Emergency Vehicle Traffic Management System using Cloud

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Abstract: The problem of traffic congestion in cities is growing all the time. The rise in traffic is attributable to an increase in the number of cars on the route and restricted road extension. Because of the traffic congestion, emergency vehicles such as ambulances, fire trucks, and other vehicles are unable to arrive on time. There is a significant loss of life as a result of this. The proposed system controls traffic lights automatically for every junction along a route. Quick routes are plotted using Google Maps API, (mainly, Google Places API and Google Directions API) to provide a viable solution for emergency vehicles. IoT with the help of Cloud provides a higher performance, scalability, less downtime at a reasonably lower cost. The major purpose of this system is to ensure that emergency vehicles, such as ambulances, get to their destinations on time, reducing the time spent stuck in traffic.

***Index Terms*— GPS, ESP8266, Raspberry Pi, Azure Cloud, Google Maps API.**

I. INTRODUCTION

According to the Times of India, a Bengaluru Bruhat Bengaluru Mahanagara Palike (BBMP) official said, "There are 200 ambulances in the city and of these, 163 are functional. Each ambulance takes nearly four hours to complete one cycle, which includes transporting the patient from home to hospital and later sanitizing the vehicle as per protocol."

The world is facing a problem with increased population and growth in the number of vehicles, which results in traffic congestion. In countries such as India, the rate of road expansion is much lower than the rate of vehicular growth. Statistics show that vehicle growth is increasing at around 11% per year, while road extension growth is only around 4%.This has led to increased traffic congestion, which has many negative effects. Poor traffic congestion can slow down economic growth, lead to wasted fuel, and have a negative impact on the environment. Studies show that traffic congestion wastes 2.5 million liters of non-renewable fuel each day. Experience has taught us that in order to control traffic congestion and thereby lessen the number of unnecessary fatalities and disabilities brought on by traffic collisions, long-term road safety must be planned.

The Places nearby API and Directions API from Google Maps are included in this project. The Places API enables you to look up information about a place using a number of different categories, including businesses, well-known landmarks, and geographic locations. The Directions API is a web service that returns directions between places in JSON or XML format via an HTTP request. We employ it to determine directions, between accident location and the emergency service (like hospital). IOT hub, Service bus, and Function app were the services used in this project. An IoT application and the connected devices use the managed Azure IoT Hub service, which is hosted in the cloud and serves as a central messaging hub.

II. EXISTING METHODOLOGIES

A. RFID and GPS based Automatic Lane Clearance System for Ambulance

There are two units in this system.
Specifically: 1. Ambulance Unit
2. Junction Unit

Ambulance Unit: The ambulance unit will be installed in the vehicle and includes a transceiver connected to a microcontroller, a GPS receiver, and an RFID reader. The ambulance's GPS coordinates are continuously transmitted to the GPS receiver by using timing signals from the GPS satellites to determine its location. When an ambulance leaves the hospital for an emergency case, an RFID card is scanned close to the RFID reader, and when it is authenticated, the GPS coordinates transmission through the transceiver is activated.

Junction Unit: The Junction Unit, which will be installed at the traffic signal post, is made up of a transceiver and a microcontroller that are interfaced. The transceiver receives the GPS coordinates that the ambulance unit transmitted. The Junction Unit's microcontroller program contains the coordinates of a point at a specific distance, which, when passed by the ambulance, causes the traffic signal to turn green. The message that an ambulance is approaching is displayed on an LED screen at the same time, alerting drivers to move over. The point's distance from the signal may vary depending on the traffic conditions at various intersections and may be programmed to meet specific requirements.

B. Image Processing based Automatic System for Ambulance

It consists of three phases:
1. Vehicle Detection and Counting
2. Ambulance Detection
3. Decisions Based on Data

Vehicle Detection consists of the following steps: Camera Positioning, Image Subtraction, Blob Detection, Blob Analysis, Blob Tracking, Vehicle Counting, Data Processing.

