Automatic Traffic Signals In Smart Cities For Speedy Clearance Of Emergency Vehicles

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Abstract- *In today's world, the organ donation is now increasing due to its awareness and high demands. But the problem regarding is that organs remain healthy for a very short time. So transporting them is a highly time depending task and countries as India where the transportation is poor and vehicles are more, it's a very important task to manage the road signals for green corridor because of many patients' losses his life only due to traffic congestion. When some VIPs cars are travels through road it results in 40 minutes to 60 minutes early traffic jam which creates problems for peoples and ambulances create green corridor the high manpower required also so much money gets wasted on it. So it's a hard task to regulate the traffic. In these project, we developed a system which creates the green corridor by automatically changing signals for any emergency vehicles. In my system, I connect the various traffic signals in the city using the internet. In the early state, we just have to gives the path which we have to follow then the total further signal controlling action done automatically.*

Keywords- Green corridor, GPS, IOT, Traffic signal controlling,

I. INTRODUCTION

India is a second most crowded country with the growing economy. In India, the road congestion is the main problem. Vehicles are more, and the rate of infrastructure is slow, due to cost constraints and space [1]. Indian traffic system is disarranging and non-lane based, so it must require a way by which we can solve the problem. Brainy management of traffic flows is to be used to avoid the traffic congestion [2]. Emergency vehicles in various countries would not have their own access to roads. Which results ambulances are gets blocked from reaching their end point. Moreover, when lights flash and sirens are on, drivers at intersections are must give a path to emergency vehicles [4]. Unfortunately, many agitated drivers do not. "With all the horns, whistles, lights, on the ambulance, still not everybody gives a path to us," says rescuer from the Emergency Medical Services quoted in the article [6]. The one thing that certainly still grabs everyone's attention is a red traffic signal. Even though people want to give a path to the ambulance, traffic conditions might prevent them to give a path to the ambulance [7]. Using an Intelligent Control System designed for ambulances will allow the ambulance to move faster and to reach its destination in proper time.

The automatic traffic signal system is designed to achieve maximum throughput and easy flow of vehicle traffic. Unfortunately, at some time emergency vehicles are getting fixed in the traffic jam and clearing such jamming condition is difficult. It also required high manpower and money to do that [9]. If such unwanted condition cannot be removed then the emergency vehicles will have to fix the traffic for a long time. Due to such conditions, people's faces so many problems [13]. So to avoid these we must use an automatic traffic signal control system in smart cities for speedy clearance of emergency vehicles.

figure1. Ambulance stuck in a traffic jam

We can use Micro-controllers, processors, sensors, GPS, GSM, RF, Zigbee, and IoT concept to build a system which can mainly use to avoid the traffic jam condition [8]. GPS based system is mainly used for the developing because it is soft to develop and the main thing is it doesn't require any input from the person who is driving the emergency vehicles [10].

II. RELATED WORK

Traffic jams are the main issue in cities of developing Countries like India, China. The second-class families now become economically strong and the population of second-

class families is also more which results in more vehicles in numbers. Due to space problems roads are small which results in traffic block and chaotic condition [3]. In the Green Corridor System, all the red signals which come in the track of emergency vehicle becomes green, means it creates a green track to the emergency vehicle [11]. A 'green corridor' is the part of traffic control system. With a 'green corridor' setup, an emergency vehicle does not get any red signal because as the vehicle comes near to the traffic signal, the signal becomes green and create a green track to the vehicle [13].

GPS is placed on the vehicle do not have any problem. The disadvantages of the green corridor system are when the wave gets disturbed the whole system gets collapsed. If the emergency vehicles reach late at the signal the traffic jam condition can occur [15]. Till now these type of system is developed using strobe light Emitting System, The mobile Infra-Red Transmitter (MIRT) System, Acoustic Systems, RF Systems and using GPS system, In all the above systems the GPS system is mainly used because the GPS is easy to install and working over it is somehow easy [3].

Acoustic Systems-

The acoustic system includes a receiver placed over a traffic signal, which receives the siren sound of the ambulances and after that, it matches the sound with the stored sound if it matches then the signals gets turned green and the path of ambulance become free. But the disadvantage of the acoustic system is that the delay is more to free the path [4].

Infra-Red Transmitter System-

This system is developed for the undercover police. This device is smooth to use as comparing the strobe light system which is explained below. It doesn't have any high light beam which deflects the driver attention like a strobe light and it's most important ability is that it can change the traffic light within 3 to 5 seconds [2].

