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Advancing Speed Regulation and Dynamic Control In Specified Zones

Sukanya G[1], Balaji S[2], Kishore Adhithyaa B[3], Chiranjeevi V[4], Adhithya V[5], Arunkumar S[6]

[1,2]Faculty,and[3,4,5,6]Students
Dept. of Electrical and Electronics Engineering, Sri Krishna College of Technology, Coimbatore, India.
g.sukanya@skct.edu.in,balajimechanical105@gmail.com,20tuee034@skct.edu.in, 20tuee010@skct.edu.in, 20tuee002@skct.edu.in,21tuee603@skct.edu.in

Abstract:*By introducing a novel approach to dynamic speed management that applies to electrical and combustion vehicles in high-priority zones, the proposed concept addresses safety problems in and around educational institutions, medical centres, and congested roadways. Using strategically positioned transmitters that generate distinct signals within predetermined ranges, the system makes use of radiofrequency technology. Automatic speed adjustments are made possible by vehicles equipped with Arduino microcontrollers and radio frequency receivers that react to these signals. Additionally, the system has a liquid crystal display, throttle control, and a user interface that's easy to use. Traffic signals automatically change to green for importance passage in response to ambulance signals, which is a unique function. Key parts include RGB-colored LEDs for traffic indications, direct current (DC) geared motor, potentiometer, H Bridge L298; radio frequency transmitters; 433 MHz radio frequency receivers; liquid crystal display; and 12V SMPS power supply. Some of the anticipated results are increased security, effective traffic control, prompt emergency response, simple user interface, and flexible system operation. In order to provide a safe and responsive traffic control system, this project combines technology and safety.*

Keywords: *Traffic safety, Microcontroller, High priority zones, Dynamic speed control, Radio frequency technology, Emergency signal.*

1. INTRODUCTION

A novel idea of attempting to prevent vehicles with excessive speeds from entering vital places, such as hospitals and educational institutions, in the fast-paced world of today. Consider a system that interacts with automobiles via innovative radio frequency technology to regulate their speed automatically in designated areas. By implementing dynamic speed regulation where it matters most, this project seeks to increase road safety. The utilization of RF technology is at the core of this creative project. The system uses transmitters that are carefully positioned in strategic locations rather than depending on set speed limits. Cars traveling through these zones are equipped with receivers that receive signals from these transmitters. Consequently, the vehicles adjust themselves to maintain compliance with the speed limitations without depending entirely on the drivers' attention.

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The project handles emergency scenarios in addition to speed regulating. For example, traffic signals are quickly turned green by the system while an ambulance need to travel via a certain region. This prompt action ensures a safe and effective passage during crises by allowing the ambulance to travel through the region without any delays. This initiative serves as an excellent example of how technology may be used to improve road safety as we go forward. Not only should speeds be managed, but a system that is flexible and responsive and puts safety first in high-risk locations should also be developed. Against the backdrop of fast evolving technology, this project is a shining example of how innovation can actually improve people's lives on a day-to-day basis.

2. LITERATURE REVIEW

This report a set speed control mechanism, found in the majority of current vehicle speed control systems, is insufficient in high-alert areas. The purpose of this article is to autonomously lower the vehicle's speed in relation to the maximum allowed speed restriction at a given place. Our proposed Real Time Automated Acceleration Management System maintains the functionality of all machinery while being very user-friendly for the driver. By electro-mechanical technologies, the controlling portion of this system completely eliminates the need for human involvement. In this prototype, a mobile global positioning systems device is used to gather the zones area and the corresponding highest speed limits. The built-in algorithm constantly tracks and contrasts the speed increased by manual acceleration with the highest speed allowed at that specific place. As a result, the motor's speed is reduced to the permitted speed set for that specific zone. In this study, the prototype's hardware complexities is reduced because the vehicle motor's speed is electrically regulated via pulse width modulation and an infrared sensor. The prototype model can be directly embedded on the vehicle through the use of Laboratory View simulation software to create a digital representation of the system. Modeling for a working model was created using an Arduino system for testing [1].

