

# Traffic Control System for Emergency Vehicles

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**Abstract— Traffic lights are crucial for managing the flow of vehicles on the road. In particular, when there are emergencies, the traffic situation is getting worse. Emergency vehicles find it challenging to cross busy road during periods of traffic congestion. A medical facility must be reached by emergency vehicles like ambulances, or victims of accidents must be transferred to it as soon as possible. They could be late for rescue efforts because of traffic signals. Identification of emergency vehicles, control of traffic lights, and provision of a clear path for their travel are the objectives of traffic signal control for emergency vehicles. Emergency vehicles and traffic signals are connected by this system. The main element of this system that implements the control system is radio frequency Identification (RFID). The RFID tag helps to verify that emergency vehicles are leaving the traffic signal, and it also makes use of ultrasonic sensors to determine the density. The emergency vehicle can clear all junctions without wasting time at the traffic signals thanks to the theory that movement of the emergency vehicle near the traffic signal and changes in density reflect in changing the signal. This keeps happening until the ambulance arrives at its destination. These processes all took place without any assistance from humans.**

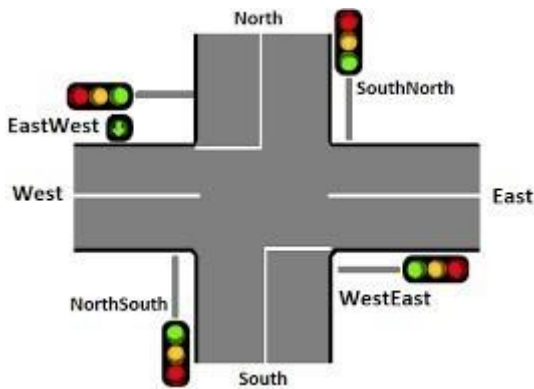
**Keywords:** *RFID, ultrasonic sensor, emergency vehicles*

## INTRODUCTION

The movement of vehicles and pedestrians along a route, traffic congestion, or the movement of people (including both vehicles and pedestrians) through an area or along a route are just a few examples of how traffic can be described. Each definition has its own distinct identity. According to a report released on April 18 by The Boston Consulting Group on behalf of Uber, commuters in Delhi, Mumbai, Bengaluru,

Chennai, and Kolkata spend 1.5 hours longer on their daily commutes during peak traffic hours than those in other Asian cities. Congestion during peak hours refers to the extra time needed to travel a certain distance. At an intersection of two or more roads, traffic is directed using traffic signals, also known as stoplights. It visually signals when to go, go slowly, and stop. Once in a while, aside from that, traffic signals inform drivers when it is safe to make a turn. These signals can be manually operated or set to operate on a basic timer that alternates between cycling traffic on one road for a predetermined period, then on the other for the same period, before repeating the cycle.

To instruct drivers to obey the posted sign, traffic signals are used as teaching aids. Road safety is ensured by obeying traffic signals, which use a common color scheme to make things simple to understand. At traffic lights, the color red signals that there may be a hazard up ahead and tells drivers to stop. Danger or warning are typically indicated by the color red. In addition, you should only make a left turn at a red light if a sign instructs you to. Furthermore, when doing so, you must stop vehicles and pedestrians traveling in the opposite direction. The approaching red signal is signaled by a traffic light that is currently yellow. As a result, you should begin to slow down as soon as a yellow light appears to prepare for a red light. If you cannot stop for any reason, watch out for any vehicles that may be approaching the intersection at the same time. A green light denotes safety and the word "GO," much like a red light denotes danger and the word "STOP." You should wait until all traffic has passed through the intersection before moving forward to be extra cautious.