This system is made of two subsystems, first is a transmitter which is fixed over the ambulance and the second sub-system i.e. Receiver which is fixed at the signal, it receives the data signal from the transmitter system and accordingly changes the signals [2].

The Strobe Light Emitting system-

In this system, the high light emitting device is fixed over the ambulance at various positions like at top and in the middle. These light is going to transmit the high-intensity light at the signal. The strobe light receiver is fixed over the traffic signal, which receives the high-intensity light at as per that it can go to recognize the direction of the ambulance and then it will clear the traffic signal [3].

This system is having a disadvantage like it emits high-intensity light, so it can go to distract the other vehicle drivers due to which the accidental conditions can occur[3].

The RF System-

In this system, from the communication point of view, the RF transmitter and receiver is used in between two traffic signals and in between the Transmitter system and receiver System. The transmitter system builds with the RF transmitter, a Microcontroller, a keypad for giving input, with a display which shows the status of the system. The Receiver system builds of RF receiver, a microcontroller with LED light to show the indication of the signal changes and a buzzer which is used to indicate the ambulance is coming .The disadvantage of RF system is we can't analyze the direction of the emergency vehicle so due to that, the input is given using keypad by the emergency vehicle driver before reaching the signal [5].

GPS System-

These systems avoid the disadvantages of the RF system i.e. the Direction disadvantage. Using GPS we can easily get the location of the emergency vehicles i.e. The Ambulance and a Receiver system which is placed on a signal. The transmitter is fixed in the Emergency Vehicle. The transmitter system builds with the Microcontroller, GPS and an internet connection which is required to transmit the GPS data over the cloud system. The Receiver is placed at traffic signal which is built with the microcontroller with GPS system and a LED is used to show the signal changes, there is also a Buzzer system which gives the indication that the emergency vehicle passes that road. As the emergency vehicle crosses the GPS range at receiver the Microcontroller changes the signals and creates a green path to the emergency vehicle. These also have a disadvantage that the system gets failed where the traffic signal system is not used. Again, one disadvantage that the GPS shows the same coordinates in between 75m to the 100m range so in case of close signals in between 100m to 120m the system gets failed.

figure2. Systems studied in the literature survey

III.PROPOSED SYSTEM

Proposed system made up of mainly two sections –

1) The transmitter sections.
2) 2)The receiver section.

1. Transmitter section-

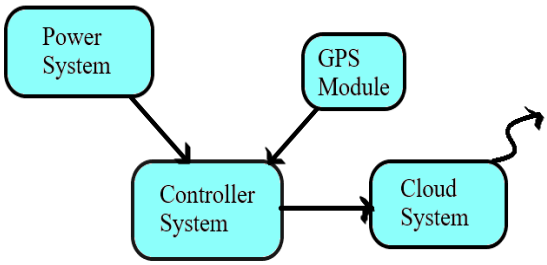


figure3. Transmitter Section.

The figure shown above it shows the transmitter section which is again divided into some another subsection, which is explained as below.

A. Controller system- (NodeMCU)-

NodeMCU is mostly used for IoT applications because of it smaller in shape and it is having a wifi ESP8266 module inbuild in it. The ESP8266 is working on 2.4Ghz frequency. It is having some features like, it is having 802.11 b/g/n, an Integrated low power 32-bit MCU, an Integrated TCP/IP protocol stack, support WPA/WPA2, SDIO 2.0, it is having SPI, I2C UART, I2S, general purpose I/O, PWM in it etc.

figure4. The Controller (Node-MCU)

B. Communication system-

Communication system builds with two sections i.e. GPS Module and cloud system.

- ***GPS Section-***

GPS Module gives the location of the system. It is connected to various satellites which provide data in the form of longitude and latitudes. Using GPS we can get the exact position of the system. It also gives the time and velocity data to the system. Using GPS it is possible that we will get the location on the earth by calculating the distance of it from the satellite. Using GPS we can navigate the system from a location to the location. This device is developed for the military applications. But after 1980 it becomes free to use for civilians also.

- ***Cloud System-(ThingSpaeak)-***

Cloud is of two types, Public and Private. The public cloud named as ThingSpeak is used by me for developing this system. ThingSpeak, an “Application Programming Interface” (API) and web service for the “Internet of Things” (IoT). While the interpretation as to what should be understood under the term is changing over time, here we refer to enabling objects or simple devices to be identified and communicated with via the Internet. The ThingSpeak API is open source interface which understood the data, collect it and gives the output to the humans and machines.