This paper explains about the theft of vehicles is a prevalent problem in society because there is no security system in place for vehicles while driving. For every car user, one of the primary concerns becomes the vehicle's safety technology. This paper presents a multiple-layered security system that includes an owner speed limiter, an emergency vehicle monitoring feature, and a thief alerting feature. The owner can receive location data on the car from any point in the world in the event of a theft. Our system's use of Raspberry Pi provides the car with capable and robust security. In addition to using a camera for monitoring automobiles anywhere, this article uses a Global system for mobile/ Global positioning system to provide real-time vehicle location data. This research presents a user-friendly and cost-effective solution that has the potential to guarantee vehicle security globally [2].

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The objective of this paper is reducing traffic accidents is a top priority in the modern world as there are more and more automobiles on the road. One of the main causes of accidents when driving is breaking the law. This research suggests an appropriate approach to significantly lower the number of traffic accidents caused by speeding in this particular circumstance. In contrast to current methods, which regulate a vehicle's speed at a fixed rate, this work suggests a combined strategy to efficiently regulate a vehicle's speed at a variable rate depending on the maximum speed limit allowed in protected or restricted zones, such as busy areas, schools, and hospitals. One potential way to regulate the speed of the car according to the posted speed restriction at a given place is to use an inactive Radio Frequency Identification that is integrated with the global positioning systems tracker in the car. For our work, we utilize a prototype that looks like an electrically controlled road car with personalized speed limitations. When the car gets close to a Radio Frequency Identification tag, a radio frequency identification reader inside the car detects the tag's unique encoded signal and uses that information to autonomously regulate the speed of the car. Along with overcoming radio frequency identification's drawback, the work suggests a way to improve a radio frequency identification security by simulating speed control using global positioning system's data [3].

This report gives data about Traffic safety in the roadways relates to strategy and precautions used to lessen the likelihood that someone would be killed or seriously injured while utilizing the road. Long-term initiatives to improve road security have had a significant impact on records for safety on the roads. A significant decrease in risky behaviors, such as driving while intoxicated or failing to wear a seat belt, confirms this. At that time, a great deal of traffic-related incidents continued to cause suffering for a great deal of individuals or their relatives. According to the International Health Organization (World Health Organization), injuries caused by traffic accidents will be the most often acknowledged cause of death by in the year 2030. Modern safety technologies will be included in new automobiles all around the world to assist drivers in making the right decisions and, in emergencies, controlling their vehicles. At the forefront of traffic safety, the migration methodology is expected to be driven by the market and rapidly expand globally. These measures provide a comprehensive understanding of the severity of the problem and, in turn, the time required to implement the system to prevent such mishaps. The suggested system will assist us in lowering the risk of incidents in this way. The work proposes several noteworthy features, including collision notification that notifies the victim's relative about the accident, Traffic control at red lights ensures that a vehicle does not violate the signal. Vehicles can enter no-entry zones and change their speed in various zones by using speed control. While alcohol analysis identifies drunk driving, horn control prohibits honking in areas where it is forbidden. [4].

This study presents the design and verification of a vehicle's autonomous speed control method using a proportional integral derivative controller and Kalman filter. The system is proven using computer simulations, considering many uncertainties including disturbances, system fluctuation,

and feedback sensor noise. In the simplest open loop control, the performance degradation brought on by disturbance and system change is displayed. The automated automobile speed management system is developed using a feedback mechanism based on a proportional integral derivative controller in order to address this issue. Moreover, the autonomous automobile speed management system applies the Kalman filter to mitigate performance degradation brought on by possible feedback sensor noise during the evaluation process. In the end, it has been confirmed that the developed proportional integral derivative controller and Kalman filter autonomous automobile speed management system not only meets all performance requirements but also has the capacity to reject disturbance, handle system variation, and lower feedback sensor noise [5].

In this report, currently, one of the main issues facing our nation is traffic accidents. The primary cause of those traffic accidents is careless driving. An autonomous system that would direct drivers in an emergency is necessary due to the alarmingly high rate of mishaps and uncontrollable cars on the road. The best way to prevent an accident is to regulate the speed of the car when something like a person, another car, or any other object gets in front of it. In our initiative, we offer a way to reduce traffic accidents and regulate vehicle speed. Vehicles employ ultrasonic detectors to identify impediments. An Arduino Uno is used by Cortex Advanced RISC Machine M4 to evaluate the data and send instructions to the wiper motor, which brakes the vehicle. Moreover, an alarm will sound to notify the driver as soon as an object from the rear approaches a car [6].

