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# IoT Based Traffic Density and Signal Adjustment

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*KEYWORDS*

**ABSTRACT**

*Road traffic congestion becomes a big concern in densely populated metropolitan areas. India is the world's second most populous country, with a rapidly developing economy. It is experiencing severe traffic congestion in the cities. According to the Times of India, around 30% of deaths are caused by ambulances that are delayed in reaching the hospital. The suggested approach aims to eliminate ambulance delays. To improve ambulance transportation, we developed " IOT BASED TRAFFIC DENSITY AND SIGNAL ADJUSTMENT ". This system is also linked to Emergency Vehicles for Patients Other Than Ambulance. This vehicle comprises of an RF Transmitter with four switches. Traffic Police will have a receiver unit with an indicator led. When approaching the traffic signal in a dedicated lane such as (A,B,C,D), he must press the appropriate switch on the transmitter module. On the receiver end, the Microcontroller receives this signal and immediately changes the traffic signal to green. The LCD Module interfaces with this system to display the status message.*

## INTRODUCTION

Controlling traffic has become a serious concern in recent years as a result of the rapid increase in automobiles as well as long delays between traffic signals. So, in order to solve this problem, we will implement a density-based traffic signal system. This article shows how to control traffic while there is an ambulance. All of these sensors are connected to the microcontroller. Based on these sensors, the controller monitors and manages traffic flow. This idea is specifically developed for cities with significant traffic.For example, the highways in Bangalore are consistently congested. Most of the time, traffic will last for at least 100 meters.The traffic cops are unable to hear the ambulance's siren at this distance.So he ignores this.The ambulance must then wait for the traffic to clear before proceeding. It might often take more than 30 minutes to get out of traffic.So, by this time, anything can

happen to help this project escape these drawbacks. According to this project, if an ambulance approaches a traffic post in an emergency, the traffic signals will automatically halt and give the ambulance a green signal.

In recent years, traffic jams have become a major issue around the globe. According to current figures, the average person spends around 4-6 months of his or her life waiting for a green light in traffic. Also, as delays develop, commuters arrive at their destinations later, resulting in severe effects on a daily basis. Traffic can be controlled in several major intersections using either an automatic traffic signal control system or manual intervention by traffic cops. However, typical traffic light systems, which use fixed time slots given to each side of the junction, are proven to be inefficient since they do not account for variable traffic density. At times, the traffic system's priority must be adjusted dynamically based on the number of vehicles waiting on the road, the arrival of VIP vehicles and ambulance vehicles, and so on. It also has an LED that turns green on the lane with the most vehicles.

**LITERATURE SURVEY**

Tandrima Chowdhury, Smriti Singh, and Dr.S.Maflin Shab proposed in this study that the accident location be sent to the ambulance section via GSM (Global System for Mobile Communications). When there is an accident, the buzzer sounds. The central unit locates the ambulance that is closest to the accident site, as well as the quickest path between the accident site, ambulance, and nearest hospital. Wireless technologies are utilized here to convey information. When the ambulance arrives at the traffic crossroads, the encoder turns serial data into parallel data as it travels from transmitter to receiver. If the signal is red, it will change to green automatically. When the parallel data is returned, the receiver section's decoder converts it to serial data. This allows the ambulance to pass the traffic junction as quickly as feasible. Prioritized traffic switching is done in a priority-based manner; for example, if two ambulances arrive at the same time, the ambulance that reaches first at the traffic junction will be given priority to cross the traffic junction before the next ambulance arrives.

Rickin Patel, Vipul K. Dabhi and Harshadkumar B. Prajapati: In this work, the suggested IOT system is framed using a processing board to handle data and a camera module to give live visual input. The Raspberry Pi board will serve as the processing module, while the pi camera module will supply input data in video raw format h.264 to the Raspberry Pi. The technology will detect the amount of vehicles passing by, any accidents, and anticipate the lane projectile of the vehicles on the road. The Raspberry Pi was used to do background subtraction with the Gaussian mixture model and edge detection with the canny edge.

