

# PROJECT TITLE: AUTONOMOUS EMERGENCY VEHICLE DETECTION AND RESPONSE SYSTEM

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## KEY OBJECTIVES

1. Enable the autonomous car to detect and respond to an approaching ambulance by:

- Moving aside safely.
- Avoiding obstacles while giving way.

2. Allow the ambulance to:

- Signal its presence to nearby vehicles.
- Interact with traffic lights to ensure smooth passage.

3. Traffic Signal Management:

- Turn red lights green when the ambulance approaches.



## ABSTRACT

- Traffic congestion is one of the primary reasons for delays in emergency medical response.
- This project proposes an intelligent autonomous system where ambulances can communicate with traffic signals and autonomous vehicles to clear a path.
- The system integrates V2V (Vehicle-to-Vehicle) and V2I (Vehicle-to-Infrastructure) communication, using NodeMCU (ESP8266) microcontrollers, ultrasonic sensors, and IR sensors.
- A prototype demonstrates how an autonomous vehicle reacts to an ambulance's signal, ensuring a green corridor for emergency vehicles.
- The project aims to reduce emergency response time, minimize human intervention, and enhance traffic management efficiency.

## LITERATURE SURVEY

### 📌 State-of-the-Art Review on Traffic Control Strategies for Emergency Vehicles

Published in: IEEE Access, October 2022

Explores modern traffic control methods to improve emergency vehicle movement efficiency.

### 📌 Exploring Different Approaches for Automated Vehicle Detection:

A Comprehensive Review Published in: ICCS 2023, May 5, 2023 Compares AI-based techniques for detecting vehicles in real time for better traffic management.

### 📌 A Survey of Autonomous Vehicles: Enabling Communication Technologies and Challenges

Published in: Sensors, January 2021

Discusses vehicle-to-vehicle and vehicle-to-infrastructure communication for self-driving cars.

### 📌 Vehicle Detection Techniques for Collision Avoidance Systems:

A Review Published in: IEEE Transactions on Intelligent Transportation Systems, March 2020

Reviews sensor-based detection methods used in collision prevention for autonomous vehicles.

### 📌 Various Acoustic-Based Emergency Vehicle Detection Techniques:

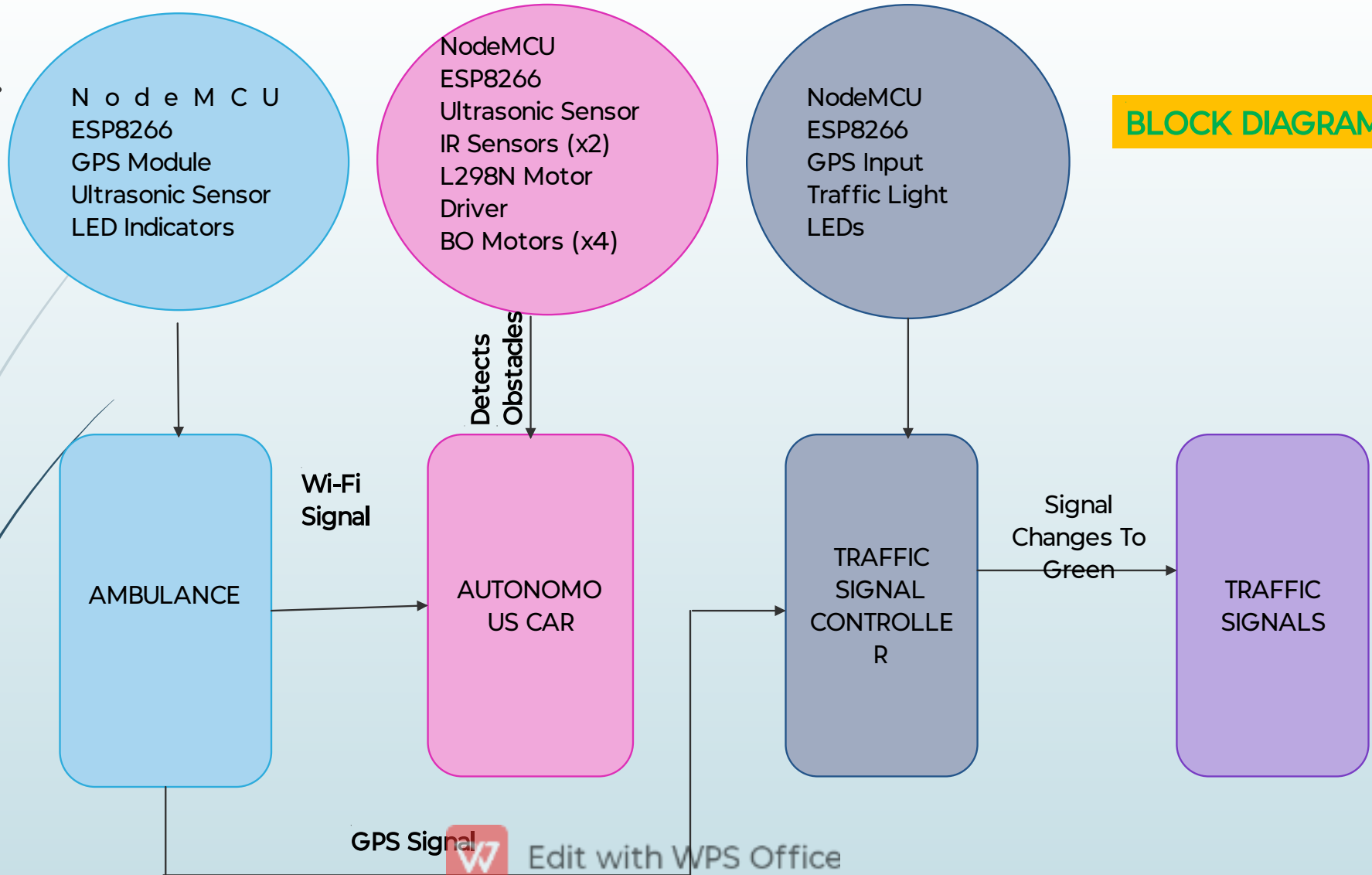
A Review Published in: IEEE Access, June 2019

Analyzes sound-based recognition methods to detect approaching ambulances in noisy environments.