This paper gives the vehicle electronics are starting to become standard. Control circuits employ vehicle networking to boost vehicle dependability and safety, guaranteeing high-performance intelligent control. In order to improve the driver-vehicle interface and prevent or lessen emergency situations, this report describes the creation of a vehicle speed regulated driving technology for a semiautonomous car. Several protocols are used in automotive networking, which is a technique for data communication between dispersed electronic modules using a serial data bus. Microcontrollers communicate with one another without the assistance of a host computer thanks to the automotive bus known as Computer Area Network In order to handle an emergency, this system will evaluate, implement, and control automated headlight monitoring and control, automobile speed control with identification of obstacles, temperature, seatbelt, and battery voltage through two nodes that are communicating over Computer Area Network protocol. Through mutual communication, these nodes monitor and regulate the previously mentioned parameters [7].

This paper elaborates the worldwide car population is increasing, which raises the important problem of an increase in accidents, the majority of which are caused by accelerating. Only a small improvement has been made, despite the Highway Protection division that numerous efforts to inform drivers of limits for speed through the placement of numerous sign boards. This might be avoided by employing radio frequency technology to manage speed in an easy-to-use yet

efficient manner. with an increase in the production of driverless cars. Because it's so easy to use, it may be used for both as well as current automobiles. Preventing automobiles from exceeding the permissible speed limits in designated areas is the primary goal [8].

This paper outlines in the modern world, transportation by roads has grown into a basic need for every individual. Though the current transportation system has reduced travel time, it has also raised danger to human life. The creation of a highway security precaution is the primary goal. This paper presents a revolutionary system that can automatically regulate the vehicle's acceleration by identifying the symbols on the speeding signs that are placed along the sides of the highway and taking the appropriate action to alert the operator by delivering a warning. When a motorist fails to decrease their acceleration even after a warning sign is given, the vehicle's information is reported to traffic officials, and the vehicle's speed is lowered to the speed shown in the acceleration labels. Using a GPRS module to relay the vehicle's location and real-time image processing to identify the speeding signal identify, Arduino Uno is utilized to transmit the data to the cloud. PHP analyzes the information sent on the servers, and based on the analysis's findings, the appropriate actions are taken [9].

3. METHODOLOGY

The proposed system focuses on achieving dynamic speed control in high-priority zones using an integrated system of RF technology and microcontrollers. The primary objective is to ensure the safety of specific zones, including schools, hospitals, colleges, and accident-prone areas. RF transmitters strategically placed in these zones emit unique signals, and vehicles equipped with RF receivers and microcontrollers respond to these signals for automatic speed adjustments. In electric vehicles the speed will be automatically controlled when the RF receiver receives the signal whereas, in combustion vehicles the speed will be controlled by fuel injector. Additionally, in emergency situation like when the ambulance struck in the heavy traffic jam, this proposed system helps to turn the red signal into green automatically and it give way to cross the traffic jam and also all the vehicles in that traffic jam gets alert message when the ambulance is near to that particular zone. Further more, in an emergency scenario, such as when an ambulance gets stuck in heavy traffic, this suggested system assists in automatically turning the signal that is red into green, allowing traffic to move through the jam. It also sends out alerts to all of the other vehicles in the block when the medical vehicle approaches a specific zone.

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A. The Advantages of the Proposed System

- Automated Speed Control
- Zone-Specific Adaptability
- Reduced Human Intervention
- Swift Emergency Response
- Advanced Technological Integration

Automated Speed Control: Introduces automated speed adjustment using Radio Frequency transmitter and receiver and microcontrollers. This system automatically controls both Electrical vehicle and combustion vehicle.

Zone-Specific Adaptability: Dynamically adjusts speeds based on specific zones such as schools, hospitals and restricted zones for enhanced safety.

Reduced Human Intervention: Minimizes the need for human monitoring, ensuring consistent and accurate regulation. The use of this advanced speed control system will reduce the manual analysis.

