Traffic Signal Automation for Faster Emergency Care using GPS and IOT

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Abstract - *Traffic congestion has now become a major problem in this technical era. There are various reasons for this traffic congestion to happen. Some of the reasons for traffic congestion are crowding of vehicles, improper functioning of traffic signals etc. . Due to this traffic congestion, sometime delay occurs for the ambulance to reach the hospital. This leads to waste of time and also sometime causes death to the person. To overcome this situation, we have proposed an IoT based traffic light signal control for ambulance using mobile app, Which helps the ambulance to reach the hospital utmost fast and also helps in saving the patient life. This project is based on the IoT and mobile app to save the human life at critical situation. Our project establishes the communication between the traffic signals and the ambulance so that the traffic signal can respond to the arrival of the ambulance. The major role of our project is to control the traffic lights from the ambulance based on the latitude and longitude. Our project runs in a flutter app which helps in accessing the GPS co-ordinates inside the app and creates a connectivity with the help of sockets to control the signals based on the latitude and longitude values obtained within the app. In our project we used Node.js and Express.js as middleware and MySQL as database. Thus, our project will act as a life saver.*

Keywords: Flutter, GPS, Node.js, Express.js, Firebase, MySQL, Socket, IOT

I. INTRODUCTION

We have titled our project as "Faster Emergency Care using GPS and IOT". The main objective of our project is to help the ambulance to reach the hospitals at the earliest as possible by automating the signals with the help of Flutter and Node.js. We have implemented it with the help of mobile app designed in flutter which reduces the cost of using any devices to get the latitude and longitude details of the ambulance. Since, in this modern era everyone has a smartphone we don't need any other devices to get the GPS co-ordinates of the ambulance. Ingeneral, an ambulance needs to wait for some time to cross the signal because of the traffic congestion. A traffic police who is monitoring a signal can hear the ambulance siren sound only if the ambulance is at a distance of 200 metres from the signal. The traffic police need to clear the traffic and make a way for the ambulance to cross the signal. But it takes more time to clear the traffic. So this way of clearing the traffic and making a way for the ambulance is currently being followed in our country. This kind of approach may work some time but most of the time it results in lot of issues. Another disadvantage of using this kind of approach is if the traffic police is not available at that particular signal it makes it a very difficult task for the ambulance to cross that signal. This approach

entirely depends on the traffic police. Let us consider a scenario where the ambulance needs to cross more than 10 signals to reach the hospital. In this situation ambulance need to wait for a long time in each signal for the police to clear the traffic. Sometimes due to this delay in reaching the hospital the patient who is travelling in that ambulance might die. We have developed this project to help the ambulance drivers to cross the signals without any trouble or without getting stuck in traffic congestion. Our project reduces the role of traffic police in clearing the traffic. Our project acts as a life saver and saves the life of the people.

II. LITERATURE SURVEY

The related works from the past are categorized below.

2.1 A. Balamurugan, G. Navin Siva Kumar, S. Raj Thilak, P. Selvakumar,"Automated Emergency System in Ambulance to Control Traffic Signals using IoT"[1]

This paper states that this project is developed to establish the socket communication between the traffic signals and the ambulance so that the traffic signals can respond to the arrival of the ambulance at the respective signals and respond according to that[1]. When the traffic signals changes its states according to the position of the ambulance at that signal it canmake a free way for the ambulance to cross the signal by operating the signals[1].This project is based on the IoT and cloud to save the human life at critical situation[4].The traffic signal is automatically controlled using a simple mobile phone app which uses GPS by capturing the latitude and longitude of the ambulance vehicle and sends signal to the local system, hence making uninterrupted traffic to the ambulance vehicle. And then, the traffic signals are controlled by cloud server.

2.2 Joseph Owusu, Francis Afukaar and B.E.K. Prah, "Urban Traffic Speed Management: The Use of GPS/GIS"[2]

This paper states that the GPS-GIS integrated system provides real-time meaningful location and status of the vehicles in the network. The system has been used to show the immediate positional changes

frequently with speed and directions of the vehicles travelling in Kumasi[2]. With the help of the geographic components available in a dataset and visualizing the results in a map provided a clearer picture of the traffic details of every available route in the network[2]. The GPS gives the clear indication of the road sections where speeds are impossible and driver behaviour is also affected giving transport planners the option to choose the desired speed management technique to improve the traffic system[7].

