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AUTOMATIC VEHICLE SPEED LIMITER AND TOLLDETECTION USING RFID TECHNOLOGY

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ABSTRACT
As the number of automobiles on the roads continues to increase, reducing traffic accidents has become a critical issue. One major cause of accidents is the violation of traffic laws, particularly speeding. This article proposes a solution to mitigate speed-related road accidents by introducing a variable speed control system for vehicles, especially in protected or restricted areas such as busy streets, school zones, and hospital vicinities. Unlike current methods that control vehicle speed at a fixed value, this study suggests an integrated approach that allows vehicle speed to be adjusted dynamically according to the maximum permissible limit in specific areas. The proposed system integrates RFID technology with GPS location tracking within vehicles, ensuring that the vehicle speed corresponds to the posted speed limit in each area. The model employed in this study is similar to the energy management system of a car, incorporating a speed limit feature. As a vehicle approaches an RFID-tagged speed limit zone, its RFID reader detects the tag's identification mark and automatically adjusts the vehicle's speed accordingly. Additionally, the study simulates speed control using GPS data to address the limitations of RFID and proposes solutions to enhance the security of RFID tags. By implementing this integrated approach, the study aims to significantly reduce speed-related accidents and improve overall road safety in sensitive and high-risk areas.
Keywords: RFID, GSM, GPS, Over speeding, speed control, Arduino, LCD display.

I. INTRODUCTION
In the current circumstances, accidents are the result of rash driving, lack of proper age limits, and insufficient knowledge of driving and safety regulations. This leads to significant destruction and loss of life. According to a survey conducted by the WHO, nearly 450,000 accidents occur in India, resulting in 150,000 injuries each year. In 2022, speeding was identified as the most common cause of road accidents, accounting for 72.3% of accidents and 71.2% of deaths. Government departments have taken steps to control and monitor vehicle speeds on public roads. However, these measures have not been efficiently implemented. Currently, the road transport division uses laser speed detectors and radars, which require personnel to operate them on-site. This method is not ideal for continuous monitoring, as it is time-consuming and costly.

To address these issues, we aim to develop a system that controls vehicle speed based on the speed limit in a simpler and more cost-effective manner. This system operates independently of human intervention and functions 24/7 without fail. Initially, a laser module was considered, but it was deemed too expensive. IR sensors were found to be easier to design and cost-effective, but their primary drawback was that they only worked in the line-of-sight region. Finally, RFID was identified as a well-performing, efficient, reliable, and cost-effective solution. In this work, the system uses RFID communication as the primary component to control vehicle speed. The system identifies designated speed limits associated with specific locations or zones, and the vehicle's speed is automatically restricted to comply with these predefined limits. This mitigates the risk of accidents and promotes adherence to speed regulations. This innovative solution seeks to address concerns related to speeding, especially in zones with varying speed restrictions, ultimately contributing to safer and more controlled traffic conditions.

II.LITERATURE REVIEW
Ref [1] introduced strategies to improve road safety and driver health, including integrating GPS systems with truck and bus speed limits, safety assessment engineering, and applied fatigue testing.

This approach aims to improve vehicle maintenance, verify adherence to safety guidelines, and reduce traffic accidents. Ref [2] proposed a vehicle security system that integrates GPS/GSM technology for tracking, speed control, and monitoring using a camera. The suggested DRL model learns many discrete speed limits in a continuous action space by utilizing a new actor-critic architecture suggested by Ref [3]. Ref [4]'s proposal includes employing high-quality driving data to examine the relationship between safety-related factors and driver crashes. Ref [5] proposed a method that includes vehicle detection, tracking, refinement, and speed validation. Ref [6] used a normal distribution to model the relationship between boat speed and traffic, showing that the current speed limit in the Shanghai section of the Yangtze River is reasonable. Ref [7] proposed a method incorporating a hybrid approach based on reinforcement learning (RL) and disturbance observer (DOB) for speed limit control. Ref [8] developed a method for creating a speed-limiting system on toll roads that involves needs analysis, design development, and implementation stages. Ref [9] proposed a method that utilizes a computer vision approach to detect vehicle speed using a video camera and optical sensor, providing precise results with an error of less than 7%. Ref [10] presented a method that involves extending input rates and torques, conducting lubrication system studies, and testing dynamic behavior throughout the entire design speed range. A method to enhance the effectiveness of the Advisory Intelligent Speed Adaptation System by introducing the Speed Limit Compliance Index (SLCI) is suggested by Ref [11].

