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Ambulance Detection Based Traffic Signal Control

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ABSTRACT: Traffic congestion in urban areas significantly delays emergency medical services, often resulting in critical loss of life. This paper presents an intelligent ambulance detection-based traffic signal control system designed to provide dynamic signal preemption for emergency vehicles. The proposed system utilizes technologies such as RF communication, GPS tracking, image processing, or IoT-based sensors to identify the presence of an approaching ambulance at an intersection. Upon detection, the traffic controller automatically overrides normal signal timing and grants a green signal along the ambulance's route, ensuring faster and uninterrupted passage. Once the ambulance clears the intersection, the system restores standard traffic operations. The model aims to reduce emergency response time, improve road safety, and enhance traffic management efficiency. Simulation and prototype results demonstrate a significant decrease in ambulance delay compared to conventional fixed-time traffic signal systems, making the approach suitable for smart city transportation infrastructures.

I. INTRODUCTION

In today's fast-paced urban environments, road traffic congestion is a persistent problem that affects not only the daily lives of commuters but also the effectiveness of emergency response services. Among these, ambulances often face critical delays due to traffic signals and congestion at intersections, which can lead to life-threatening situations for patients in need of urgent medical attention.

Traditional traffic signal systems operate on fixed timing or adaptive models that optimize traffic flow based on vehicle density but do not account for emergency vehicle prioritization. As a result, ambulances frequently get stuck in traffic, losing valuable time that could be the difference between life and death.

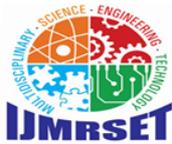
To address this issue, the proposed project aims to develop an intelligent traffic signal control system that detects the presence of an approaching ambulance and automatically alters the traffic signal to provide a clear path. By incorporating technologies such as image processing, RFID, GPS, or IoT-based systems, the system can recognize an ambulance in real-time and give it signal priority, thereby reducing delays and improving emergency response times.

This project contributes toward building smarter and safer cities, where intelligent transportation systems (ITS) can ensure quicker emergency services, reduce road accidents involving ambulances, and improve overall traffic management.

II. LITERATURE REVIEW

Traditional traffic signal systems operate on fixed timing or simple sensor actuations and do not prioritize emergency vehicles, often causing delays for ambulances in congested urban traffic. To address this, researchers have proposed various detection-based signal control methods to reduce emergency response time.

Early approaches used **sensor technologies** such as RFID tags, GPS tracking, and roadside sensors to identify approaching ambulances and trigger signal preemption. These systems improved detection but were limited by infrastructure costs, range issues, and accuracy challenges.



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With advances in computer vision and machine learning, **camera-based detection** has gained popularity. Techniques using deep learning models (e.g., object detection algorithms) can identify ambulances in real time, even in heavy traffic, and communicate with signal controllers to change light phases accordingly.

Emerging work also focuses on **IoT and Vehicle-to-Infrastructure (V2I) communication**, enabling direct data exchange between ambulances and traffic signals for faster, coordinated response.

Overall, literature demonstrates that intelligent ambulance detection and adaptive signal control significantly reduce delays compared to conventional methods, though implementation challenges remain in terms of cost, scalability, and real-time reliability.

III. PROBLEM STATEMENT

With the rapid growth of digital technology, creating or modifying documents using editing software has become easy and widespread. Manual document verification is slow, error-prone, and impractical for handling large volumes of digital documents. As a result, an automated system is required to ensure secure and reliable document verification.

Today, digital and scanned documents are extensively used in education, banking, government, and private organizations for identity and record verification. At the same time, advanced editing tools enable forgers to manipulate text, images, photos, and seals with high precision, making fake documents difficult to detect through manual inspection.

Manual verification depends heavily on human judgment and cannot efficiently process the large number of documents submitted online. Moreover, high-quality forgeries often contain subtle modifications such as font inconsistencies or minor logo alterations that are not easily visible to the human eye.

