AN APPROACH FOR EMERGENCY VEHICLE CONGESTION REDUCTION USING GPS AND IOT

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Abstract— Traffic plays a very important role in our daily lives whether we are going to offices, schools or even when coming back to home. Everyone wants a peaceful way to reach their destinations. In case of emergencies like an accident, it's very much important that we have a proper system that can handle all these situations in a smarter way. Now with the existence of technologies like the Internet of Things, it's very easy to maintain these kinds of complex systems without human intervention. The main aim of our proposed work is to design a new traffic management system that can handle any of the given critical situations easily. The emergency might not be only for emergency vehicles such as ambulances or fire engines, it can be an emergency patient in a private vehicle who must reach the hospital as soon as possible. Any individual or an ambulance representative who is registered with the government database can make their vehicles as emergency vehicles if there is an emergency such as an accident so that they can reach a hospital as soon as possible. We are going to make an android application that uses GPS live location of the user and sends the data to the database such that the traffic signals can be changed accordingly and clear the traffic. Also, the system detects empty lanes using Passive Infrared (PIR) Sensors and changes their signal to red such that it reduces traffic congestion.

Keywords— Smart traffic system,Traffic congestion, Emergency vehicles, Ambulance, Global Positioning System, Traffic Flow Control.

I. INTRODUCTION

As per the reports, the traffic in India is worse than in any other country in the world. In a country with a population of 135 crores, it is very difficult to manage the traffic of this scale manually. Recently India has come up with the concept of Smart Cities, with the cities smarter than ever the need for automated traffic management is very much necessary in such cities.According to a survey, more than 20% of patients in need of emergency care perished on the road before reaching the hospital owing to traffic bottlenecks and difficult drivers.

Any individual or an ambulance representative who is in an emergency should be able to reach their destination as soon as possible. Using the Internet of Things, giving way to the emergency vehicle or clearing the lane in which the emergency vehicle is travelling might alleviate this difficulty.

The current invention is broadly directed to a system and method for tracking an emergency vehicle's real-time position and allocating a lane to the vehicleusing internet of things. The present invention more particularly relates to a system and a method for tracking the real time location of the emergency vehicle and allocate a lane for the vehicle.

The system makes use of GPS module in the andirod phones to detect the location of the emergency vehicle and that data is compared with the traffic signal geographic location present in the database. Which can be used to detect if an emergency vehicle is present near a traffic signal.

The main contributions of the paper are as follows:

- The proposed approach provides a system that tracks the real time location of the emergency vehicle.
- It alsoprovides a system that identifies the emergency vehicle and allocate a lane.

The rest of the paper is organised as follows. Section 2 examines prior research studies that have been conducted to analyse the information in order to arrive at the suggested strategy. The suggested technique is described in detail in Section 3. Section 4 examines the outcomes of the recommended method. Section 5 concludes the study with a brief summary.

II. LITERATURE SURVEY

Deepali Ahir et al. [1] presented an Intelligent Traffic Control System for Smart Ambulances, in which the ambulance driver uses an android application with GPS to identify the nearest signal based on the ambulance's current position. And that particular signal is turned green until the ambulance passes by, after which it reverts to its previous state. As a result, it is a life-saving project since it saves time during an emergency by controlling traffic signals. However, their project has a flaw in that the driver must manually manage the device, which could lead to more accidents.

Norlezah Hashim et al. [2] suggested a peripheral interface controller-based automatic traffic light controller for an emergency vehicle. During an emergency, this concept intends to assist emergency vehicles crossing the road at a traffic light junction. A Peripheral Interface Controller (PIC) was utilised to programme a priority-based traffic signal controller for an emergency vehicle in this project. An emergency vehicle, such as an ambulance, might automatically cause the traffic light signal to change from red to green in order to clear its path. When the ambulance has completed crossing the road, the traffic light operation will return to normal using Radio Frequency (RF). The design was found to be capable of responding within a 55-meter range.