III.EXISTING METHOD

Implementation of the innovative design of automatic speed limiter device for trucks and buses based on road location analysis

The automatic speed limiter device for trucks and buses has a novel design that employs road location analysis to restrict speed. It uses GPS to trigger a relay that shuts off fuel flow. Different speed restrictions can be applied to pedestrians, highway, and toll roads depending on the location of the vehicle thanks to this technology, which enables automatic speed limit adjustments. After testing on a variety of roads, the device was shown to be successful in regulating speed, with average speeds of 32 km/h on pedestrian roads, 58 km/h on interstate roads, and 52 km/h on toll roads. According to the research, the device can help improve driver behavior and compliance with traffic laws, which will improve road safety and lower the number of truck and bus accidents.

Demerits of the existing system

Reliability: The system's effectiveness may rely heavily on the accuracy of road location analysis, which could be impacted by factors such as GPS signal reliability, map inaccuracies, or changes in road conditions.

False Positives/Negatives: There's a risk of the system incorrectly identifying road conditions or speed limits, leading to either unnecessary speed restrictions or allowing vehicles to exceed safe speeds.

Technological Limitations: The device's functionality could be limited by the available technology, such as sensor accuracy or processing power, potentially resulting in suboptimal performance.

Cost: Implementing and maintaining such a system could be expensive, especially for smaller trucking or transportation companies, potentially leading to increased operational costs.

User Acceptance: Drivers may resist the use of speed- limiting devices, perceiving them as restrictive or intrusive, which could lead to morale issues or even non-compliance.

Legal and Regulatory Challenges: There may be legal or regulatory hurdles to overcome, such as ensuring compliance with local traffic laws or obtaining approval from relevant authorities for the use of such technology.

Maintenance and Support: Regular maintenance and updates would be necessary to ensure the system's continued effectiveness, which could pose logistical challenges for fleet operators.

IV. PROPOSED MODEL

RFID is an auto-identification invention that uses radio waves to determine an object's identity or that of a person. The essential elements that comprise a normal RFID framework incorporate a transponder,

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also known as a tag in which a unique serial code is stored on a microchip that transmits when vital through a connected radio wire and the RFID reader which is used to obtain and identify the information provided by labels. RFID technology is as of now utilized in a few transport-related utilizations like vehicle stopping or