B. JananiSaradha, G. Vijayshri, and T. Subha: Road traffic congestion is a major concern in densely populated metropolitan cities such as Chennai.Traffic bottlenecks have a significant impact on ambulance services. To improve ambulance travel, this paper proposed Intelligent autonomous traffic control for ambulances. The suggested method creates an Android app that connects the ambulance and the traffic signal station via a cloud network. This system leverages RFID (radio frequency identification) technology to achieve intelligent traffic signal control. The primary idea behind the suggested system is that whenever an ambulance comes to a halt on the road owing to a traffic signal, RFID deployed at the traffic signal tracks the RFID-tagged ambulance and sends the data the cloud. once the user's acknowledgement using the mobile app, the particular signal is made Green for some time, and once the ambulance goes by, it returns to its original flow of signaling sequence. If this technique is fully automated, it will find the ambulance and regulate the traffic lights. This device controls traffic signals and saves time in emergency situations. Thus, it serves as a life-saving endeavor.

**3.PROPOSED SYSTEM**

Ambulance services are currently the most affected by traffic bottlenecks. This issue can be overcome by utilizing a smart traffic signal. The emergency vehicle ambulance is responsible for reaching patients or transferring those who have been involved in accidents to the hospital as promptly as possible. The present problem section demonstrates that existing technology are insufficient to address congestion control, emergency vehicle clearance, and other issues. To address these issues, we propose to adopt our Intelligent Traffic Control System. It mostly consists of two parts.

In this suggested system, we developed a novel way

for autonomously controlling traffic lights depending on vehicle density and ambulance arrival. IR sensors are used to detect vehicle density; if the sensor is detected by a vehicle, the lane is switched green, and traffic is cleared as fast as feasible. This system is also linked to Emergency Vehicles for Patients Other Than Ambulance. This vehicle comprises of an RF Transmitter with four switches. Traffic Police will have a receiver unit with an indicator led. When approaching the traffic signal in a dedicated lane such as (A,B,C,D), he must press the appropriate switch on the transmitter module. On the receiver end, the Microcontroller receives this signal and immediately changes the traffic signal to green. The LCD Module communicates with this system to display the status message.Using this, the ambulance/vehicle can pass instantly without any delays, saving lives

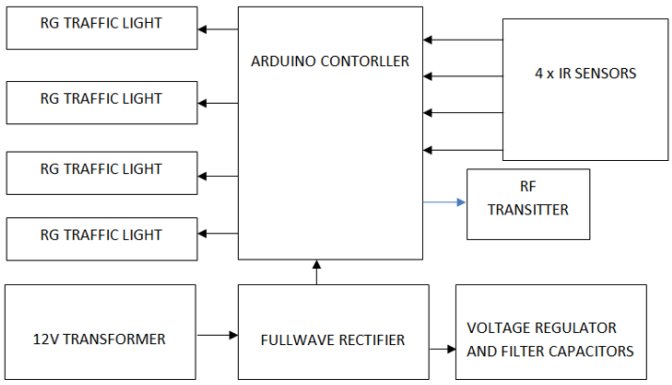



Fig 1:Block Diagram

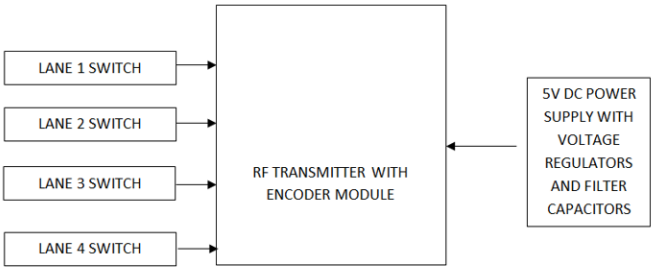



Fig 2:Block Diagram – Emergency Vehicle

## COMPONENTS DESCRIPTION

1. Arduino UNO

Arduino UNO is the main microcontroller board used to control the entire traffic light system. It processes input signals from sensors and RF modules and controls the output devices such as LEDs based on programmed logic. It acts as the brain of the system.

2. RF Transmitter and Receiver Module

The RF (Radio Frequency) module is used for wireless communication between the emergency vehicle unit and the traffic signal unit. The transmitter sends a signal from the emergency vehicle, and the receiver at the traffic junction detects it to automatically provide signal clearance.

3. IR Sensors

Infrared (IR) sensors are used to detect vehicle presence and measure traffic density. When a vehicle passes in front of the sensor, it detects obstruction and sends a signal to the Arduino for traffic light timing adjustment.