2.3 Dr. Khalifa A. Salim, Ibrahim Mohammed Idrees, "Design and Implementation of Web-Based GPS-GPRS Vehicle Tracking System"[3]

This paper states that they have used an integrated cost effective web based GPS-GPRS vehicle tracking system was designed and implemented[3]. This system helps the ambulance drivers to view the present and past GPS locations recorded from the ambulances on Google Map through a website.[12] The current location of the target vehicle was acquired by GPS device which is integrated in the ambulances and the location coordinates are sent through GPRS service provided by the GSM network. The GPS data are sent using the POST method of HTTP protocol, the data at server side are stored in a MYSQL database tables and can be retrieved as request using GET method of HTTP protocol for position browsing on map[1]. A web application is developed using JavaScript, Ajax, XML, and MySQL with embedded Google Map to retrieve and display on track location co-ordinates[3]. The system uses an On-Vehicle Module consists of GPSreceiver and GSM modem, the device resides in the vehicle to be tracked[6]. In order to track the movement of the vehicle.Google Map free service and the use of HTTP protocol as a data sending method reduces the monthly cost for an individual user or an enterprise.

2.4S. Dhivya, M.Palani, S.Saravanakumar, S.Venkatesh, M. Vikhneswaran, "IoT BASED TRAFFIC SIGNAL CONTROL FOR AMBULANCE"[4]

This paper states that the rescue vehicle assumes a important part to make the harmed patient reach the doctor's facility in an opportune time. At

initial stage, the latitude and longitude values are set to zero[4]. Once when the ambulance starts the latitude and longitude values which were initially zero are updated with the current latitude and longitude of the ambulance. The cloud process is then handled by the apphost[4]. After the cloud process, it retrieves all the possible signals from the device as well as the traffic signal. It tracks the automatic location updation of the signals. It then allocates a static value of the signal which is probably at a distance before one kilometre from the signal. It then compares both the updated value as well as the static value declared. If both the updated value as well as the static value is equal then the cloud starts controlling the signal automatically by turning into green[13].

III. PROBLEM STATEMENT

When we compare with other countries the emergency system in our country is not that good. The only emergency system which is in proper execution is the 108 service. As we all know 108 is telephone number emergency service to reach ambulance services all over India. A typical problem faced here is after getting the patient inside the ambulance it takes a long time for the ambulance to reach the hospital due to the traffic congestion and the number of signals in our country. Traffic signals in our country has a fixed time period to switch between the signals. In case if there is any emergency vehicles approach the signal then also there is no change in switching the signals. Whenever ambulance reaches a certain signal, it has to wait for a long time to cross that signal or else it requires a police to clear the traffic but it also takes time.

IV. TECHNOLOGIES USED

4.1 Flutter

Flutter is a hybrid app development framework developed by google. We have used flutter to develope a mobile app to get the latitude and longitude details using the GPS available in smartphones. After getting the latitude and longitude it performs the tasks to operate the signal. It transfers the data to the custom backend server developed using Node.js

4.2 Firebase

Firebase is developed by google to perform multiple tasks. Firebase is used for OTPauthentication when the ambulance driver initiates a login action.To verify the mobile number of the ambulance driver OTP authentication is again used. We have also used firebase real time database to track the live location of the ambulance. After tracking the live location firebase sends the location details to our custom backend server.

4.3 Node.js

Node.js is a backend framework which handles the data sent from the flutter app. By default it creates a server which handles the request and response. Request and response can be of any type, it can be a text, image, file, audio, video etc. Node.js is also called as JavaScript runtime environment.

4.4 Express.js

Express is a minimal and a flexible Node.js web application framework that provides a robust set of features for web and mobile applications. Along with node.js it makes the work much moresimple.Express.js helps in creating the server and listening to that particular server in a easy way. It also provides a custom middlewares to handle the request at different levels. It also provides a custom validator to validate each data sent from the frontend.