Sangamesh S B et. al [3] proposed an advanced Traffic signal control system for emergency vehicles, This project intends to manage emergency vehicles such as ambulances and fire engines in order to avoid traffic and arrive at their destination in time to save lives. The cloud is at the heart of this system architecture, which is built on the Internet of Things (IoT). The suggested

system uses real-time GPS to track the vehicle's location and upload it to the cloud, as well as smart traffic lights that are present along the vehicle's journey. The system keeps track of emergency vehicles so that they can pass through traffic with no or little delays, lowering the number of deaths on the way to the hospital and reducing the damage of property in the event of an accident.

Vidya R et al. [4] presented an intelligent traffic control system, stating, "The number of cars is slowly increasing day by day throughout the world." In India's biggest cities, the number of vehicles is likewise growing. As a result, massive traffic congestion develops, slowing traffic speeds, lengthening travel times, and increasing queuing. This causes drivers to become enraged and engage in road rage; these conditions may have an impact on the patients in the ambulance if they are not transported at a faster pace. As a result, residents of the metro area waste a significant amount of time. Timely arrival at the hospital due to traffic congestion.

M.S.D.SaiVarmaet. al [5] proposed an Intelligent traffic control system for emergency vehicle using rf technology,Their research attempts to create a traffic management system that detects emergency vehicles at traffic signals using RFID (Radio Frequency Identification) technology.The signal has an RF receiver, and the emergency vehicles have an RF transmitter, so the lanes can be freed based on the detection of RF in the signal. They explain that though RF's range is limited 10 metres, it can be extended utilising technologies like Zigbee.

However, the existing technologiesused RFID or BUZZERS to clear lanes for emergency vehicles which does not give the real time information about the vehicles. In order to overcome the limitations, there isa need to develop a system that traces the real time location of the vehicle and accordingly provide a vacant lane for the emergency vehicles. The technical advancements disclosed by the present invention overcomes the limitations and disadvantages of existing and convention systems and methods.Table 1 shows the summary of various existing work approaches, advantages and limitations.

III. ROPOSED MODEL

We will create a system in which the user (who may be a city resident with a health issue or an emergency vehicle representative) can pre-register and log in to the app with his vehicle information. Regular users and emergency vehicle representatives have unique options. When a normal user logs onto the app, he will be able to inform his emergency contacts. He can choose a neighbouring hospital and handle traffic from there.

When an emergency vehicle representative logsinto the app, he should choose the type of vehicle he is driving and his destination. From this point on, the programme behaves in the same way in both of the aforementioned scenarios.The app gives the user a route to their destination, then checks the GPS location of the devices against traffic signals along the route. If the user is close to a traffic signal, data such as user id, location, and nearby traffic signal ID (every traffic signal has a unique id) is sent to the database.

The traffic control room gets an upcoming emergency vehicle request and verifies the authenticity of the request by looking up the vehicle type using the registration number. The request is reported as spam if it is discovered to be fake. If the request is verified, a request for the arrival of an emergency vehicle is made to the destination in order to make the required preparations. The car is given the quickest route to its destination and is added to the traffic signal's emergency vehicle queue.

The system at the traffic light is searching the database for emergency cars. The vehicle data is added to the queue if there is an emergency. The queue comprises of all emergency vehicles that will pass the signal at the same time, so that priority may be given to the first vehicle to join the queue, and the lanes are freed appropriately, and the vehicle data is popped from the queue, otherwise the signal system will operate properly.We will reduce traffic congestion by turning the light red when no traffic is detected in a specific lane, allowing drivers in other lanes to go to their destinations without wasting time.

Table 1. Shows the Summary of literature survey

Ref.No	Methodology	Advantages	Limitations and Enhncements
[1]	Android application with GPS	Using technologies like GPS.	• The driver must manually control the system which might lead to further accidents. • We can automate the process of controlling of the traffic signal.
[2]	Peripheral Interface Controller (PIC)	Radio Frequency (RF) technology less chances to tamper	• The range of RFID is very less. • Range can be further increased by using technologies like Zigbee.
[3]	Real-time GPS	Using GPS and cloud technologies to control traffic.	• GPS module were used to get the user location. This can be expensive as there is requirement for a separate module in vehicle. • Using GPS which is directly built into mobile can be used.