A. Fig.1. Four-way traffic control [18]

Traffic lights are used to control how quickly and safely vehicles and passengers can move through an area. Drivers who disobey the laws and guidelines outlined by traffic lights run a very high risk of getting into an accident. As a result, traffic lights contribute to a decrease in vehicle collisions. Traffic lights also aid in time savings because they coordinate traffic flows and routes without causing congestion. It also contributes to establishing discipline in people's daily lives because those who disregard traffic regulations and warning signs must pay fines to the authorities. Before traffic lights were installed, traffic was governed by the traffic police. Traffic lights shield traffic police officers from roadside air pollution by reducing the amount of time they must stand on the road directing traffic.

The wireless Radio Frequency Identification (RFID) system consists of two components: readers and tags. Readers are electronic devices that use one or more antennas to pick up signals from RFID tags by transmitting radio waves and receiving them back from the tags. Tags can be passive or active, transmitting their identity and other data to nearby readers using radio waves. Passive RFID tags are battery-free due to the reader's power supply. Active RFID tags are powered by batteries. RFID tags are capable of storing a wide range of information, from a single serial number to several pages of specifics. It is possible to carry readers in one's hand, suspend them from the ceiling, or mount them on a post. [19]

Fixed readers and mobile readers are the two different types of RFID readers. The network-connected RFID reader has two mounting options: surface-mounted or portable. Signals that turn on the tag are transmitted via radio waves. The internal transponder of the RFID tag sends a wave back to the antenna after being activated, where it is converted into data. The read range of RFID tags is affected by the kind of tag, reader, RFID frequency, and interference from other

RFID tags and readers. Stronger power source tags have wider read ranges as well. [19]

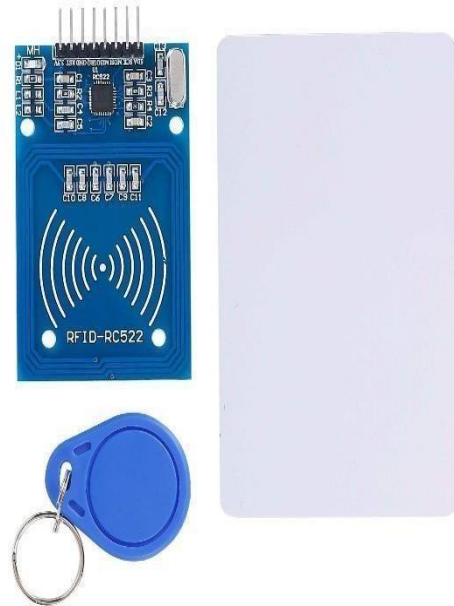


Fig.2. RFID Module [19]

To find out how close an object is, an ultrasonic sensor uses a transducer to send and receive ultrasonic pulses. High-frequency sound waves reflect off of boundaries, producing recognizable echo patterns. Sound waves that are

louder than the range of human hearing are necessary for ultrasonic sensors to operate. Our ultrasonic sensors work like many others by using a single transducer to transmit and receive pulses. Sonic sensors, like many other types of sensors, use a single transducer to send and receive pulses. The sensor can figure out how far away a target is by measuring the amount of time between sending and receiving ultrasonic pulses. The fundamental idea that underpins this module is simple. It uses an ultrasonic pulse with a frequency of 40 kHz that travels through the air and, if it encounters a wall or other object, returns to the sensor. The distance can be calculated using the travel time and sound speed.[20]

Ultrasonic sensors are effective at detecting transparent objects. Applications that use infrared sensors, for example, have difficulty determining liquid levels in this particular use case due to target translucence. Ultrasonic sensors can identify objects regardless of their color, surface, or composition, except very soft materials like wool that would absorb sound. Where optical technologies might fail to detect transparent objects and other things, ultrasonic sensors are a dependable replacement.[20]



Fig.3. Ultrasonic sensor [20]