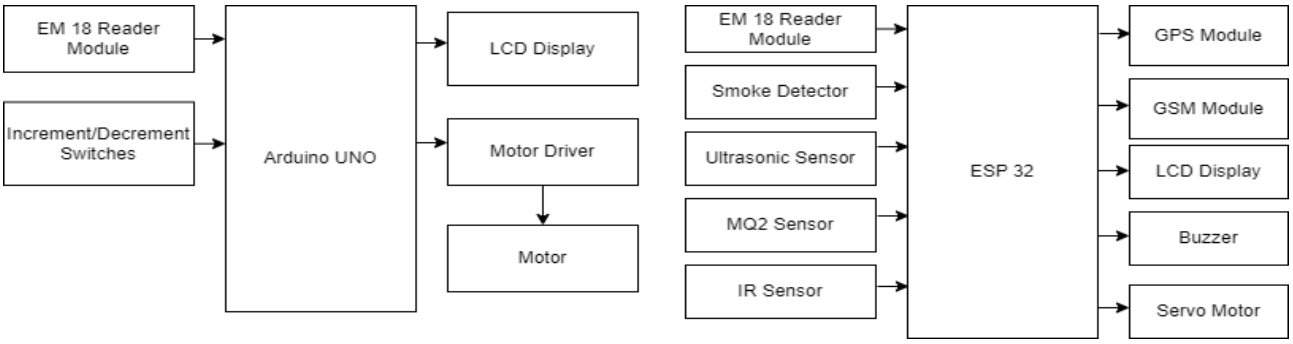

Fig 1. Proposed Model

discovery frameworks, where labels are joined to vehicles and perusers or sent at control focuses on recognizing the vehicles passing by transitory speed constraints can be effortlessly presented by changing or implementing unused labels, it'll be less complex, cheaper, and less demanding to preserve. Our strategy involves using RFID to collect data on speed limit violations on the road, warn drivers when they are speeding, and subsequently limit the speed of the vehicle. In any case, given that is the street-side gadgets that are giving the data, we are inquisitive about utilizing RFID in an inverse way to current frameworks by finding labels on the street side and receiver in automobiles. In our inquiry about the velocity constraint, we put it on RFID labels, which will be implanted on certain areas of the street lanes. A peruser installed inside the car will retrieve the relevant speed restriction data from the labels when the vehicle passes such a surface location on a specific roadway. That data seems at that point to be demonstrated on a car show, or we utilized a driver caution framework to embrace the driver they are speeding. Our framework would be suited for all zones and its speed limit readings would be reliable in all climate circumstances without requiring tuning into satellites or base stations. Unused street plan Temporary speed constraints can be effectively prevented by altering or actualizing modern labels; it'll be easier, cheaper, and less demanding to preserve.

Tollgate detection using RFID technology involves placing RFID readers at toll booths and equipping vehicles with RFIDtags. When a vehicle approaches the toll gate, the RFID readerdetects the tag and processes the toll payment electronically,allowing for seamless and efficient toll collection without the need for manual intervention. This method can improve trafficflow and reduce congestion at toll booths. Additionally, it provides a convenient and cashless payment option for drivers.

I. FLOW CHART

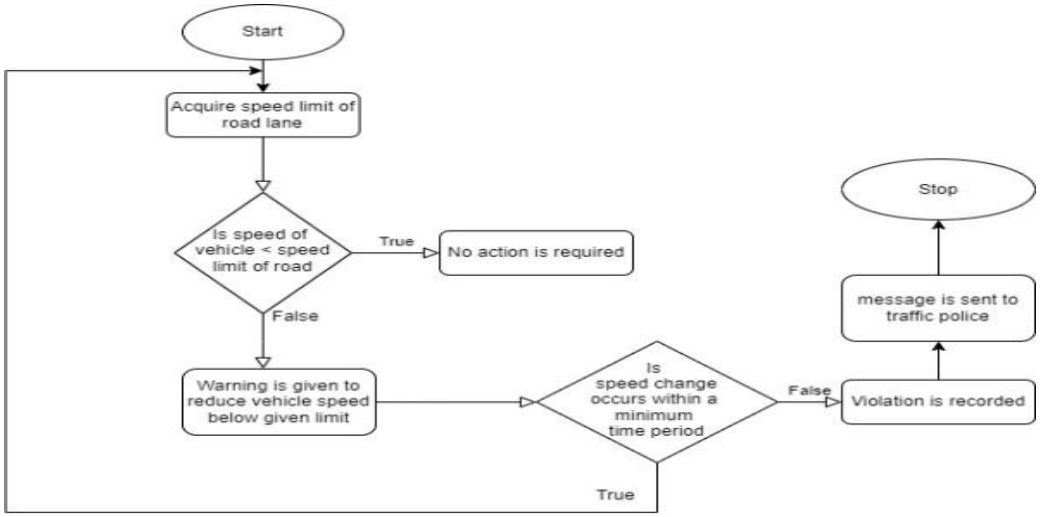

Fig. 2. The flow chart of proposed system

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V.HARDWRE DESCRIPTION

A.Arduino

Arduino is an open-source microcontroller based on the ATmega 328p microcontroller. It is one of the most popular platforms used for Internet of Things (IoT) connectivity. The Arduino board includes circuit breakers, crystal oscillators, voltage regulators, and other components. It features 2 kB of RAM, 1 kB of ROM, and 32 kB of Flash memory, and can be easily programmed using the Arduino IDE software.