4.5 NPM

NPM stands for Node Package Manager. It is a community where the packages of node integration are available. The packages needed for the development of node application can be found here. NPM is installed automatically with the installation of node.js. Examples of NPM packages are nodemon, mysql, mysql2 etc. In fact Express.js can be installed only with the help of NPM.

4.6 MYSQL

MYSQL is a relational database where data can be stored in a relational type. In other words, Data can be stored in the form of tables. Each table consists of several field or columns. Each column can store multiple data or records inside the table. It uses query to perform the tasks. Query can be insert, update, select, delete etc.

4.7 SOCKET

It helps in establishing a real time communication between the client and the server. We have used sockets for live tracking of the location of ambulance, which then helps in operating the signals to make the ambulance cross the signals.

V. EXISTING SYSTEM

In our country, there were many projects developed for traffic signal automation. A drawback in that is none of them have been implemented. All these projects are still in development phase or because of some reasons it is not implemented. The only methodology available in our country is manual monitoring of traffic signals by traffic police. A traffic police who is monitoring a signal can hear the ambulance siren sound only if the ambulance is at a distance of 200 metres from the signal. The traffic police need to clear the traffic and make a way for the ambulance to cross the signal. But it takes more time to clear the traffic. Major disadvantage of using this kind of approach is if the traffic police is not available at that particular signal it makes it a very difficult task for the ambulance to cross that signal. This approach entirely depends on the traffic police.

VI. PROPOSED SYSTEM

We all know that there is a high traffic at a particular time in our country. Due to that, all the traffic signals should be maintained in a proper way to reduce the accidents. Similarly if there is some emergency situation then the ambulance may get blocked in the signal it leads to major problems sometimes it can even cause death to the patient travelling in the ambulance. To avoid this, based on all analysis, all traffic signals should be controlled based on the arrival of the ambulance at that signal. In order to provide a faster emergency, our proposed system is built in real time to help the ambulance to cross the signal.

The main objective of our application is to reduce the time spent by ambulances in the traffic signals. Most of our traffic signals are automated and sometimes police also control these signals during peak hours. Ambulances can cross the signals without slowing down, if there are less than two rows of vehicles are there in the signal and if the vehicles in the first two rows move front or to side even if the signals are on red. Another option is that, the police who is controlling the signal can hear the ambulance siren sound. But it is possible for the police to hear the siren only if the ambulance is at a distance between 100 to 200 metres from the signal. Our project gives a perfect solution for the above problems. describes the entire flow of our project.
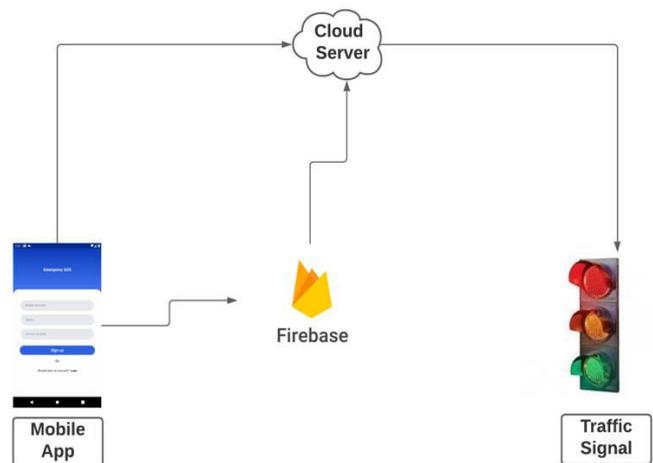

Figure6.0.1

6.1 Ambulance Driver Registration and Confirmation

In order for an ambulance driver to register we need an interface. Here the interface is provided in the form of a flutter app. As a first step the ambulance drivers need to install the app. They can install the app either by using the apk or they can directly download the app from Google Play Store. After installing the app, they will be directed to a driver registration page.

It asks for a basic details like name, mobile number and the vehicle number of the ambulance. When they enter these details, an API will be called which is written in node.js and express.js. These details entered by the ambulance driver will be sent in that API. After the verification of these details the data will be stored in the MYSQL database.

Next step is that the ambulance driver need to verify his mobile number to complete the registration. OTP authentication is managed by firebase. An OTP will be sent to the mobile number entered by the driver during the registration process to verify his mobile number. OTP verification has been implemented with the help of firebase developed by google. On successful completion of OTP authentication his number will be verified.