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## BLOCK DIAGRAM



GPS Signal



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## FLOW CHART

### Autonomous Car and Ambulance Communication System

This project showcases collaboration between autonomous cars and ambulance vehicles to manage urban traffic.

#### Working Process

Outline the step-by-step process for how the system integrates vehicles and traffic management.

#### Communication Mechanisms

Discuss the communication methods employed between components for effective coordination.

#### Between Vehicles

RF and Wi-Fi/Bluetooth methods serve as the primary communication links between cars and ambulances.

#### With Traffic Lights

Ambulances utilize Wi-Fi signals to communicate changes with traffic light systems seamlessly.

#### Initial State

Autonomous cars navigate roads while traffic lights operate under normal conditions.

#### Ambulance Activation

The ambulance sends an emergency signal to cars and traffic lights, activating the system.

#### Signal Reception

The autonomous car receives signals and adjusts its movement to ensure safety while clearing the path.

#### Traffic Response

Traffic lights respond by changing to green for the ambulance, ensuring a clear passage.



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## HARDWARE DESCRIPTION

### FOR AUTONOMOUS

#### CAR

- NodeMCU (ESP8266):  
For processing and
- Wi-Fi  
communication.
- Ultrasonic Sensor (HC-SR04): Detect  
front obstacles.
- IR Sensors (x2):  
Detect side  
obstacles or lines.
- L298N Motor Driver:  
Control BO motors.
- BO Motors (x4):

Enable movement.

### FOR AMBULANCE

#### ROVER

- NodeMCU (ESP8266):  
For signal  
transmission and  
obstacle detection.
- Ultrasonic Sensor (HC-SR04): For  
navigation.
- LED Indicators:  
Simulate sirens or  
signals.

### FOR TRAFFIC SIGNAL:

- NodeMCU (ESP8266):  
Receives signals  
from the ambulance.
- LEDs: Red(x2),  
Green(x2), Yellow(x2)  
Simulate traffic lights



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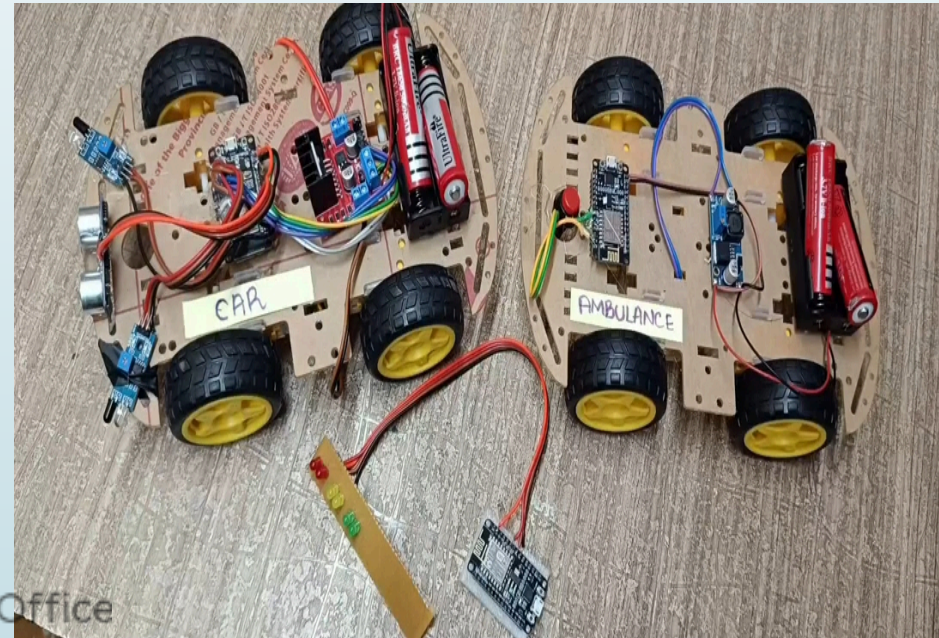


## RESULTS

- Successfully implemented a working prototype demonstrating real-time vehicle-to-vehicle communication.
- Autonomous vehicle correctly identifies an approaching ambulance and moves aside.
- Traffic signal system dynamically adjusts to prioritize emergency vehicle movement.
- The system significantly reduces ambulance response time in simulated scenarios.

## FUTURE ENHANCEMENTS

- Integration with GPS: Use real-world GPS data for location-based signal control.
- Advanced Communication with V2X Technology : Implement Vehicle-to-Everything (V2X) communication for enhanced accuracy.
- AI & Machine Learning for Smarter Decisions : Train AI models to optimize autonomous car movements.
- Four-Lane Traffic Signal System Expansion : Implement at a busy traffic junction with multiple lanes and traffic lights.





## DEMO VIDEO OF PROTOTYPE

Autonomous  
vehicle  
emergency  
detection  
and  
response system



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## REFERENCES

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# THANK YOU!



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