To overcome these challenges, there is a strong need for an automated Fake Document Detector system. The proposed solution uses Optical Character Recognition (OCR) to verify text content, Image Processing to analyze visual elements, and Machine Learning techniques to classify documents as genuine or fake. This approach reduces human effort, improves accuracy, and enables fast, unbiased, and scalable document verification.

IV. SYSTEM ARCHITECTURE

The system architecture of an ambulance detection-based traffic signal control project consists of interconnected modules that work together to provide signal priority to emergency vehicles. The ambulance is equipped with a transmitter unit such as GPS, RFID, RF module, or IoT device that sends its identification and location data when emergency mode is activated. At the traffic intersection, a detection module—such as an RFID reader, RF receiver, GPS receiver, or camera for image processing—identifies the approaching ambulance within a specific range. The detected signal is then sent to a processing and control unit (microcontroller or embedded system), which verifies the ambulance information and temporarily overrides the normal traffic signal timing. The controller switches the traffic light to green in the ambulance's direction while turning other lanes red to ensure safe and fast passage. After the ambulance clears the intersection, the system automatically restores the standard signal cycle. Optionally, an IoT-based monitoring system can be integrated for real-time tracking and centralized traffic management.

V. SYSTEM OVERVIEW

The ambulance detection-based traffic signal control system is designed to reduce emergency response time by giving priority to ambulances at traffic intersections. In conventional traffic systems, signals operate on fixed or pre-set timing cycles without considering emergency vehicles, which can cause critical delays. This proposed system introduces an intelligent mechanism that detects an approaching ambulance and automatically adjusts the traffic signal to ensure a clear path.

The system works by equipping the ambulance with a transmitter device such as GPS, RFID, RF module, or IoT-based communication unit. When the ambulance is on an emergency call, the transmitter sends identification and location data to a receiver installed at nearby intersections. Once detected, the processing unit (microcontroller or embedded



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controller) analyzes the signal and overrides the normal traffic sequence. The signal facing the ambulance route is turned green, while all other directions are set to red, allowing safe and uninterrupted movement.

After the ambulance passes through the intersection, the system restores the regular traffic signal operation. The overall system improves emergency response efficiency, enhances road safety, and supports smart city traffic management by integrating communication, detection, and automated control technologies.

VI. RESULTS AND OUTCOMES

An ambulance detection-based traffic signal control system significantly improves emergency response efficiency and overall traffic management. By automatically giving green signals along the ambulance's route, the system reduces waiting time at intersections and shortens overall travel time, often by a substantial margin depending on traffic conditions. This faster clearance helps patients reach hospitals more quickly, increasing survival chances, especially in critical situations such as cardiac arrest, stroke, or severe trauma. The system also enhances road safety by reducing the need for ambulances to run red lights or drive aggressively through congested junctions, thereby lowering the risk of accidents. Additionally, traffic flow disruption is minimized because signals return to normal operation after the ambulance passes. Overall, the outcome of this system is faster emergency response, improved patient outcomes, safer intersections, and more efficient urban traffic management.

VII. ADVANTAGES & DISADVANTAGES

- **Advantages:-**

1. **Reduced Ambulance Response Time:**

Prioritizing ambulances at traffic signals significantly decreases their waiting time at intersections, enabling faster arrival at emergency sites and hospitals.

2. **Improved Emergency Service Efficiency:**

The system enhances coordination between traffic management and emergency responders, improving overall effectiveness of ambulance services.

3. **Enhanced Road Safety:**

Creating green corridors reduces the likelihood of accidents involving ambulances navigating through congested traffic or making risky maneuvers.

4. **Adaptive Traffic Management:**

Dynamic signal control adjusts to real-time conditions, reducing unnecessary delays for ambulances without severely impacting regular traffic flow.

5. **Scalability:**

The modular design allows expansion to cover extensive road networks and multiple vehicle types (fire trucks, police vehicles).

6. **Integration with Smart City Infrastructure:**

Facilitates incorporation into broader Intelligent Transportation Systems (ITS) for holistic urban traffic management.