### I. LITERATURE SURVEY

- [1] Seetharaman.R1, Karthikeyan.S2, Saranraj.M3, Sankar Kumar.P4, Nina Mohamed.M5, et al. presented a system in LabView titled Smart traffic system for emergency vehicles and density-based traffic control using RFID [55]. RFID is used to determine traffic density in this instance. The number of vehicles in a lane is counted using a reader and tags. The tags are fastened to the cars, and the reader is set up in the middle of the road. The traffic signal time is extended as more cars pass the reader, which counts them as they pass. LabVIEW is used to carry out the stimulation. The type of detector used in this camera has a temperature sensitivity of 0.038°C. The field of vision is 49°/18mm x 36°/25mm, and the maximum resolution is 640x480 pixels. Additionally, this has a reading precision of 1% and can detect temperatures between -40°C and 400°C. The pantilt, which acts as the orienting mechanism, is connected to the camera.
- [2] Miamian Cao1, Qari Shuai1, Victor O.K. Li1, et al. created an intelligent transport system with traffic signal control that is centered on emergency vehicles. The controller continuously tracks the speed, delays, separation from the stop line, and stay time of the emergency vehicles after spotting them approaching an intersection using an algorithm.
- [3] S. Dr. K.V.S. Kaushik Henrik Raman Rajeswari Rao developed a computer vision system for the detection, use, and analysis of emergency vehicles. Instance segmentation and obstacle detection are the two computer vision techniques selected for emergency vehicle recognition. A CONVOLUTIONAL NEURAL NETWORK (CNN) specifically created under the name Furter RCNN is used for obstacle detection.
- [4] Sai Manikandan Pila, S. Radhika, Sai Surya Prakash Mokka, and others The RFID tag attached to the vehicles was read using an Arduino-based RFID reader. The green signal will turn on for the path with the most vehicles after the reader has counted the number of passing cars for a predetermined amount of time. When XBEE detects emergency vehicles, the green light is activated.
- [5] The RFID-Based smart traffic control framework for emergencies was presented by Tejas Naik, Roopa Lakshmi R, Diya Ravi N, Pradhan Jain, Sowmya B H, and others. The lane is opened up for assistance when one of the many tags this system uses is found. It makes use of RFID tags to calculate signal density.
- [6] This paper proposes a model that uses real-time IP and obstacle detection using an acoustic signal processing algorithm that may introduce false positives into obstacle detection using both image processing and a convolutional neural network (CNN) architecture. The model is called SSD and uses SSD, a convolutional neural network architecture. To speed up their work, researchers Abhishek Raman, Kaushik S, Dr. Rajeswari Rao, and K.V.S. Dr. Mina Moharrir et al. developed a hybrid framework.
- [7] Aman Firdous, Indus, and Vandana Niranjana demonstrated a smart traffic light system that automatically adjusts its timing based on traffic density using an Arduino Uno AT Mega 328. Digital IR sensors are used to detect traffic, and then IR sensors are used to identify vehicles based on the signal reflected from them. Traffic signals are properly adjusted using roadside sensors to control traffic density. Every IR sensor is connected to the Arduino Uno via wires, enabling it to read data from them. With two LEDs per lane in each signal, the system uses LED traffic signals. Compared to the conventional traffic system, using this system development at a traffic intersection takes less time because we don't have to worry about manually controlling the flow of traffic. We develop a working prototype of a smart traffic signal that automatically alters its timing by the flow of traffic using solar power from solar panels.
- [8] According to Olausson Ajayi, Antoine Bagola, Homophone Maluleke, and Ifeoma Chukwubuezeet. al., queues at traffic intersections can significantly lengthen the travel times of medical emergency vehicles (EVs) by as much as 20%. This frequently has the power to decide between life and death. Setting EVs as a priority might be a way to overcome

this problem. In this paper, a priority preemption model for electric vehicles in smart cities is suggested. It makes use of sensors to continuously monitor the EV's position and speed, and it adaptively modifies the timing of all the traffic lights in its path. This guarantees that the EV arrives at its destination with little to no delay. According to experimental findings, the suggested model may be able to reduce travel delays incurred by medical EVs by up to 35%.