Fig- GPS Module

Fig- Cloud (ThingSpeak)

figure5. The Communication system.

C. Power supply section-

This section includes a battery of 12v or 9v which is used to give power to each node of the system. We can also build power supply using the transformer, Rectifier, filter, and Regulator.

2.The receiver section-

The figure6 shows the receiver section which is again divided into another subsection.

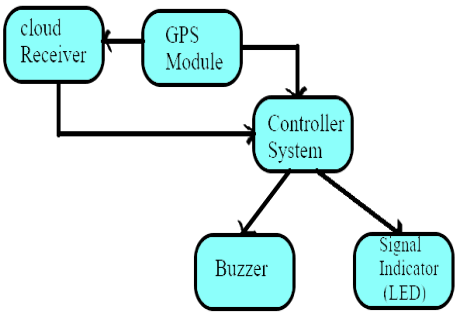


figure 6.The receiver section

A. Controller system-

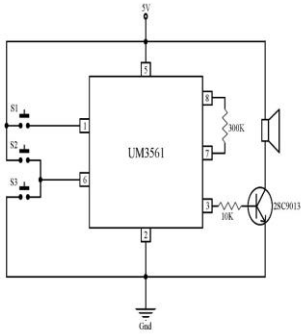
A controller section is same as the transmitter controller section. Here also the same controller nodeMCU is used.

B. Indicator system-

The indicator system is consisting of the buzzer and LED for traffic signal indication.

- ***Buzzer and LED -***

We used here UM3561 Buzzer IC. Using this IC we can generate 4 different sounds. We just have to connect these IC to the buzzer then the buzzer gives the sounds of ambulances, police siren, and Fire brigade trucks. We used three colors of LEDs here which gives the indication of changes in the signals.



BUZZER

LED For Traffic Signal Indication

figure7. Buzzer and LED for system indication

C. Communication system-

The communication system used at receiver is same as that of the communication system at the transmitter section. Here also GPS and the same ThingSpeak cloud give the location of the ambulances or police vehicles and for uploading the location of the traffic signal respectively.

IV. PROPOSED ALGORITHM, FLOWCHART & HARDWARE DESCRIPTION

- ***Flowchart-***

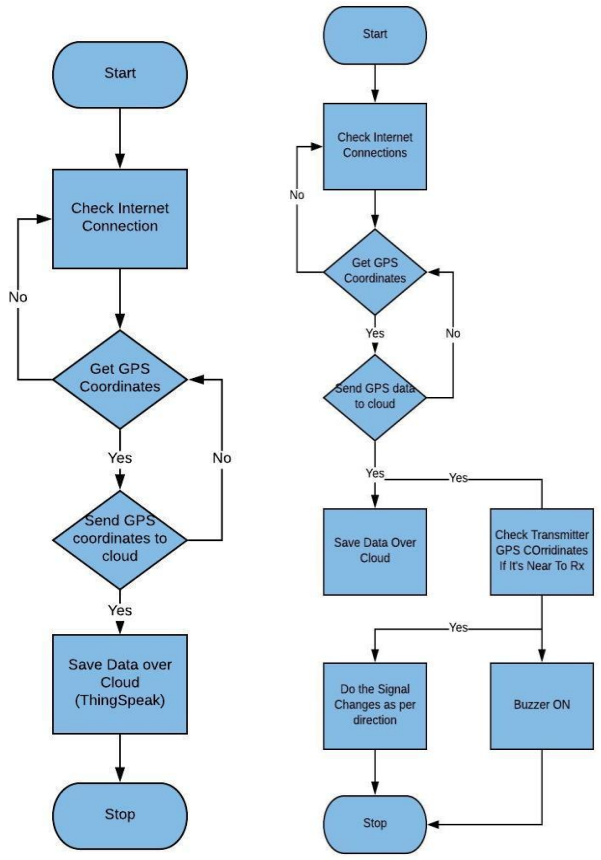


figure8. Transmitter and Receiver Flowchart respectively.

The flowchart for the system is divided into two main parts flowchart of transmission section and flowchart of receiver section. The transmission flowchart shows the working flow at the emergency vehicle while the receiver flowchart shows the working flow at the traffic signal.