[4]	Arduino UNO, IR sensors and LEDs	Stolen vehicles can easily be detected using RFID based vehicle positioning.	• All the vehicles should be equipped with RFID and the data of all the vehicles should be present at the traffic signal module. • Instead of placing RFID for all vehicles only emergency vehicles can have an RFID
[5]	RFID(Radio Frequency Identification)	RFID can be a cheaper solution and are not easy to tamper.	• The Range of RFID can be a problem. • Range can be further increased by using technologies like Zigbee.

To execute the aforementioned principle, we may use a PIR sensor to identify automobiles in the lane.

We proposea smart traffic monitoring system with ambulance safety in this article, in order to solve the above-mentioned concerns about emergency vehicles being stuck in traffic. The suggested design focuses on smart traffic monitoring as well as the Ambulance Safety feature, which manages traffic so that emergency vehicles such as ambulances do not become stopped in a congested crossroads zone.

A. Design Objectives

The following are some of the goals we want to achieve through our planned work:

- Ensures that the emergency vehicle's travel lane is clear so that it does not become stranded in a traffic bottleneck.
- Allows hospitals to check real-time information about emergency cases such that they can have prior arrangements
- Allows traffic control rooms to monitor real-time traffic.
- Decrease the waiting time of traffic by making empty lanes red.

B. Architecture

The architecture comprises ofthe ESP 8266 Wi-Fi Module, PIR Sensors, and LED lights are connected to the Arduino Mega microcontroller using jumping wires, and the code for its operation is written using the Arduino (IDE) application.

1. Arduino Mega 2560- The Arduino Mega 2560 is a microcontroller board. It can be programmed using the Arduino Software (IDE). This might be referred to as the brain of our planned project. Arduino connects all of the parts and sensors. The written code is also loaded into Arduino, allowing our code to work with physical components.
2. ESP8266 Wi-Fi MCU- The ESP8266 Wi-Fi MCU is used to detect the emergency vehicle near to it by posting HTTP requests to the server.
3. PIR Sensor- A PIR Sensor is a device that detects traffic in a specific lane. When there is no traffic in a lane, the traffic light becomes red.
4. RGB LED lights - The three signals of a traffic signal light are shown using RGB LED lights, with Green signifying "Go," Red signalling "Stop," and Yellow indicating "Ready."
5. Jumping wires (Male to Male & Male to Female)—Used to link each component from Arduino as well as other components.
6. Breadboard (one normal breadboard and four small breadboards)- According to the four-way junction, LEDs are put on four tiny breadboards. A regular breadboard is used to connect parts and provide power to various parts.
7. The architecture diagram in fig1 showhow all the above mentioned modules combine to make the disussed system.

C. Working

The proposed smart traffic management system is designed to work at intersections with three or more roads, each with two lanes. In the absence of an emergency vehicle, the system will check for empty lanes with green signals and turn them red; otherwise, it will work in a regular pattern, as illustrated in fig 3, with the signal turning green in a clockwise sequence for each of all roads for a predefined interval of time.

When an emergency vehicle notifies its details such as destination, Current location with the android application the application shares the details with the dashboard application present at the traffic control room which verifies the vehicle and accepts the request. Once the request is accepted the shortest route from the location of the emergency vehicle to the destination is shown on the application and the GPS data of the emergency vehicle is compared with the traffic signal location. Once the vehicle is near the traffic signal the emergency vehicle data is sent to the database which is monitored by the IoT module present at the Traffic signal as shown in figure 2. Once the traffic signal gets the vehicle's details the signal in the route is changed to green such that emergency vehicle can easily avoid traffic congestion.