A Bluetooth module and a phone with active Bluetooth are required for the phase of detecting the ambulance. Once the ambulance is close to the signal, the driver can instruct the Bluetooth module to change the traffic signal accordingly by sending a command to it.
When an ambulance is seen, the timing is extended by 20 seconds if the signal is green, and by 40 seconds if the signal is red. This can be expanded to include any number of signals along the ambulance's route in order to handle urgent cases right away. When choosing the signal timing, it is possible to determine how long the signal lights should be on by analyzing the traffic flow in a given area for a predetermined period of time.

III. PROPOSED METHODOLOGIES

A. Establishing connection between GPS and ESP8266:

The ESP8266 Node MCU board will be connected to the NEO-6M GPS module's 4 terminals. Connect the VCC terminal to the ESP8266's 3.3V pin and then attach the GPS module's TX (transmitter) and RX (receiver) terminals to the board's GPIO pins. The two devices will communicate to one another via software serial.

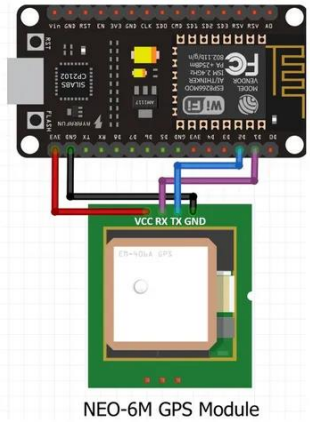

Fig 3.1: GPS and ESP8266 connection

B. Working:

At the origin, the on-board unit containing the GPS is initiated and the coordinates of the emergency vehicle are sent to IoT Hub (Microsoft Azure).

This triggers a Function to plot a route to nearby emergency services. Functions App fetches nearby emergency services using the Places API and a route is generated to the nearest emergency service using Directions API. We can customize the output by giving the parameters like the radius and limit the number of outcomes.

A MongoDB Database has the list of traffic junctions with their coordinates, which is then queried to get a list of traffic junctions lying along the route.

The system turns the appropriate path green when an emergency vehicle is in the vicinity of a traffic junction.

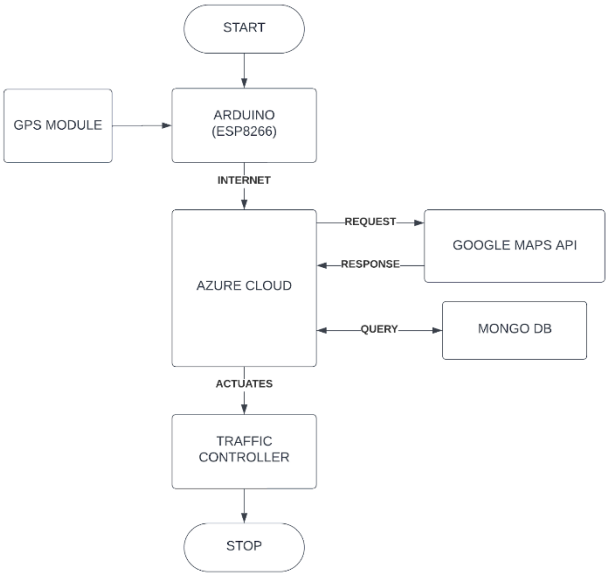

Fig 3.2: Block diagram

IV. RESULTS

The ambulance management system consists of an on-board unit(OBU) and traffic controller. The on-board unit sends the GPS data to Azure Cloud. The proposed system is able to manage the traffic light according to the movement of the ambulance. It reduces the waiting time for ambulances.

```
PS C:\Users\reach\OneDrive\Desktop\Github_projects\MainProject> node "c:\Users\reach\OneDrive\Desktop\Github_projects\MainProject\Result.j
s"
Starting ...

Fetching list of nearby emergency services from Places API ...
0:Sudha Prevention Centre
1:Hanumagiri Clinic Dr. Varna Dr.Venugopal
2:Re life hospital- best multispeciality hospital in bangalore
3:S.G Hospital
4:Hanumagiri Clinic
```