The Arduino board provides several GND pins for grounding circuits, as well as voltage supply pins: a 5V pin supplying 5 volts and a 3.3V pin supplying 3.3 volts. Arduino products are available with voltage ranges from 3.3 volts to 5 volts.

The board also includes analog input pins (labeled A0 to A5 on the UNO) found in the "Analog Input" section, and digital pins (labeled 0 to 13) which are used for digital inputs and outputs. These digital pins can signal inputs like button presses and outputs like power semiconductor diodes. Additionally, some digital pins can function as Pulse Width Modulation (PWM) pins for controlling devices like servos.

Arduino's versatility and ease of use make it a favorite for developing IoT projects. Its robust ecosystem supports seamless integration into various applications, such as supply chain management and product life cycle management, making it a crucial tool for IoT development.

Fig 3. Arduino uno

B *LCD Display*

Liquid crystals are the main component of LCDs, or liquid crystal displays, a type of flat panel display. The definition of LCD comes directly from its name: it is the fusion of two different states of matter, liquid and solid. LCDs use liquid crystals to create a visible image. Displays made with LCD technology can be significantly thinner than those made with cathode ray tube (CRT) technology.

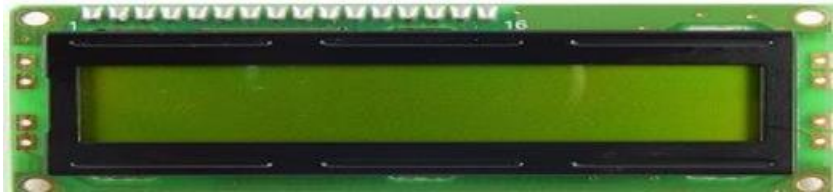

Fig 4 : LCD Display

C.EM 18 Reader

The EM-18 RFID reader module is a popular RFID (Radio Frequency Identification) reader module commonly used for reading RFID tags. It operates at a 125 kHz frequency and can be easily

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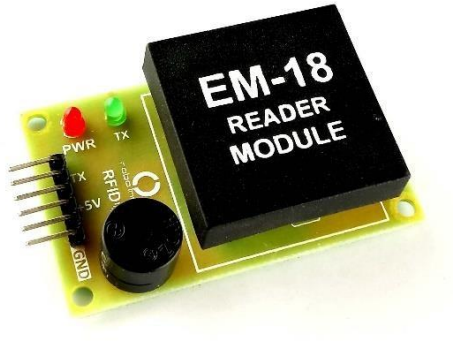

Fig 5 .EM 18 Reader

interfaced with microcontrollers like Arduino for various applications such as access control systems, attendance systems, inventory management, etc.

D.*Motor Driver*

A motor module known as a motor driver enables simultaneous control over the speed and direction of two motors. The L293D IC serves as the foundation for the creation and development of this motor driver. The L293D is a 16-pin motor driver integrated circuit designed to supply drive currents in both directions at voltages between 5 and 36 volts.

ESP32 is a potent microcontroller built by Espressif Systems. Due to its dual-core processor, integrated Bluetooth and Wi-Fi, numerous GPIO ports, and support for multiple communication protocols, it is commonly used in various applications.