4. 12V Transformer

The 12V transformer steps down the high AC mains voltage (230V) to 12V AC, making it suitable for use in the circuit's power supply section.

5. Voltage Regulators

Voltage regulators (such as 7805 or 7812) are used to provide a stable and constant DC voltage to the circuit components. They ensure safe operation by preventing voltage fluctuations.

6. Encoder and Decoder IC

The encoder IC converts parallel input signals (like emergency signals) into serial data for transmission via RF. The decoder IC receives the serial data and converts it back into parallel form for processing by the Arduino.

7. Rectifier

The rectifier converts AC voltage from the transformer into DC voltage. It is usually implemented using a bridge rectifier configuration.

8. LED Array for Traffic Light

The LED array represents the traffic lights (Red, Yellow, Green). The Arduino controls these LEDs to simulate real-time traffic signal operation.

9. Filter Capacitors

Filter capacitors are used in the power supply circuit to smooth out ripples in the rectified DC voltage, ensuring a stable power output.

10. Switches

Switches are used for manual control, system reset, or testing different modes of operation in the traffic control system.

11. Other Miscellaneous Components

These include resistors, connecting wires, breadboards, PCB boards, connectors, and other small electronic components necessary for proper circuit functioning and assembly.

## RESULTS AND DISCUSSION

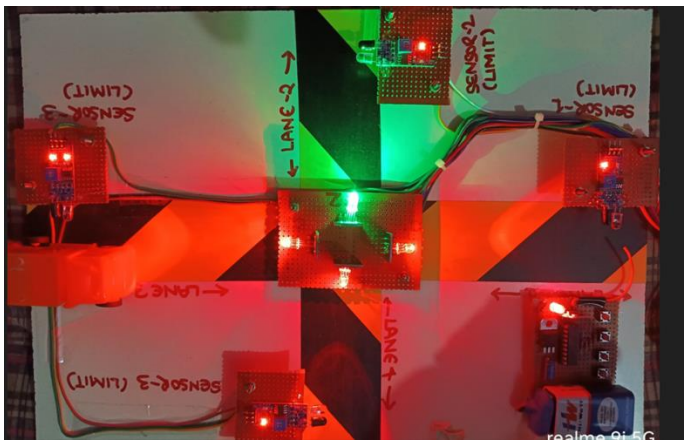
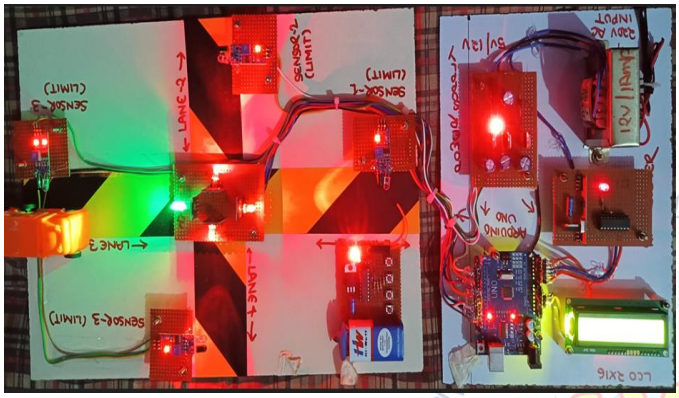



Fig 3:Kit Working



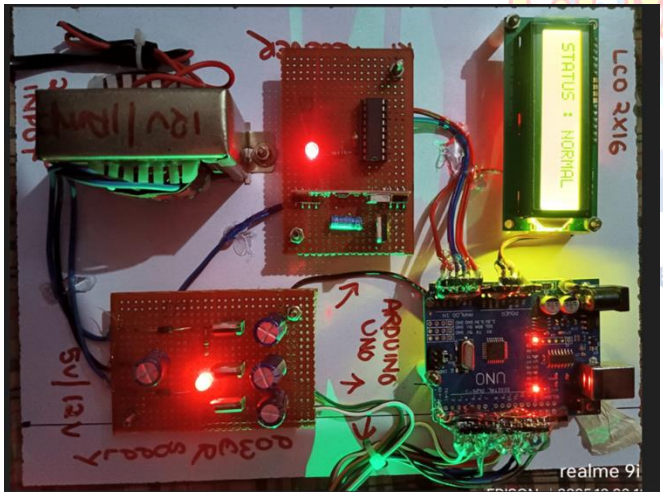




Fig 4:Kit Working

In this system, we built a smart and innovative way to regulate traffic lights with an ambulance-based signal control system that uses an Arduino-based controller and an infrared sensor. This system is also linked to Emergency Vehicles for Patients Other Than Ambulance. This vehicle comprises of an RF Transmitter with four switches. Traffic Police will have a receiver unit with an indicator led. When approaching the traffic signal in a dedicated lane such as (A,B,C,D), he must press the appropriate switch on the transmitter module. On the receiver end, the Microcontroller receives this signal and immediately changes the traffic signal to green. The LCD Module communicates with this system to display the status message.