Final step is that the driver needs to wait for the confirmation of the higher authority/admin to use the app as an ambulance driver. Only after the approval of the higher authority/admin the ambulance driver gets the access to use the app.

6.2 Admin Module

Admin/higher authority has the overall access to this app. Ambulance driver gets the access to this app only if he is approved by the admin. Admin can also view the list of ambulance drivers registered in the app. A map with the current location of the ambulances which are travelling will be displayed in the admin module.Admin also has the module to remove the ambulance driver and restrict his app access.

6.3 Driver Login

After successful verification of the mobile number and approval by the admin the ambulance driver gets the access to login and use the app. Login requires only a registered mobile number. When the driver enters his registered mobile number, an OTP will be sent to his mobile number. After entering the OTP, firebase verifies the OTP. If OTP is correct then the ambulance driver is allowed to use the app. After successful login a map will be displayed in the screen to mark the start points as well as the destination to be reached.
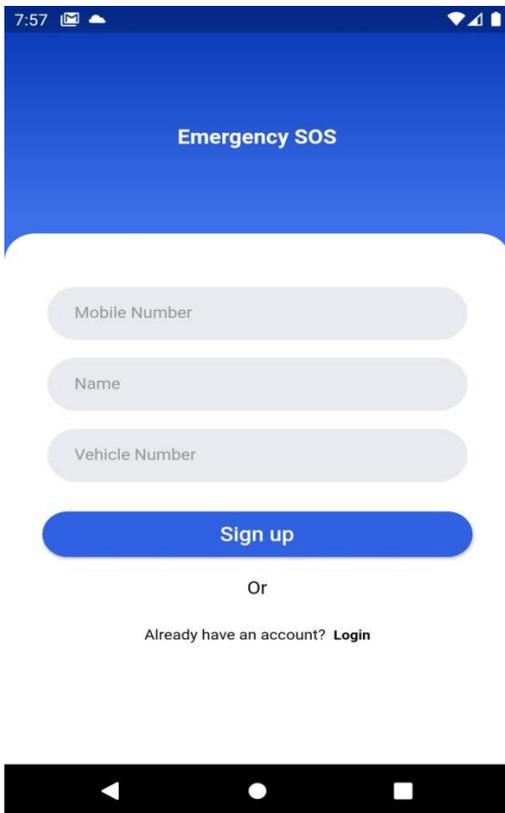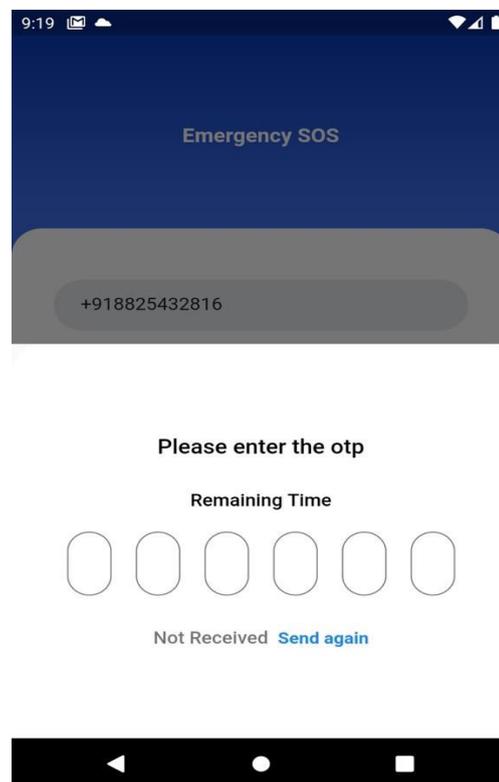
Figure6.1.1

Figure6.3.1

6.4 Tracking the Location of Ambulance

To track the live location Google Map API has been used. Ambulance driver need to mark the start and end location in the map which is visible in his screen. The start and end location are sent through an API which then stores these details in a table. When the ambulance moves from the start location,the latitude and longitude of the ambulance is tracked with the help of GPS.After getting the latitude and longitude a socket connection is established between the ambulance and the node server using socket.io.