Swift Emergency Response: Facilitates quick responses to emergency vehicles through smart communication. The system automatically changes the red traffic signal into green signal.

Advanced Technological Integration: Integrates RF communication, and microcontrollers for real-time adaptive speed control and innovative safety features.

B. Block diagram and Working Principle

The basis of operation is the cars' RF receivers' ability to detect distinct RF signals. After deciphering these signals, the microcontroller uses the H-Bridge L298 to regulate the fuel injector and DC geared motor, which modifies the vehicle's speed. The speed control procedure is managed by an algorithm, which guarantees rapid and seamless modifications. Additionally, the system has a unique function that ranks emergency vehicles especially ambulances higher than other vehicles. An automatic green light at intersections is triggered by a specific signal that is emitted by a designated radio frequency transmitter on the ambulance. This special feature makes sure that traffic signals change smoothly to green as soon as an ambulance approaches, allowing the emergency vehicle to pass through the crossing quickly and unhindered.

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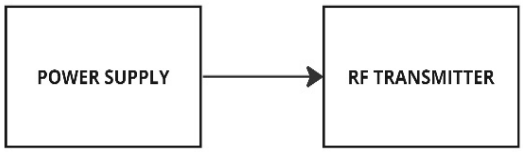


Fig 1.Block Diagram Of Transmitter

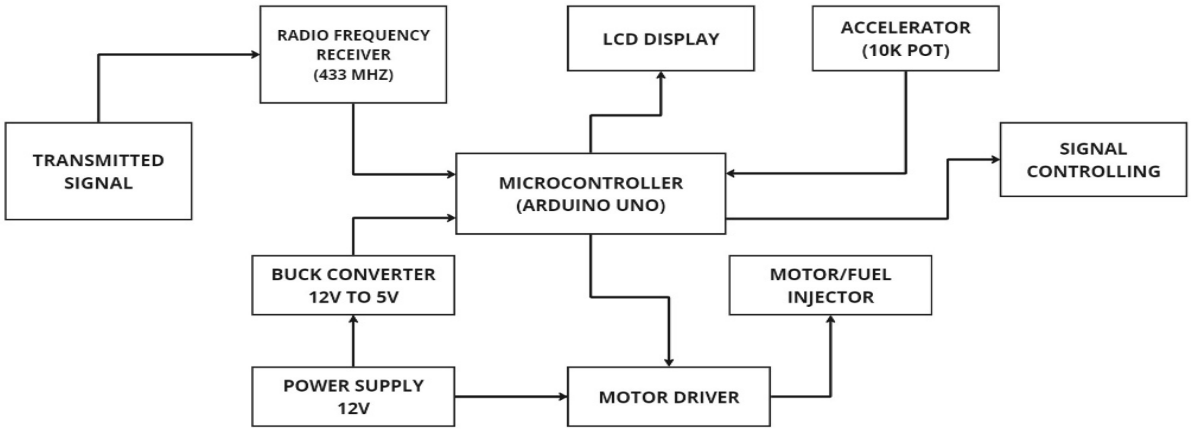
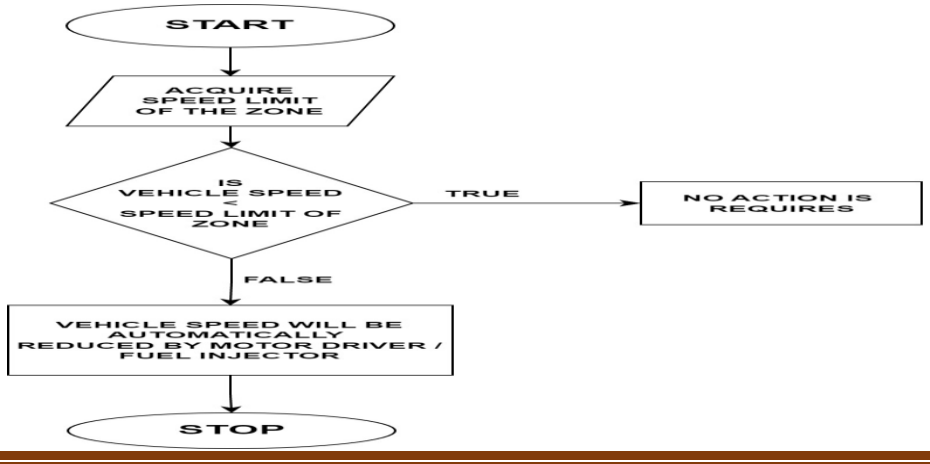