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able to reduce travel delays incurred by medical EVs by up to 35%.

- [10] Nitesh Kumar, Syed Shamateur Rahman, Nevin Dataset, et al. presented a model for the Intelligent Transport System. Fuzzy Inference Enabled Deep Reinforcement Learning Based Traffic Light Control is the name of the system. It is advised to use a dynamic and intelligent traffic light control system (DITLCS), which uses real-time traffic data as input to dynamically adjust the duration of the traffic light. Additionally, the proposed DITLCS functions in three different modes: Fair Mode (FM), Priority Mode (PM), and Emergency Mode (EM), respectively, where all vehicles are given equal priority, different categories of vehicles are given varying levels of priority, and emergency vehicles are given the highest priority. A deep reinforcement learning model is suggested to change the phases of the traffic lights (Red, Green, and Yellow), and a fuzzy inference system is used to choose one mode from three modes (FM, PM, and EM) based on the traffic data. The open-source simulator Simulation of Urban Mobility (SUMO) was used to test DITLCS using a realistic simulation on a map of the Indian city of Gwalior. The simulation outcomes show that DITLCS outperforms other cutting-edge algorithms on several performance-related metrics.

II. AIM, SCOPE, AND METHODOLOGIES

B. AIM

The current approach aims to develop a system that utilizes an Ultrasonic sensor and RFID to determine density and identify the Emergency vehicles respectively, with the signals changing by density and Emergency Vehicles.

C. EXISTING METHODOLOGIES USED

The RFID EM-18 reader module that we are using continuously emits radio frequency waves at a frequency of 125 kHz. The transponder on the specific tag would transmit its unique data to the RFID reader at the same time that it was receiving the transmitted data from other tags. An RFID tag's coil strip will become excited and start to power the tag's transponder when it enters that radio frequency wave range. These data will be delivered to the processor. Each distinct piece of data is seen by the processor as a separate vehicle. According to the number of moving vehicles, data delivery will be proportional. Depending on how much traffic there is, the traffic signal's timing will change. To adjust the signal timing to the volume of traffic on each road, the procedure rotates counterclockwise and continuously checks the roads. Each ambulance has a distinctive tag ID. This particular ID activates the signal for that lane and disables the signal for all other lanes when it crosses RFID.

As a result, the traffic is properly managed. [1]

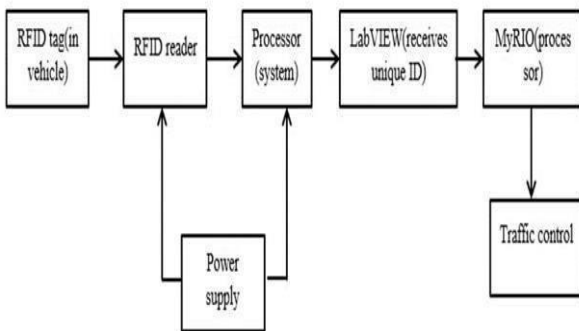


Fig.4. Block Diagram of the existing system [1]

The RFID tag is fixed to the vehicle and the RFID reader module will emit a radio frequency wave. The tag will transmit the unique ID to the reader when it detects frequency within the specified range of the reader. The processor will treat the ID as a vehicle once it receives the tag ID from the reader and sends it to it. The number of vehicles is then calculated as a traffic density, with each Id being counted as a separate vehicle. As a result, traffic signal timing is adjusted by the number of vehicles. The timing for Fig.6. Output Image of existing methodology [1] keeping the signal open depends on the type of vehicle using the specific road. The other three roads operate similarly in III. PROPOSED METHODOLOGY an anticlockwise direction. Normally, traffic lanes are

