IoT driven automatic vehicle speed reduction system using arduino and RF technology

***Abstract*- India, ranking highest in terms of fatalities among 207 countries according to the World Road Statistics (WRS) of 2020, faces a pressing issue with road accidents, with a significant 74% attributed to excessive speeding as reported in the 2021 road accident report. To tackle this problem, the government has mandated the incorporation of safety technology, including over speed warning systems, in vehicles. While current solutions involve costly and inefficient implementations utilizing artificial intelligence (AI), Internet of Things (IoT) sensors, Light Detection and Ranging (LiDAR) technology, and the Controller Area Network (CAN) protocol, our proposed model offers a cost-effective and efficient alternative. Emphasizing integration of speed reduction and obstacle detection, particularly in vulnerable areas like schools and hospitals, our solution aims to mitigate road accidents resulting from human error.**

***Keywords*-*Artificial Intelligence,Light detection and ranging (LiDAR),Controller Area Network(CAN).***

**INTRODUCTION**

In the contemporary era, the challenge of maintaining and controlling vehicle speeds has emerged as a significant issue, leading to accidents resulting from reckless driving or excessive speed. The "IoT-driven Vehicle Speed Reduction System" project aims to address this problem by regulating vehicle speed in various zones.

The primary objective of this project is to implement a system that effectively limits and manages vehicle speed within specific mapped areas, facilitated by the RF module. These areas typically include schools, colleges, educational institutions, medical facilities, hospitals, bustling markets, highways, and residential neighborhoods—zones characterized by high traffic volume and associated road risks. Thus, there is a critical need for a structured solution to enhance safety in such areas, ultimately preventing numerous unnecessary fatalities and injuries resulting from accidents.The concept involves implementing area-based speed control for vehicles using RF transmitter and receiver modules. Transmitters are placed in designated areas where vehicle speed limits need regulation. These transmitters emit signals received by receivers installed within vehicles, facilitating speed control. Upon entering a mapped area, vehicle speed is reduced to a predetermined limit and

maintained until exiting the zone. Subsequently, drivers resume control based on traffic regulations. This project aims to enhance road safety in specified areas through area-based speed control. Obstacle detection and avoidance constitute crucial elements for any autonomous land vehicle. Ensuring the flawless ability of an autonomous system to navigate safely around obstacles is paramount to prevent potential harm to the driver or pedestrians. Therefore, it is essential to comprehensively assess all available methodologies for ensuring the secure maneuvering of a vehicle.

Obstacle detection can be seamlessly integrated into IoT-based automatic vehicle speed reduction systems through a variety of techniques. These include employing methodologies such as the Single Shot Multibox Detector (SSD) method and MobileNet V2 architecture. Additionally, integration can involve utilizing Inertial Measurement Units (IMUs) in conjunction with roadside unit detection, as well as implementing adaptive neighborhood search radius clustering algorithms and LiDAR technology. These techniques collectively enhance the capability of the system to detect obstacles efficiently and adjust vehicle speeds accordingly, thereby contributing to improved road safety.

By integrating advanced obstacle detection techniques into the IoT-driven Vehicle Speed Reduction System, we can significantly enhance road safety in high-risk areas, effectively mitigating the risks associated with reckless driving and excessive speed.

**RELATED WORK**

The paper presents a system for controlling vehicle speed in specific zones using an Arduino Uno board. Vehicle speed adjustments are made based on input signals from the receiver, with a speed encoder sensor facilitating speed modification. The proposed system also includes Electrocardiogram and Photoplethysmogram sensors in the transmitter unit.[1]

The system uses various technologies such as Arduino-based microcontroller boards, wireless communication technology Zigbee, Raspberry Pi boards, and image processing. The system can automatically control the speed of vehicles by receiving signals from transmitter units placed in the zones and decoding them in the receiver units in the vehicles [2][3][4][5]. Additionally, the system can also include features like object detection to prevent accidents and automatic illumination of street lights in low light conditions [6]. The primary goal of this approach is to reduce accidents caused by over-speeding and improve safety in speed-restricted areas .

