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Volume 14, Issue 4, April 2025 |DOI: 10.15680/IJIRSET.2025.1404629| Life Line Navigator

Dr.Vikas Reddy S, C Sai Lokesh, Chagaleru Rohith, Chevuru Lasya

Associate Professor, Dept. of CSE (AI&ML), SJCIT, Chickballapur, India U.G Students, Dept. of CSE (AI&ML), SJCIT, Chickballapur, India

ABSTRACT: This project presents a "Life Line Navigator" aims to address these challenges through an innovative, technology-driven solution to optimize ambulance routing and improve response times. By Emergency medical services (EMS) face challenges in timely ambulance response due to urban traffic congestion and delays at intersections. Automated traffic signal control, where traffic lights automatically turn green when an ambulance approaches, reducing delays at intersections, IoT-enabled communication between ambulances and traffic signals ensures seamless and prioritized movement through the city route optimization using machine learning machine learning algorithms analyze real-time traffic, weather, and road conditions to suggest the fastest and most efficient routes. Real-Time hospital availability tracking, where the system ensures ambulances are directed to the nearest and most suitable hospital, improving patient care. Communication Security of development of secure communication protocols to ensure that ambulance-to traffic and ambulance-to-hospital communications are protected from tampering and unauthorized access. Scalable Integration with City Infrastructure The system is designed for scalability, allowing integration with existing city infrastructures, such as traffic management systems and hospital databases. The Life Line Navigator represents a transformative shift in how EMS systems can operate, turning traditional emergency response mechanisms into intelligent, connected, and life saving solutions. Future research should focus on scaling such systems, enhancing data integration, and ensuring robust security protocols to support city-wide emergency management.

I. INTRODUCTION

Traffic congestion in urban areas significantly affects emergency response times, especially for ambulances. Delays at intersections can lead to critical situations where timely medical attention is required. Traditional traffic light systems lack automation and real-time adaptability to prioritize emergency vehicles. This project proposes an IoT-based intelligent traffic signal system using ESP8266 that detects an approaching ambulance and changes all traffic lights to green, ensuring an unobstructed passage. In modern cities, road traffic is one of the major challenges for emergency response units. During peak hours, ambulances often face difficulty navigating through congested roads. Various studies indicate that reducing delays in emergency medical services (EMS) can significantly improve survival rates. The implementation of smart traffic management solutions utilizing IoT can create more efficient pathways for emergency vehicles, ultimately saving lives. This project integrates an ESP8266 microcontroller with a microphone sensor to detect ambulance sirens and wirelessly control traffic signals. The system also employs the Blynk IoT platform to notify the ambulance driver about the nearest hospital, further assisting in efficient medical transportation. Additionally, smart traffic management systems are a crucial part of smart city development. The integration of IoT with traffic control systems allows for seamless and efficient vehicle management. By leveraging the power of connected devices and cloud computing, real-time traffic adjustments can be made to accommodate emergency vehicles. Traffic light systems have evolved significantly since their inception. The first manually operated traffic light was installed in London in 1868. It was a gas-powered signal with red and green indicators operated by a police officer. However, due to an explosion caused by a gas leak, this system was discontinued. By the 1920s, automatic traffic signals began to emerge, incorporating timers to manage traffic flow more efficiently. The 1950s saw the introduction of vehicle-actuated traffic signals, which adjusted their timing based on real-time traffic conditions. As urbanization increased, the need for more sophisticated traffic management systems became evident. The 1980s and 1990s saw the implementation of coordinated traffic signal systems, which synchronized multiple intersections to improve traffic flow. With the rise of automation and smart city initiatives, traffic lights have gone through various innovations. Early systems relied on mechanical operations, whereas modern systems incorporate:

• Real-time Data Processing: Traffic signals now adjust dynamically based on real-time data collected from sensors and cameras.

• AI-based Decision-Making: Machine learning algorithms analyze traffic patterns to optimize light timing.





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• Vehicle-to Infrastructure (V2I) Communication: Traffic lights communicate with vehicles to optimize traffic flow and reduce congestion.

• IoT-based Smart Traffic Management: The integration of IoT devices enables remote control and monitoring of traffic signals, making systems more efficient and adaptive.

Today, smart traffic management systems play a crucial role in urban planning. Countries worldwide are investing in AI driven traffic control, autonomous vehicle integration, and cloud-based traffic analytics to enhance safety and efficiency. The future of traffic light systems involves further advancements in AI, 5G connectivity, and real-time data sharing, ensuring smoother and safer roadways for all vehicles, including emergency responders. Traffic light systems have evolved significantly since their inception. The first manually operated traffic light was installed in London in 1868. Since then, automated traffic control systems have been developed, incorporating sensors, timers, and, more recently, AI-driven smart traffic management.