- ***Proposed Algorithm-***

1. Check the internet connection at both receiver and transmitter section.
2. Collect the GPS coordinates at both transmitter and receiver side.
3. Send that data (GPS Coordinates) over the cloud (ThingSpeak).
4. Save both transmitter and receiver data over a cloud.
5. Receiver controller check that the transmitter coordinates is near or not?
6. If the Coordinates are near then receiver controller do the change in signal change and turn on the alarm system.
7. If it's not near to receiver coordinates then it continuously check the status of emergency vehicle is it come near or not.

- ***Hardware Description-***

Figure 9 shows the hardware view of a node. The same node is at the receiver which is placed over a traffic signal. In this, we can see that the nodeMcu is connected to the GPS Neo 6M Using 4 pins. These 4 pins are Transmitter, Receiver, GND, and VCC. Also, a Supply to NodeMcu is given by a USB cable which is connected to PC or Laptop**.**

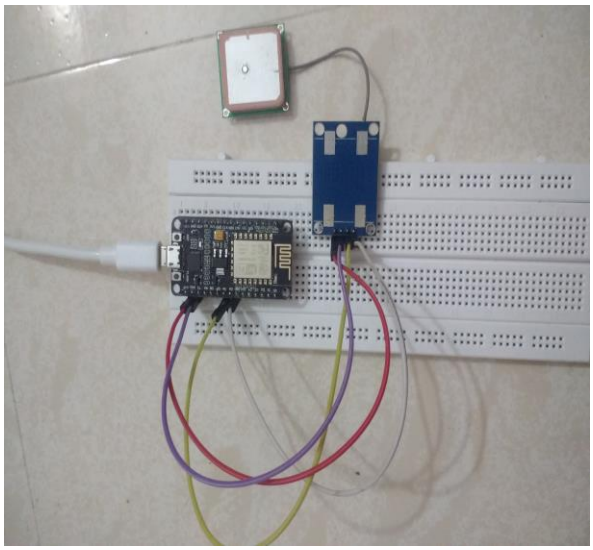


Figure9. The hardware of node.

V. RESULTS AND DISCUSSION

Figure 10 shows the view of data i.e. coordinates of the GPS over a ThingSpeak cloud network. The data transfer over it is using an internet. ThingSpeak is a public cloud. The data view is in two types first in longitude and second is latitude. Using this we can get the location of the emergency Vehicle or Traffic signals.

Figure 11 shows the actual view of the location over a Google map. Using these we can check the position emergency vehicle. The data is uploaded to cloud at every 5 seconds. When that data updated at the same time the location get refreshed over a map. Means it reduces the delay time and provides the real-time system.

Figure10. Longitude And Latitude position of Emergency Vehicle.

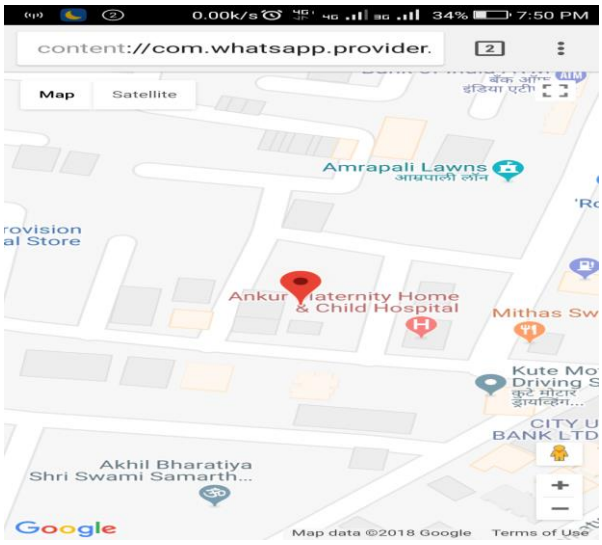


figure11. Live location on Google Map.

VI. CONCLUSION & FUTURE SCOPE

Using Automatic traffic signal changes based on GPS system we can control the traffic. By this system, the traffic jam problem faced by the peoples can be reduced. Also in some condition where the emergency vehicles get fixed in a traffic jam, such hectic situations can be avoided using this system. So in cities of countries like India, where the road is small and vehicles are more the automatic traffic signal control system can become more useful.

In the future, this system can be upgraded by using new and cheaper controllers. The Mobile app can be developed in future for getting information to the emergency vehicle drivers. also, it will be developed to resolve a problem of many emergency vehicles comes at a time on one traffic signal.

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