Fig 4.1: List of hospitals

```
Fetching Route from Direction API ...
Distance : 3.7 km
Encrypted Polyline : od|mActhxMj@d@DGRW|C_ExAsB`DeEfA_BhBuDh@cAt@iB`A{Br@sBhB{HjCiLrAsG`BmHn@_CTeAL}@LwBDg@f@iDTi@b@i@hAo@XY|Ao@d@_@LSzAiC
p@{@p@a@`CsAlBq@rCw@xC}@xC}@^MvCs@bCu@^Sp@c@fAy@lC}B|@k@LJdALj@Hp@DbBTtANhAH`BDVDLHBHBL@LA`@StCZHPJb@\b@j@

JunctionID : 001,004
JunctionName : Junction-1,Junction-4
```

Fig 4.2: Shortest path, distance and junctions

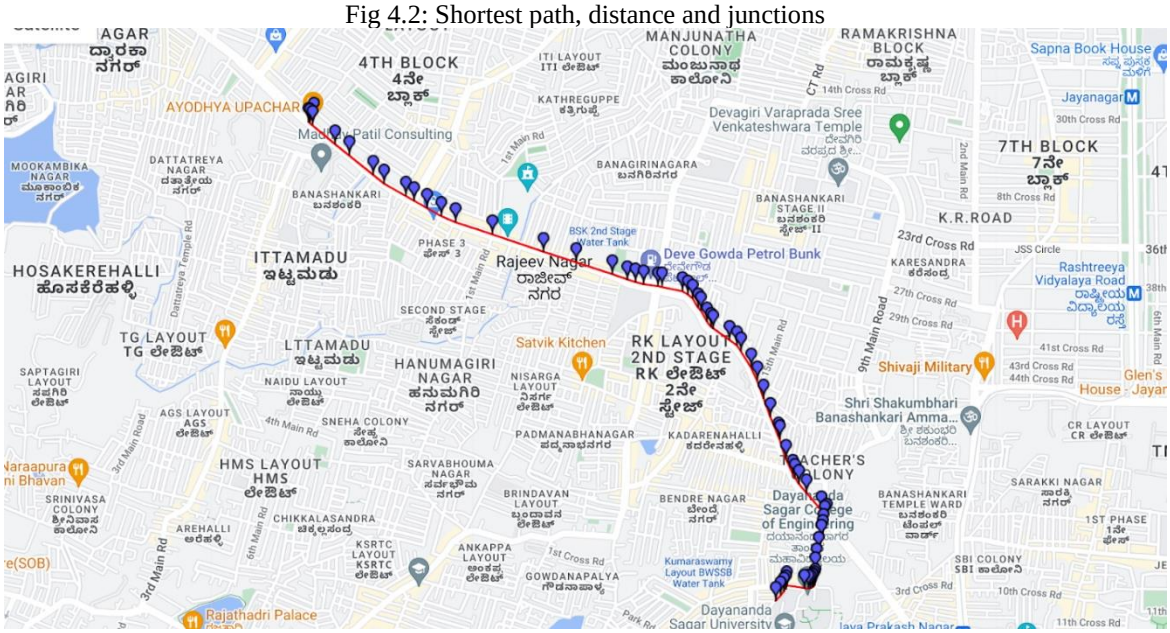

Fig 4.3: Polyline plotted

V. CONCLUSIONS AND FUTURE SCOPE

The proposed Traffic Control for Emergency Service is built around the use of Google Maps API to monitor traffic conditions. The Google maps APIs are used to find the list of emergency services and the shortest route to the nearby emergency services. GPS coordinates and an emergency command are sent to the server. An emergency command is sent to the specific signal that is closest in terms of detection. Depending on the direction the server sent, that specific signal is turned green. By incorporating a GPS navigation system, the system is enhanced to take into account real-world conditions so that we can lower the likelihood of fatalities in emergencies.

In addition, we want to compile a database of all hospitals, complete with their addresses and phone numbers. The user of the application can choose the desired hospital directly from a drop-down menu using this database. Additionally, the server from which the hospital can access the information intended for it can receive patient conditions directly.

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