After connecting with the socket, as a first step
Backend server checks the nearby signal based on the latitude and longitude obtained from the ambulance with the latitude and longitude stored in our database table using a formula. After finding the nearby signal by which the ambulance may travel the next step of calculation begins.

As a second step after getting the nearby signal location, we need to find the path on which the ambulance is going to come. Every traffic signal will have a minimum of two junctions and a maximum of five or six junctions. Traffic signal in each junction differs in latitude and longitude. For example, a signal located towards East will have different latitude and longitude. Similarly signals located towards West, North and South will also differ in latitude and longitude. We can find the position of the ambulance using a formula. We can find the ambulance position by comparing the current latitude and longitude of the ambulance with the latitude and longitude of the signals located towards East, West, North etc.

Figure6.4.1

After finding the position of the ambulance with respect to the signal location, it checks for the distance between the ambulance and that traffic signal. If the distance between the ambulance and the traffic signal is less than or equal to one kilometre, then that particular signal will be turned to green and the remaining signals at that junction will be turned to red until the ambulance crosses that signal. If the distance between the ambulance and traffic signal is greater than one kilometre then it waits for the ambulance to come closer at a distance less than or equal to one kilometre. It waits for the ambulance to cross the signal, once the distance between the ambulance and the traffic signal increases more than 200 metres then the signal is left to function on its own. The socket connection between the ambulance and that particular signal will be disconnected. This process continues until the ambulance reaches the destination which is the hospital.

6.5 Traffic Signal Simulation

1. Arduino

We know that Arduino can be used to build digital devices. Arduino is used here to simulate the signal by operating the LED's based on the position of the ambulance with the help of UART cable.

Figure6.5.1

2. LED

To turn on an LED, the Arduino needs to send a HIGH signal to one of its pins. To turn off the LED, it needs to send a LOW signal to the pin. You can make the LED flash bychanging the length of the HIGH andLOW states.

Figure6.5.2

3. UART Cable

A UART or serial console is absolutely essential when doing bootloader or kernel development on any computer.Due to the lack of a standard PC BIOS and the VESA BIOS that goes with it, access to the serial console on ARM devices is even more important than on the PC.

VII. ADVANTAGES OVER EXISTING SYSTEM

➢ Cost for developing is very low since we are using smartphones to get the location of the ambulance.

➢ It reduces the manpowerby automating the signal by itself

➢ The time delay in reaching the hospital due to traffic has been reduced.

➢ It provides a faster emergency care by taking the patients to the hospital at the earliest as possible.

FUTURE SCOPE

We can reduce the travel time to save the lives of the patient. By regulating the traffic signals automation during emergency situation we can reducethe pressure faced by the ambulance drivers, other vehicles that where standing near our ambulance in the signal need not worry that an ambulance is waiting nearby or behind them when a signal is not ready to be opened. Currently ambulance driver verification is processed only by a higher authority. In future ambulance driver verification can be processed by linking the ambulance driver details with their respective Aadhar cards or an openAPI to check the driver verification. An alternative method can be done by linking the ambulance driver mobile number to his aadhar card.

RESULT

Faster Emergency Care is the most essentially required one all over the world. With the idea and implementation of our project it would be great asset in saving the life of many. It starts tracking the ambulance location and finds the traffic signals which are nearby. After finding the nearby signal it

finds the position of the ambulance with respect to the signal location.

After getting the ambulance position and the signal location it calculates the distance between the ambulance and the signal. Based on the distance value it opens that particular signal and closes the remaining signals until the ambulance crosses that signal. As soon as the ambulance crosses the signal, the connection between the ambulance and the signal gets disconnected and it is left with its default state.

CONCLUSION AND DISCUSSION

Human life is precious. The Faster Emergency Care is a significant attempt to save the life of the patients who are travelling in the ambulance. We have designed it specially to help the ambulances to cross the signal in a short period of time. As we see many lives of the patients are lost due to traffic while they have been taken to the hospital in an ambulance , we have structured a framework which can securely help the ambulance to cross the signal as fast as it could be expected under the circumstances.This project is designed to overcome the drawbacks faced by existing

conventional system to make the patients reach the hospital through ambulances.

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