles in dark conditions and adverse weather (fog, rain, snow). It highlights the effectiveness of smart lighting and sensor systems powered by Artificial Intelligence (AI), Infrared (IR) technologies, and the Internet of Things (IoT). These intelligent systems enhance vehicle visibility, increase safety, save energy, and provide real-time alerts to drivers. The article also discusses the integration of IoT and AI technologies into transportation systems, enabling vehicle condition monitoring and automatic decision-making. Such systems play a crucial role in preventing road accidents under poor weather conditions. The article calls for the expansion of advanced systems aimed at enhancing transportation safety and visibility through innovative technologies.

KEYWORDS: *smart lighting system, artificial intelligence (AI), infrared technologies (IR), Internet of Things (IoT), sensor systems, transport safety, fog, real-time monitoring, energy saving, automatic decision-making, road traffic accidents.*

INTRODUCTION: Adverse weather conditions—particularly fog, rain, snow, or strong winds—can significantly reduce the visibility of vehicles. This poses serious risks for drivers and passengers and can, in some cases, lead to road traffic accidents and fatalities. In such circumstances, improving vehicle visibility and ensuring safety becomes critically important. Today, the advancement of technology—especially innovative approaches such as Artificial Intelligence (AI), Infrared (IR) technologies, and the Internet of Things (IoT)—offers effective solutions to address this issue.

The Importance of Smart Lighting and Sensor Systems: Smart lighting and sensor systems play a vital role in ensuring safety in transportation systems. Smart lighting systems can automatically adjust the intensity and brightness of lights, enhancing vehicle visibility during dark or adverse weather conditions. Sensor systems enable real-time monitoring of vehicle movement and surrounding environmental conditions.

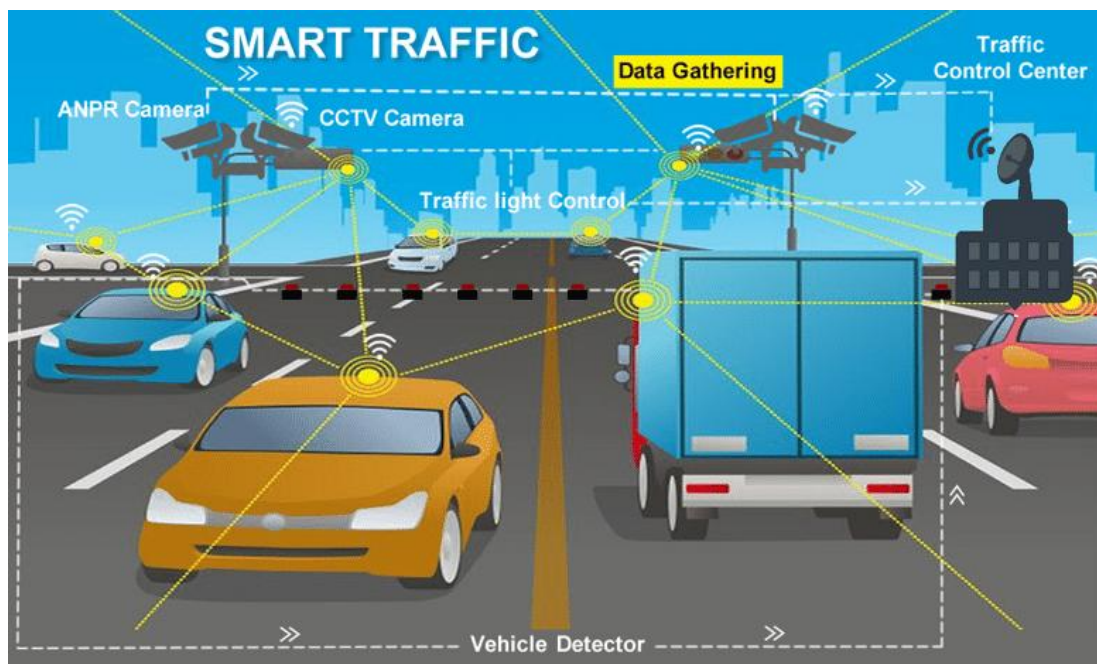


Figure 1. Smart Road Lighting System

The Role of Artificial Intelligence (AI) Systems: Artificial Intelligence enables real-time decision-making in transportation systems by analyzing various types of data. For example, AI-powered smart lighting systems can automatically detect moving vehicles and adjust the lighting level accordingly. This is especially useful in dark or foggy conditions, as AI systems ensure the proper visibility of moving vehicles.

Infrared (IR) Technologies: Infrared technologies play a significant role in enhancing vehicle visibility. Infrared cameras and sensors can detect moving objects even in areas where visible light cannot penetrate, such as during darkness or fog. These systems are often used to prevent road accidents associated with hazardous weather conditions.

Internet of Things (IoT) Systems: IoT technologies enable real-time data exchange in transportation systems. Each vehicle and its surrounding environment can be equipped with IoT devices to monitor road conditions, weather, temperature, and humidity. Through these devices, the transportation system can be integrated with other systems and send critical alerts to drivers and traffic management authorities about potentially dangerous situations.



Figure 2. Schematic View of an IoT System

Sensors and Their Integration: Sensor systems enable the monitoring of environmental changes and allow for rapid response. For example, in foggy or snowy weather conditions, lighting systems can automatically adjust based on the vehicle's location and road conditions. This greatly helps ensure effective visibility for each vehicle and enhances overall safety.

Benefits of Smart Lighting Systems: In addition to improving vehicle visibility, smart lighting systems also provide energy-saving capabilities. These systems adjust according to temperature and light conditions, ensuring that lighting is used only when necessary, thereby reducing energy consumption. Furthermore, the system automatically regulates road lighting levels, offering drivers better visibility.

Smart Systems Based on IoT and AI: The integration of IoT and AI technologies enhances the efficiency of both vehicles and lighting systems. The IoT system transmits data from vehicles to AI-based systems, which in turn improve safety and visibility. These smart systems help manage traffic automatically, adjust lighting systems, and prevent dangerous weather-related situations.

CONCLUSION: Smart lighting and sensor systems based on Artificial Intelligence (AI), Infrared (IR) technologies, and the Internet of Things (IoT) offer effective solutions for improving vehicle visibility in dark and adverse weather conditions. These technologies enhance transportation safety, save energy, and provide real-time alerts to drivers. Moreover, they play a crucial role in preventing road traffic accidents. In the near future, the continued development and widespread implementation of these technologies will significantly contribute to improving the safety of transportation infrastructure.

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