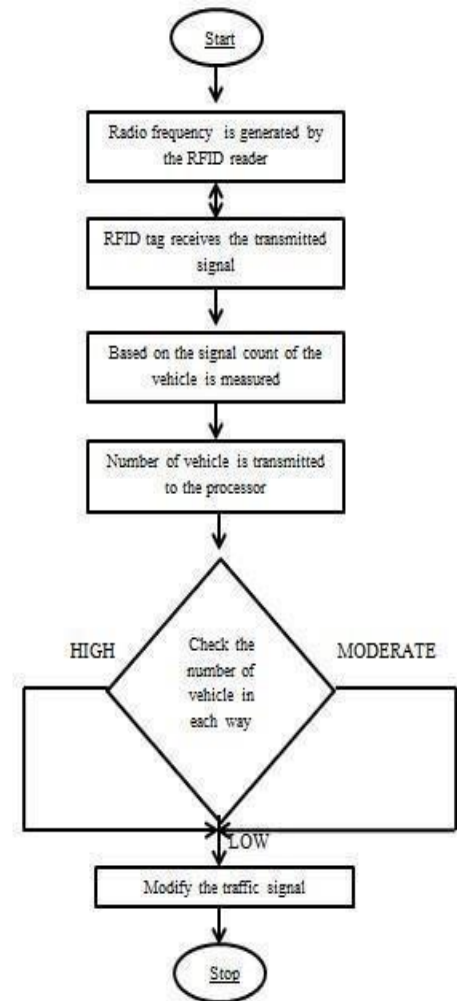
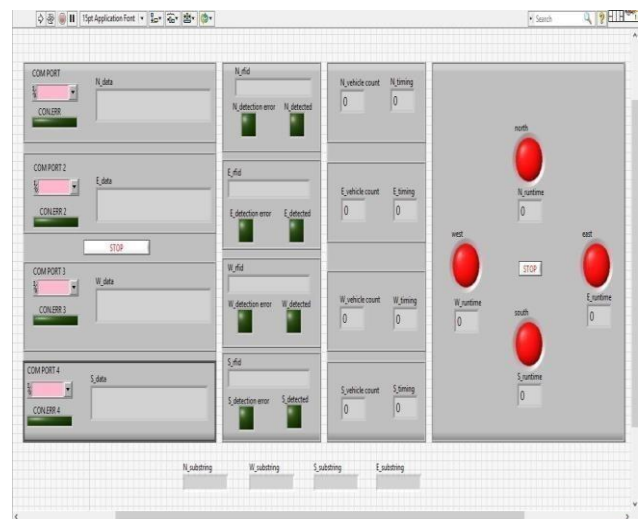


Fig.5. Block Diagram of the existing system [1]



managed based on traffic density, but when an emergency

vehicle suddenly enters the scene, the remaining lanes are emergency vehicles and Ultrasonic sensors to determine abruptly closed and the lane where the emergency vehicle is density. We will make use of both an RFID reader and an approaching is opened. [1]

involves placing an RFID reader at the signal and attaching RFID tags to the emergency vehicles. The RFID reader activates the tag using radio waves when the rescue vehicle is nearby. When a tag is activated, a wave is emitted, which returns to the antenna and is transformed into data the reader can read. The emergency vehicle will cause the signals to change from red to green in the lane where it is detected.

The traffic management system in place is already effective, but it takes a lot of time. The proposed system accurately and continuously manages traffic at every intersection. By putting this system into place, the public can save valuable time by avoiding traffic jams. Additionally, it helps to lessen congestion in areas with high traffic, which lessens accidents by preserving public life. This system prevents traffic density and allows emergency vehicles to arrive at the appropriate time, saving human lives. Additionally, it aids in minimizing human interference with traffic signals.