The IoT module present at the traffic signal also monitors all the routes in the junction such that if any route is found to be empty the traffic signal at that particular route is changed to red such that waiting time at the traffic signal can be reduced significantly.

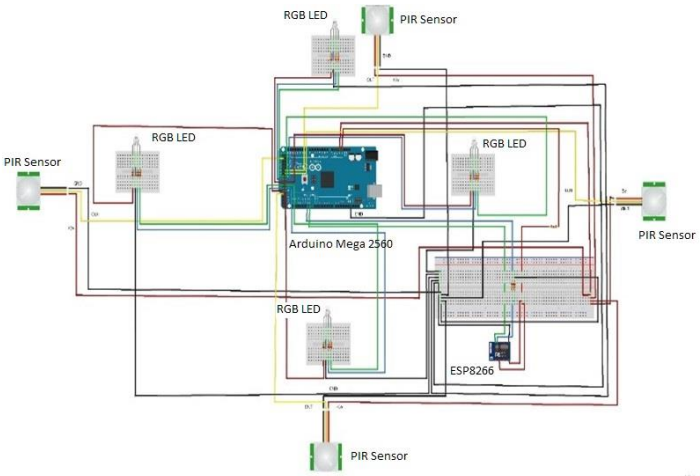


Fig.1 illustrates the schematic diagram of the components present in the system.

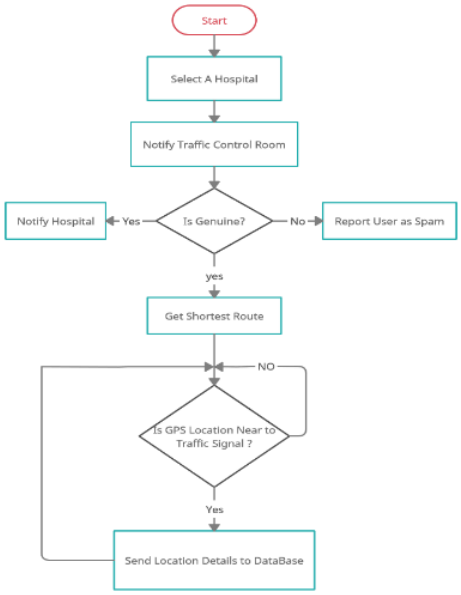
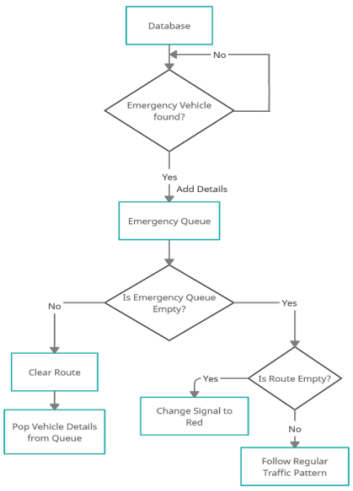


Fig.2 shows the working of the user application.



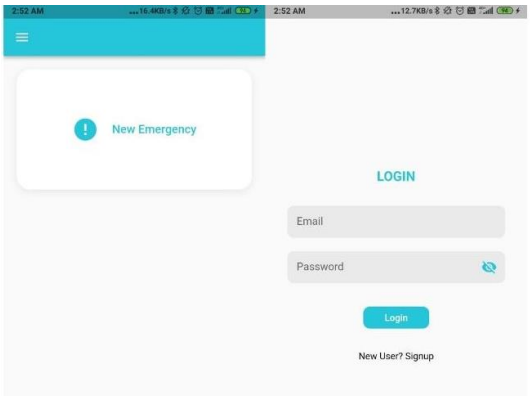


Fig.3 shows the working of the IoT Module at Traffic Signal

Working Flow for user application:

Step 1 Register the user from Android application.

Step 2 Approve user from Admin application.

Step 3 Raise New Emergency Request from application.

Step 4 Select a Hospital.