Obstacle detection for vehicles is an important component of intelligent assisted driving technology. Various methods have been proposed to achieve accurate obstacle detection. Xu et al. propose a method that combines monocular camera IMU and roadside unit detection to achieve generalized obstacle classification and reduce the complexity of the detection area [7].Ci et al. propose a method based on the local spatial features of point clouds, which estimates the probability of

obstacles using spatial feature information and transforms the results into a multi-layer representation [8]. Orr presents an algorithm that uses a fast and accurate object detection model to detect forward obstacles and propose new directions for the UAV to avoid them [9]. Adhiyaman and Balasundaram perform a detailed study on obstacle detection methodologies and ways to avoid collision, providing a mapping of the domains and subdomains used for obstacle detection and avoidance [10][11]..

An obstacle detection system can be integrated with a zone-based automatic vehicle speed reduction system to enhance safety and efficiency on the road. By utilizing technologies such as ultrasonic sensors, millimeter wave signals, and TOF distance measuring sensors, the system can accurately detect obstacles in the vehicle's surroundings [12][13][14]. The distance of the obstacle is measured, and the vehicle's speed is reduced accordingly through the implementation of protocols such as Controller Area Network (CAN) [15]. This integration allows for real-time monitoring and control of the vehicle's movement, ensuring collision avoidance and obstacle detection in a large area range [16]. The system can also display the position of the detected obstacle, enabling the driver to take appropriate collision avoidance measures . Overall, this integration of zone-based automatic vehicle speed reduction with obstacle detection provides a comprehensive solution for safe and efficient driving .The system has been tested and proven effective in various experimental settings [17][18][19].

**PROPOSED METHODOLOGY**

This paper introduces a new proposed approach for an automatic vehicle speed reduction system driven by IoT, employing Arduino and RF technology, and incorporating obstacle detection. The primary objective is to improve vehicle safety and minimize accidents by autonomously regulating the vehicle's speed in response to obstacle detection. The system employs Arduino technology, ultrasonic sensors, and RF transmitters and receivers to identify obstacles and manage the vehicle's speed. The precision and dependability of the system are guaranteed through the application of ultrasonic sensors and a logical design for obstacle avoidance.

**A. Automatic Vehicle Speed Reduction System**

The underlying principle of this automatic vehicle speed reduction system is simple, involving sensors, an Arduino microcontroller, and actuators. A speed sensor constantly observes the vehicle's speed, transmitting real-time data to the Arduino. Through a user interface, the driver establishes a preferred speed. If the actual speed exceeds this preset value, the Arduino activates actuators, such as electronic throttle control or braking systems, to decrease the vehicle's speed. This closed-loop feedback system guarantees that the vehicle stays at a secure and predetermined speed, contributing to overall road safety.

**B. Obstacle Detection**

Detection of obstacles depends on sensors that recognize objects in the system's proximity. In this approach, ultrasonic sensors play a key role, emitting sound waves and measuring the time it takes for the waves to return after bouncing off an object, thereby determining the object's distance. The microcontroller, specifically an Arduino, processes the collected sensor data and initiates specific actions, such as activating alarms, upon detecting obstacles. This method ensures effective obstacle detection and response, showcasing the versatility of ultrasonic sensors and Arduino microcontrollers in enhancing safety and automation across various applications.

**C. Arduino Module**

The utilization of Arduino in this automatic vehicle speed reduction system involves its role as the central processing unit, coordinating speed control functions. The system integrates a continuous speed sensor to monitor the vehicle's speed, with the Arduino processing this data and comparing it to a predetermined speed set by the driver via a user interface. In instances where the actual speed exceeds the preset value, the Arduino activates actuators, such as electronic throttle control systems or brake actuators, to decrease the vehicle's speed. The user interface provides drivers with the ability to interact with the system, allowing them to set desired speeds or intervene manually as needed. Safety features, including emergency braking capabilities and alert systems, are commonly embedded in the Arduino programming to prioritize system safety. Ensuring compliance with safety regulations is crucial during system implementation, and collaboration with automotive professionals may be essential for seamless integration with specific vehicle architectures.

**D. RF technology Module**

**E. Ultrasonic sensor**

**F. Integration of AVRS and OD**

**RESULT AND DISCUSSION**

**CONCLUSION**

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