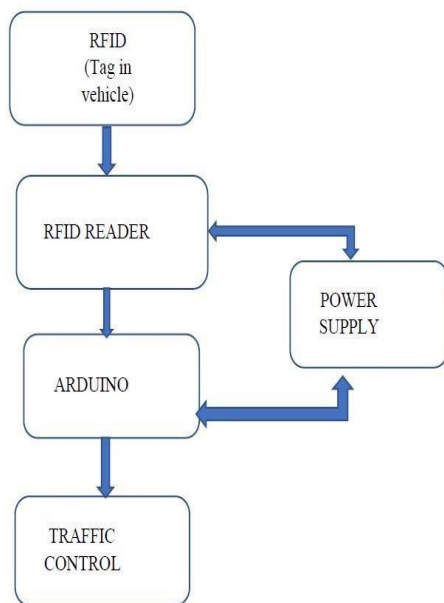


Fig.7. Block Diagram of the proposed system

Now that we have reached the final stage, we have proposed a model that combines RFID and Ultrasonic sensors, with the Ultrasonic sensor being installed alongside the RFID reader at the signal. The traffic density will be determined by an ultrasonic sensor, and the lane with the highest density will receive a green signal while the others will display a red one. The emergency vehicle's lane will be

The suggested approach uses RFID rc522 to identify

RFID tag while utilizing RFID technology. This approach

given green and the other lanes will be given red when it enters the traffic signal because the RFID reader will detect the vehicle and give it priority over the dense lane.

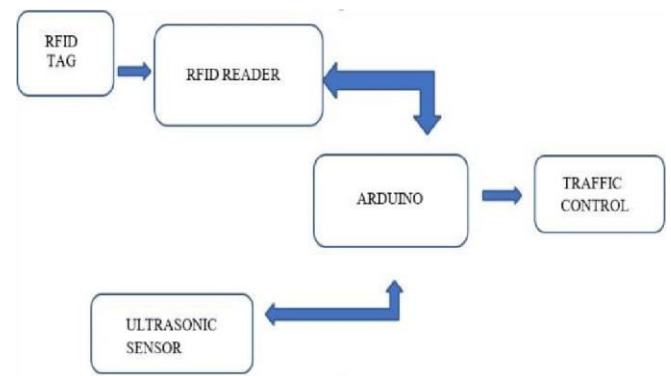


Fig.8. Block Diagram of the proposed system

The delay of the yellow signal will be five seconds, and the traffic signals will change every 45 seconds. Twenty meters from each line's signal, the RFID readers will be placed in the path. This model uses an ultra-highfrequency RFID module with a frequency of 433 MHz, and the RFID reader has a range of 100 meters. The RFID reader will recognize any nearby emergency vehicles, and the process will then proceed. In addition to this, ultrasonic sensors will also be placed along the sides of RFID readers. The most popular range for ultrasonic sensing is 40 to 70 kHz, which can detect objects at a distance of about 11 meters. The Radio Frequency Identification is interfaced with the Arduino Mega using the SPI protocol, which is the protocol used in the model.

#### IV. ADVANTAGES

With almost all of the Features present in the methodologies currently in use, the proposed methodology is simple to implement.

- Contrary to other microcontrollers used in the majority of methodologies.
- The ones used here are relatively cheap.
- Simple connections make up the circuit.
- Here, the methodology takes into account both density and the detection of emergency vehicles. In comparison to other projects.

- This one is less complex. It is simple to use and can be applied to all locations. monetary efficient.

## V. CONCLUSION

It is possible to reduce traffic in congested areas by using this model, which lowers accidents by sparing the lives of bystanders. This system aids in lifesaving by reducing traffic congestion and allowing emergency vehicles to arrive when they are most needed. Another advantage is lessening human interference with traffic signals. The recommended approach is straightforward to use and has almost all of the same traits as those currently in use. Here, the methodology considers both density and the ability to detect emergency vehicles. This project is less complicated than others in comparison. It can be used in any circumstance, is reasonably priced, and is easy to use. The RFID reader will recognize an emergency vehicle as it gets close to the traffic light, giving it priority over the backed-up lane and turning that lane green while the other lanes turn red. Similarly, density is the basis for how ultrasonic sensors operate.

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