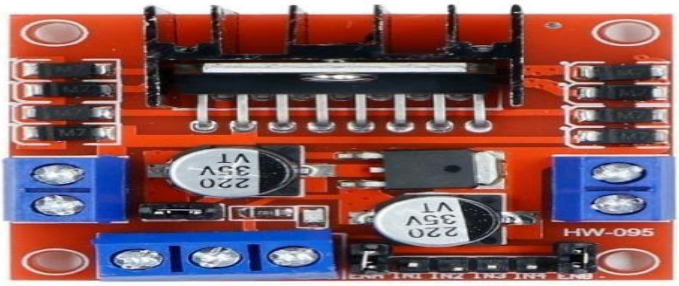

Fig 6. Motor Driver

E. *ESP 32*

ESP32 is a potent microcontroller built by Espressif Systems. Due to its dual-core processor, integrated Bluetooth and Wi-Fi, numerous GPIO ports, and support for multiple communication protocols, it is commonly used in Internet of Things (IoT) projects. Smart gadgets, home automation, sensor networks, and other projects are among the many uses for the Esp32.

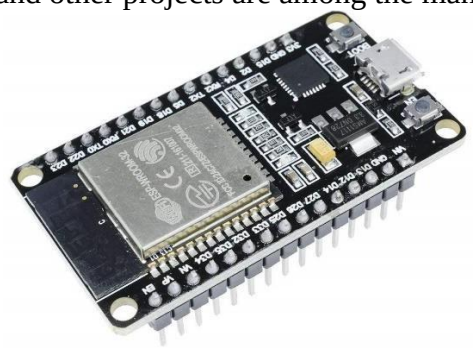

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Fig 7.ESP 32

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VI.RESULTS & ANALYSIS

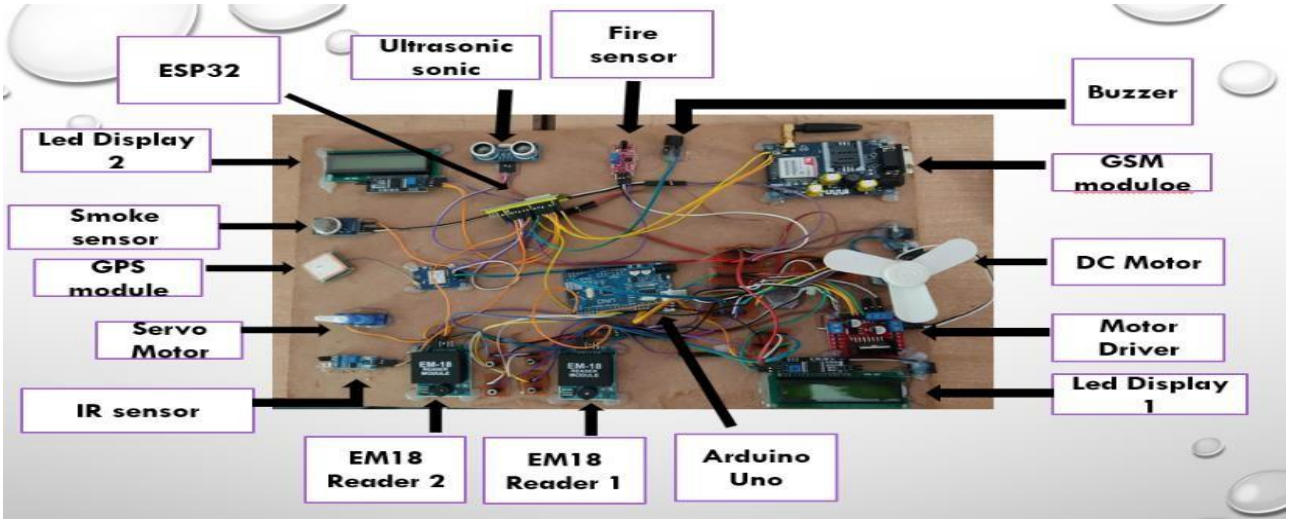

Fig8. Top View of the system of the complete system

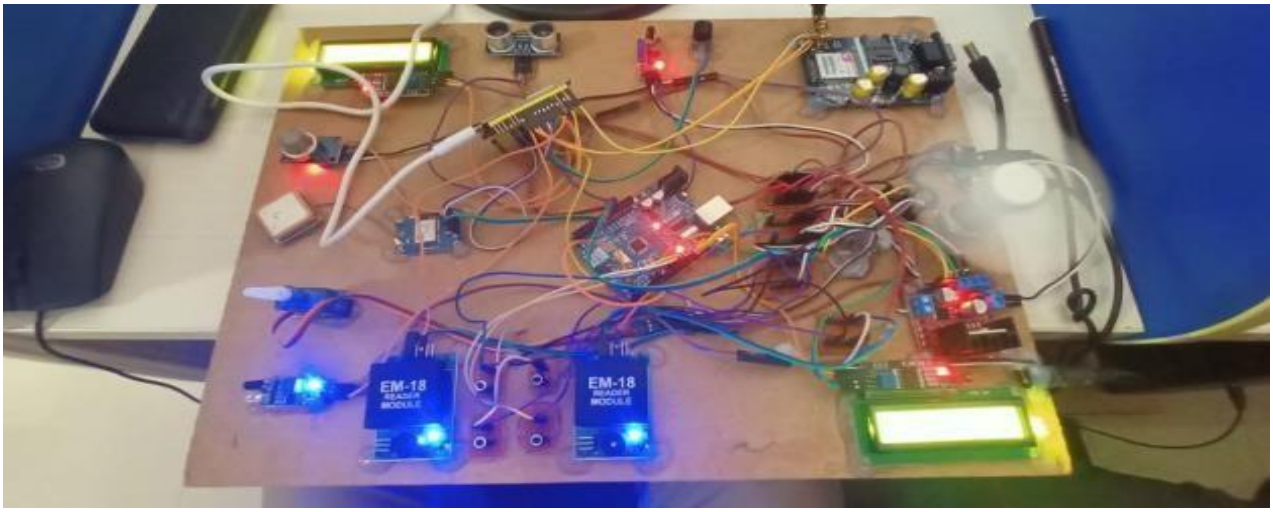

Fig9.Working model of proposed system

The proposed RFID-based speed control framework effectively alters vehicle speeds in restricted areas like schools and clinics, ensuring compliance with speed limits by automatically adjusting vehicle speed upon entering these zones. This framework enhances public safety by proactively regulating vehicle speeds. However, challenges such as RFID range extension and integration with existing infrastructure need to be addressed for effective implementation. Conducting inquiries is essential for assessing the system's efficacy and regulatory compliance. Despite these challenges, the proposed framework offers a promising solution to enforce speed limits in restricted areas using RFID technology and encourages further investigation to evaluate its effectiveness and ensure regulatory compliance.

VII.WORKING

Through radio frequency, we can effectively regulate vehiclespeed within designated zones. When the transmitter receivesa signal within the specified area, it designates it as a tuition zone and controls the vehicle's speed accordingly. Microcontroller applications, coded signals, and programmeddelays ensure continuous signal transmission. As vehicles enter these zones, their receivers detect the code, prompting automatic speed control by the microcontroller unit installedin the vehicles. Programmed microcontrollers adjust vehicle speed upon receiving the code, facilitating safe driving within these zones. Transmitters are strategically placed to cover the necessary areas for speed reduction, offering a versatile solution to mitigate accidents.

VIII.CONCLUSION

This paper describes RFID-based intelligent vehicle control. A speed limit zone alert is provided to the driver using an RFID system. Driver negligence and speeding are two elements that could result in mishaps. A driver can maintain a vehicle's limited speed without actively controlling it if they are not paying attention. Road accidents in crucial areas can be avoided by the system. There are also fewer infractions of driving laws. The primary goal in developing this system was to prevent collisions and notify drivers regarding the speed restriction for their safety. Within hospital, school, and work zones, it is utilized to control and restrict the vehicle's speed, therefore saving precious lives.

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