Step 5 Wait for the Approval from Admin.

Step 6 Travel in the route provided by the application.

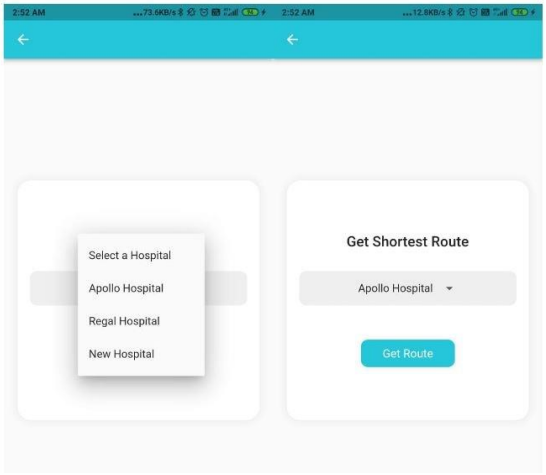


Fig.4 shows various components of android application

The detailed process on the systems working flow Is show in fig 3 and fig 2

IV. RESULTS

The following is a summary of the results gained after using the above-mentioned smart traffic management technique:
When an emergency vehicle uses the mobile app to notify the traffic control room and determine its destination. The user will be verified and the request will be accepted by the traffic control room using the dashboard web application. Once the request is granted, the app uses Dijkstra's algorithm to indicate the quickest path to the location, and the ambulance's GPS data is continually checked. As indicated in fig 2, if the vehicle is close to a traffic light, data is transmitted to the traffic signal, the vehicle data is added to the emergency queue, and the traffic signal on that route (Route 1) is changed to green, while the remaining traffic signals are changed to red. When the emergency vehicle departs that specific light, the data is plucked from the queue, and the traffic pattern resumes as usual. The Android application as shown in the fig 4 has a login page wherein user needs to login to enter the home screen. The home page has an new emergency option. Upon clicking on that button a page with near by hospitals is displayed. After selecting the hospital you will get the shortest route to the hospital and the traffic lanes are cleared accordingly as discussed in the above paragraph.
The login Screen as shown in the fig 6 uses firebase authentication for authenticating users. The nearest hospitals are stored in the firbasefirestore database and takes the user gps data to show the nearest hospitals.
The IOT Module present on various routes is shown in the fig 5.
Table 2 shows the comparison of the proposed system with other systems like RFID where in the ambulance lane gets cleard only when the ambulance reaches very close proximity to the traffic signal.

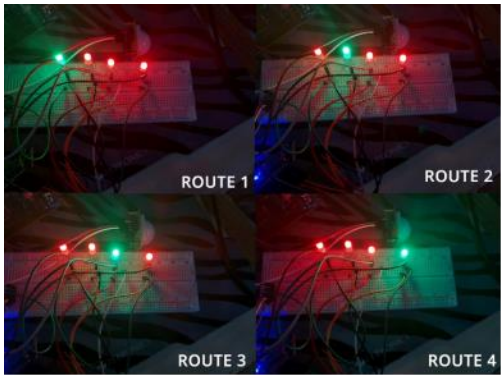


Fig 5 shows the working of the module at the traffic signal

Table 2 Shows the range comparison between different systems

Reference	Methods used	Range
[1]	Manual Clearing	0 meters
[2]	RFID	10-15 meters
	GPS based	100+ meters

V. CONCLUSION

In this proposed approach we use IoT and GPS to solve the problem of clearing the traffic for emergency vehicles and is compared with other systems like RFID. This system will be helpful for emergency vehicles for reaching their destinations without much hassle. This system makes use of GPS and the android app to get the exact location of the emergency vehicle and the website can help in detecting spam and monitoring of the emergency vehicles by the authorities such that they can have proper information about the situation prior to reaching the location. This system is accurate and user-friendly such that the end-user can easily understand the interface. This system can be extended by introducing GPS navigation with google maps and traffic signal status right from the app.

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