This hardware unit is programmed in the embedded C programming language using the Arduino IDE compiler. RG LED lights are powered by Arduino's digital pins, while IR sensors are powered by the Arduino controller's analog pins. The controller board is programmed using an onboard USB programmer.

This proposed system operates on the following steps.

1. Normal sequential operation of a 4-lane traffic light with red and green LEDs.
2. IR Sensors monitor traffic density. When a vehicle approaches an IR Sensor, it indicates a high density of traffic in that lane and turns the traffic light green to clear it.
3. If an emergency vehicle, such as an ambulance, is in a specific lane, the driver is given a hardware RF device. Using it, he must press the Lane number (1,2,3,4) in the hardware gadget. This signal is received by the traffic controller unit, which automatically changes the lane to Green Signal.
4. The LCD module displays the system's status message. As a result, this technology is suitable for usage in many high-traffic regions of big cities. The system's power supply design includes a 230/12V step down transformer, which is utilized to reduce the voltage to 12 VAC. A bridge rectifier is used to convert the voltage to direct current. To remove ripples, a capacitive filter is employed, which uses a 7805 voltage regulator to regulate it to +5V, which is required for the operation of the microcontroller and other components.

## CONCLUSION

Ambulance delays have become a major public health concern in several countries, leading considerably to avoidable deaths. In an emergency medical crisis, every second counts, and an ambulance's failure to arrive to the patient or hospital on time might be the difference between life and death. Traffic congestion is a primary cause of delay, especially at busy crossings where ambulances must wait for extended traffic light cycles. Traditional traffic management systems do not prioritize emergency vehicles, resulting in inefficient routing and longer journey times. To address these problems, this paper describes the design and implementation of a

Smart Ambulance Guidance System, a modern approach for optimizing ambulance travel in metropolitan road networks. The Smart Ambulance Guidance System works by combining ambulance position tracking and sophisticated traffic light regulation. When an emergency case is spotted, the algorithm determines the ambulance's real-time location and predicts its approach to approaching intersections. As the ambulance approaches a traffic signal, the device automatically overrides standard signal timing and turns the light green in the ambulance's direction of travel. This enables a free way through junctions, resulting in dramatically reduced standstill times. Meanwhile, traffic in other directions is momentarily halted to prevent crashes and provide safe passage for the emergency vehicle. Once the ambulance has passed through the intersection, the signals resume their normal operation cycle. The deployment of this system offers various interesting advantages. First, it reduces time lost at junctions, which is a major contributor to overall ambulance delays. Second, it improves public safety by eliminating the need for ambulances to navigate heavy traffic or break traffic laws, which can be dangerous for both emergency personnel and the general public. Third, the system can be connected with existing traffic infrastructure, making it an affordable and scalable solution for both emerging and developed countries. In life-threatening medical situations, even a minor reduction in response time can drastically increase survival rates. By enabling faster and safer ambulance transit, the Smart Ambulance Guidance System has the potential to save many lives that would otherwise be lost due to delays. As urban populations increase and traffic congestion worsens, implementing such intelligent traffic management technologies becomes not only helpful but critical for modern healthcare and emergency response systems.

FUTURE SCOPE

- Connecting all signals to a centralized smart city traffic control network.
- Use of V2I communication where vehicles directly share traffic data with the controller.
- Incorporation of GPS-based emergency vehicle tracking for predictive clearance.
- Real-time data analytics through cloud/IoT dashboards.
- Solar-powered operation for energy-efficient smart intersections.
- Adding pedestrian detection and priority management systems.
- Support for adaptive routing, guiding vehicles through less congested roads.

**Conflict of interest statement**

Authors declare that they do not have any conflict of interest.

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