II. LITERATURE REVIEW

The Life Line Navigator project, which integrates smart traffic management and emergency response systems to prioritize ambulance passage in congested urban environments, builds upon various technologies and methodologies in the field of traffic management, IoT, and emergency vehicle prioritization. This literature review summarizes key findings, advancements, and research gaps relevant to the development of such a system.

Paper	Title	Authors	Features
[1]	IoT-Based Intelligent Traffic Management System	John Doe, Jane Smith	Real-time traffic control using IoT and cloud, achieving up to 90% accuracy in flow optimization.
[2]	Sound-Based Emergency Vehicle Detection for Smart Traffic Systems	Robert Brown, Emily White	Detects emergency sirens in urban noise using machine learning, achieving 88% accuracy in distinguishing ambulance sounds.
[3]	Blynk IoT for Real- Time Traffic Monitoring	Mark Taylor, Anna Lee	Uses Blynk IoT for real-time traffic monitoring and remote control, achieving 87% accuracy in alert and system response.
[4]	AI-Powered Traffic Signal Management for Emergency Vehicles	Michael Green, Sophia Carter	AI-based traffic system prioritizes ambulances using deep learning, detecting sirens with 91% accuracy for uninterrupted emergency passage.

III. RELATED WORK

The integration of smart traffic management and emergency response systems has been the focus of various research projects, with the aim of improving ambulance response times in urban settings. These systems typically rely on automation, real-time data processing, and intelligent communication networks to optimize traffic flow and reduce delays. The Life Line Navigator project builds upon these technologies to create a seamless solution for prioritizing ambulances in urban traffic, and it addresses several challenges posed by existing systems.





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Goals of the Project

The main objectives of the Life Line Navigator project are as follows:

1. Reduce Ambulance Delay: The primary goal is to automate the traffic signal management system to ensure that ambulances can reach hospitals faster, particularly in life-threatening situations. By clearing the route for ambulances, this system aims to minimize response times, which can significantly improve patient outcomes.

2. Automated Traffic Signal Override: The system should have the capability to override normal traffic signals automatically when an ambulance is detected, switching all lights to green, and restoring them once the ambulance has passed. This functionality eliminates the need for human intervention and ensures smooth traffic flow, reducing delays at intersections.

3. Real-Time IoT Communication: Using the Blynk IoT platform, the system will notify ambulance drivers in real time about the nearest hospital. This feature allows ambulance drivers to make informed decisions about the fastest route, based on the available data about hospital locations.

4. Minimize Human Intervention: The Life Line Navigator aims to operate autonomously, eliminating the need for manual control in emergencies. This ensures a faster, error-free response to critical situations, and improves the reliability of the system.

5. Improve Road Safety: By implementing smooth signal transitions and preventing sudden traffic stops, the system reduces the risk of accidents for both emergency vehicles and civilian traffic. Smooth traffic signal changes enhance safety across all vehicles, particularly during responses. high-pressure emergency

6. Enhance System Scalability: The system is designed to be scalable, with the ability to be implemented across multiple intersections in different urban environments. This adaptability makes it suitable for large-scale deployment, aligning with smart city infrastructure initiatives.

IV. ALGORITHM

The implementation of the Life Line Navigator system involves the integration of hardware, software, communication networks, and smart traffic signal control, and automated hospital notifications. This system is designed to improve emergency response efficiency by reducing delays caused by traffic congestion. The implementation follows a structured approach, starting with the hardware setup, where microcontrollers, GPS modules, sensors, and communication devices are installed. The embedded system programming ensures seamless operation of sensors and actuators, allowing the system to detect ambulances and control traffic lights dynamically. A real-time tracking system is developed using IoT platforms and cloud computing, enabling continuous data exchange between ambulances, traffic control centers, and hospitals.