- **Limitations:-**

1. **High Implementation Cost:**

Installing detection sensors, upgrading traffic controllers, and establishing communication infrastructure across a large urban area can be expensive.

2. **Technology Reliability Issues:**

Sensors and communication devices may suffer from malfunctions, environmental interference (weather, obstacles), or connectivity failures, affecting system accuracy.

3. **Dependence on Ambulance Equipment:**

The system requires ambulances to be equipped with compatible GPS, RFID, or communication devices, which may not always be consistent.

4. **Potential Traffic Disruptions:**

Frequent ambulance prioritization in busy areas could lead to increased waiting times and frustration for regular traffic, possibly causing congestion.



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5. Complex Coordination:

Managing multiple ambulances and other emergency vehicles simultaneously across large networks requires sophisticated algorithms and may still face challenges.

6. Security and Privacy Concerns:

Real-time tracking and communication introduce risks related to data privacy and cybersecurity threats, necessitating robust protection measures.

VIII. CONCLUSION AND FUTURE SCOPE

The Ambulance Detection Based Traffic Signal Control system offers an intelligent and efficient solution to minimize delays faced by ambulances at traffic intersections. By using technologies such as GPS, RFID, RF communication, image processing, or IoT modules, the system detects an approaching ambulance and automatically overrides the normal traffic signal sequence to provide a green signal in its direction. This reduces emergency response time, improves patient survival chances, and enhances overall road safety. Compared to conventional fixed-time traffic systems, the proposed system ensures faster and more reliable traffic management during critical situations, contributing to smart city development.

In the future, the system can be enhanced by integrating Artificial Intelligence and deep learning for more accurate real-time ambulance detection under heavy traffic conditions. Vehicle-to-Infrastructure (V2I) communication can be implemented for coordinated signal control across multiple intersections. Cloud-based monitoring and data analytics can help optimize emergency routes and improve system efficiency. The system can also be expanded to prioritize other emergency vehicles such as fire trucks and police vehicles. With further improvements in scalability, reliability, and cost-effectiveness, this project has strong potential for large-scale real-world implementation in intelligent transportation systems.

REFERENCES

- [1] G. Varaprasad and S. R. Durbha, "Intelligent Traffic Control System for Priority Vehicle using Wireless Sensor Network," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 5, no. 6, pp. 1447–1454, Dec. 2015. DOI: 10.11591/ijece.v5i6.8494.
- [2] K. L. Sudha and A. Karthikeyan, "Smart Traffic Signal Control System for Emergency Vehicles," *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)*, vol. 3, no. 3, Mar. 2014.
- [3] R. Rajeshwari and S. S. Baboo, "Automatic Ambulance Rescue System," *International Journal of Advanced Research in Computer Science and Software Engineering*, vol. 2, no. 4, pp. 75–79, Apr. 2012.
- [4] T. Bala and S. Kiruthika, "Emergency Vehicle Clearance using Intelligent Traffic Control System," *International Journal of Engineering Research and Technology (IJERT)*, vol. 6, no. 6, Jun. 2017.
- [5] National Transportation Communications for Intelligent Transportation System Protocol (NTCIP), [Online]. Available: <https://www.ntcip.org>
- [6] SUMO - Simulation of Urban Mobility, Eclipse Foundation, [Online]. Available: <https://www.eclipse.org/sumo>
- [7] IEEE Standard 1609 Family - Wireless Access in Vehicular Environments (WAVE), [Online]. Available: <https://standards.ieee.org>
- [8] Ministry of Road Transport and Highways (MoRTH), "Guidelines for Intelligent Transport Systems," Government of India, [Online]. Available: <https://morth.nic.in>
- [9] T. Litman, "Smart Transportation: Planning for Accessibility Not Just Mobility," *Victoria Transport Policy Institute*, 2019. [Online]. Available: <https://www.vtpi.org>
- [10] OpenCV Library, Open Source Computer Vision, [Online]. Available: <https://opencv.org>



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