Fig 2. Block Diagram of Receiver

C. Testing, Validation, and Flow diagram

To assess the system's efficiency in a variety of scenarios, including emergencies and various priority areas, the proposed system has comprehensive testing scenarios. By comparing the system to predetermined standards, the validation procedure makes sure that speed modifications are precise and that signal responses are dependable. The outcomes of testing guide any required iterations, improving the method or system's constituent parts to increase responsiveness and efficiency. To guarantee that the system will function reliably in practical situations, ongoing verification and testing are essential.



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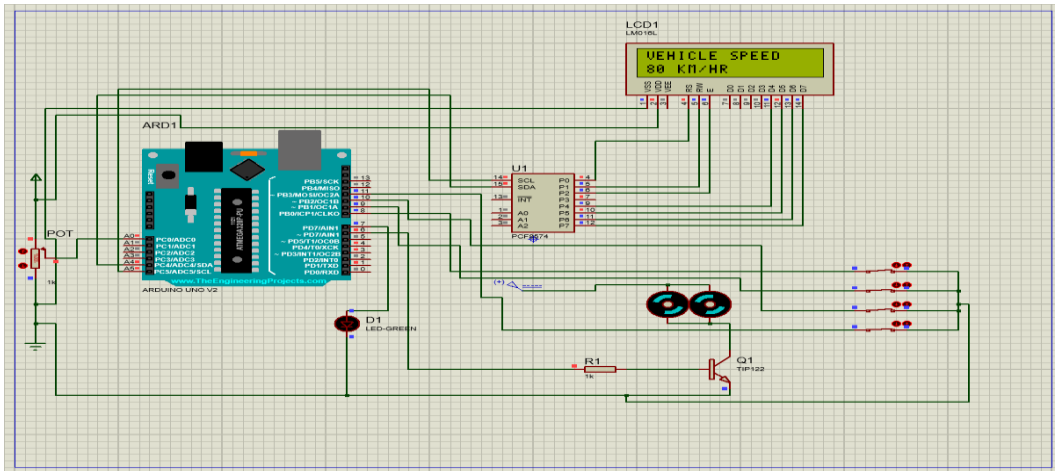

Fig 4. Flow Diagram for Changing the Traffic Signal in Emergency Scenario

4. SIMULATION RESULT

A dynamic speed control system is being developed in this creativechances to address safety issues in risky regions, particularly those surrounding schools, hospitals, and accident-prone places. Microcontrollers and advanced RF (Radio Frequency) technology are used in the implementation to produce a dynamic and adaptable system. Unique signals are generated by strategically placed transmitters that correspond to predefined speed limitations, such as 80 km/h, 60 km/h, 40 km/h, and 20 km/h. This leads vehicles that are installed with RF receivers and microcontrollers to regulate their speeds to comply with the predetermined limits. This system's particular attention for emergency vehicles especially ambulances is one of its most striking characteristics. When an ambulance gets close enough within radio frequency range, it sends out signals to other vehicles in that region, instructing passengers to slow down or stop. Moreover, by connecting with the current traffic infrastructure, the idea goes beyond what is required.Traffic lights at crossings change from red to green in response to ambulance signals, guaranteeing an emergency vehicle's clear and priority passage. Its all-encompassing strategy not only improves safety in high-risk locations but also promotes emergency response times by working well with the traffic control system. In general, the project shows how to use a variety of tactics to make high-priority areas safer and more responsive.