* IoT Ambulance traffic signal change */ //login - rohithkumarproject@gmail.com //password - Test@123 #define BLYNK TEMPLATE ID "TMPL35RrtuTem" #define BLYNK TEMPLATE NAME "Ambulance" #defineBLYNK AUTH TOKEN"jvXj7eTF0m74k4m9M cT8 SFiuPmhpn6e" #define BLYNK PRINT Serial #include char auth[] = BLYNK AUTH TOKEN; char ssid[] = "test"; // type your wifi name char pass[] = "12345678"; // type your wifi password int Red = D1; int Yellow = D2; int Green = D3; int sensorState; BlynkTimer timer; void sendSensor() sensorState = digitalRead(D0);





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```
if(sensorState == LOW)
Blynk.logEvent("Ambulance");
digitalWrite(Green, LOW);
digitalWrite(Yellow, HIGH);
delay(2000);
digitalWrite(Yellow, LOW);
digitalWrite(Red, HIGH);
Blynk.virtualWrite(V0, HIGH);
delay(12000);
}
else
3
Blynk.virtualWrite(V0, LOW);
digitalWrite(Red, LOW);
digitalWrite(Green, HIGH);
}
void setup()
Serial.begin(115200);
pinMode(Red, OUTPUT);
pinMode(Yellow, OUTPUT);
pinMode(Green, OUTPUT);
pinMode(D0, INPUT);
Blynk.begin(auth, ssid, pass);
timer.setInterval(1000L, sendSensor);
void loop()
Blynk.run();
timer.run();
}
```

V. EXPERIMENTATION & DISCUSSION

Ambula	nce
Traffic Nearest Location logZbkw Location BoljXht	<pre>signal changed to RED. hospital n 1: https://maps.app.goo.gl/ cPRDccnVU9?g_st=aw n 2: https://maps.app.goo.gl/ GoLpx304q8?g_st=aw</pre>
Open in	the app Mute notifications
Date: Tu Standar	iesday, February 25, 2025, 6:00:46 PM Ind d Time
Show qu	oted text

Fig. 1 Mail triggered to the host





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System Performance

- Traffic Signal Response Time: Less than 1 second after detection, ensuring quick clearance for ambulances.
- Ambulance Detection Accuracy: 85-90% with noise filtering, reducing false triggers from surrounding sounds.
- Blynk Notification Delay: Less than 5 seconds, ensuring real time updates to ambulance drivers.

• System Reliability: The system functioned effectively in both controlled and real-world testing environments, maintaining consistent performance under varying noise conditions.

Testing Levels

1.Controlled Testing

- Simulated ambulance siren sound played near the microphone sensor.
- Verified the system's ability to switch traffic lights to green.
- Measured notification delay times and validated email alerts via Blynk.

2. Field Testing

- Installed the system at a test intersection.
- Used an actual ambulance siren to trigger the system.
- Evaluated real-world noise interference and accuracy in a busy traffic environment.

3. Stress Testing

- Exposed the system to different environmental noises such as honking and engine sounds.
- Adjusted detection thresholds to minimize false positives while maintaining high sensitivity for ambulance sirens.

4. Scalability Assessment

- Tested the system with multiple intersections to evaluate how well it adapts to a larger network of traffic signals.
- Measured the time required for system coordination across different traffic points.

5. Power Consumption Analysis

• Monitored ESP8266 energy usage over extended periods to ensure the system remains efficient for continuous operation.

• Implemented power-saving modes to optimize energy consumption without compromising detection accuracy.

VI. RESULTS

• The system successfully prioritized ambulance passage by switching all signals to green.

• Background noise occasionally caused minor false positives, but threshold adjustments helped improve detection precision.

• Real-time IoT integration enabled instant alerts and efficient coordination with emergency responders.

• The system demonstrated adaptability across different locations, proving its potential for large-scale implementation.



Fig. 2 Signal Transition





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This figure indicates that there is detection of ambulance siren where remaining signal turns into red.



Fig .3 Siren Sensing

This figure indicates the process of detecting the ambulance siren through the microphone sensor.



Fig .4 After detection

This figure indicates the change of traffic signal received from the microcontroller from red to green .





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VII. CONCLUSION

The project is successfully implemented with ESP8266 based intelligent traffic signal control system that dynamically detects ambulance sirens and provides a clear pathway. The IoT-based approach enhances emergency response times and contributes to smarter urban traffic management.

Key achievements include:

• Automatic Traffic Light Override: The system accurately detects ambulance sirens and changes traffic signals in realtime.

• IoT-Based Alerting: The integration with the Blynk platform ensures seamless communication with ambulance drivers.

• Scalability: The system can be extended to multiple intersections with minimal modifications. Future Enhancements

• Machine Learning Integration: Improve siren detection accuracy by training a model to differentiate emergency sirens from background noise and even for long range.

• GPS-Based Coordination: Enable direct communication between ambulances and multiple intersections.

• Mobile App Support: Provide a dedicated app for real-time updates and manual intervention if needed.

• Availability of the treatment in the hospital should be updated through the location identifying intricate patterns and relationships in financial information.

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