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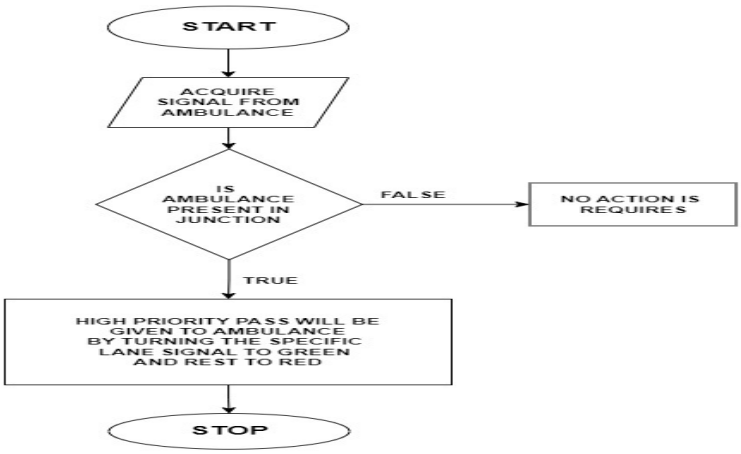

Fig 5. Simulation Result of The Proposed System

When the vehicle crossing the hospital zone, if the vehicle speed exceeded its speed limit of 20 km/hrs. in its particular RF zone, it automatically detected and reduced. Then it displayed in LCD. So, it can reduce lot of accidents which was held in hospitals zone

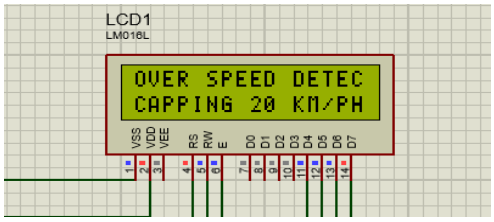

Fig 6. Overspeed Detected and Speed Reduced at Accident-Prone Zone (20km/Hr).

In the accident-prone zone, when the vehicle speed exceeded its speed limit of 60 km/hrs., in its particular zone, it automatically detected and reduced. Then it displayed in LCD. While the vehicle travelling in school/college zone, when the vehicle speed exceeded its speed limit of 40 km/hrs. in its particular RF zone, it automatically detected and reduced its speed. Then it displayed in LCD.

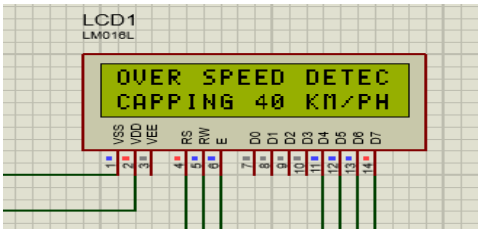

Fig 7. Overspeed Detected and Speed Reduced at School/College Zone (40km/Hr).

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5. RESULT AND DISCUSSION

A unique dynamic speed control system for electric and combustion vehicles is proposed in this project, with an emphasis on high-priority regions such as schools, hospitals, and accident-prone places. The device automatically modifies vehicle speed based on signals received within predetermined ranges by using radiofrequency technology and strategically positioned transmitters. Safety and effective traffic management are given first priority by the system, which has an intuitive interface and responds automatically to emergency situations like clearing path way for the ambulance by changing red signal into green automatically. For both traffic signal control and driver feedback, important parts include microcontrollers, RF modules, and visual indicators. Reductions in accidents, quicker emergency reaction times, and an easier-to-use interface are all anticipated results that will enhance the responsiveness and security of the traffic control system. In order to evaluate the system's performance in various traffic situations and environments, real-world testing is essential. More study is needed to integrate the system with current traffic control systems and adapt it for major metropolitan infrastructures. Strong safeguards against possible misuse and signal interference are crucial. Widespread acceptance depends on striking a balance between affordability and technological innovation.

6. CONCLUSION

As a consequence, this initiative addresses security problems around highly sensitive locations like schools, hospitals, and accident centers by offering a solution for efficient handling in those regions. The transmitter's output generates an RF signal, and the technology allows combustion and electric vehicles with RF receivers and microcontrollers installed to automatically regulate their speed. It is simple to use and has an LCD display and accelerometer control, making it a user-friendly one. Coordination of emergency services is essentially demonstrated by the automatic response to the ambulance, that flips the red signal to green and prioritizes the green light. Better security protocols, more effective traffic management, quicker reaction speeds, a smoother user interface, and enhanced performance are among the likely benefits. As a result, the concept overcomes major issues with city-wide transportation by coordinating the use of technology to formulate a system accountable for safety and security.

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