Managing and Controlling Traffic for Emergency Vehicle Using Android Application

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Abstract – One of the problem that commonly faced in transportation systems is the disruption of emergency vehicle service, such as ambulance or fire fighting units, due to the traffic congestion. This analysis developed to provide the route guidance and navigation for emergency vehicle. The goal is to provide help for the emergency vehicle to reach the destination effectively by coordinative traffic data through a wireless communication networks. Our proposed system provides shortest route guidance and navigation for the emergency vehicle among the multiple routes. And system also gives proper vehicle tracking details to traffic police through the application. So that traffic police can take immediate action to solve traffic jam in particular areas. The goal is to provide assistance for the emergency vehicle to reach the destination effectively by using machine learning algorithms and coordinating traffic information through a wireless communication networks and to find a shortest plus minimum traffic route solution for emergency vehicle.

Keywords— Emergency Vehicle, Google Map, Traffic Police, Haversine Algorithm, Wireless Communication Network.

I. INTRODUCTION

Transportation system could be a complex system. It absolutely was caused by several components that concerned within the system itself, like humans, vehicles, physical infrastructures, environment, and traffic management. All these components work and act with one another in a complex method. Several aspects of the transport system are uncertain, dynamic and nonlinear. The system is additionally very sensitive to disturbance which will cause traffic flow delayed or even stopped.

The first downside that usually faced in transportation systems is that the traffic congestion. Traffic congestion appears to be a matter that can't be avoided in everyday human life. Significant growth of the quantity of vehicle has outnumbered the expansion of road infrastructure and has become the biggest contributor to traffic congestion. Congestion additionally caused by several circumstances, like the increasing of traffic density, accidents, road repairs, furthermore as setting traffic signs don't seem to be effective. Congestion is causing the disruption of the traffic flow. The impact is time losses and energy waste.

United States, Japan, and several countries in Europe have developed a technology based on information and communication system. This technology is called Intelligent Transportation Systems (ITS) which aims to solve many problems in transportation systems [2]. ITS technology is expected to be a method to solve the problem of transportation that offers safety, security, effectiveness and efficiency of traffic, improving driving comfort, as well as supporting environmental conservation.

One of the important issues in the transportation systems are the disruption of the emergency vehicle trips. The emergency vehicle such as ambulance or fire fighting units must delay or stopped due to traffic congestion. Therefore, this research has developed to provide the enhanced route guidance and navigation for the emergency vehicle. The goal is to provide assistance for the emergency vehicle to reach the destination effectively by coordinating traffic information through a wireless communication networks.

II. LITERATURE SURVEY

Vehicular ad-hoc networks (VANETs) is one of ITS technology that have been widely used and very popular in solving many problem of transportation systems. VANETs is an emerging technology that integrating human, vehicle and road infrastructure through a wireless communication system.

The emergence of VANETs is intended to be able to increase road safety and improved traffic efficiency, as well as to reduce the transportation complexities on the environment. The appropriate use of VANETs is believed can be positively influence to improve the quality of urban travel [3].

There has been significant progress in the development of VANETs over the past few years. In the area of traffic management system, the Car-to-Car Communication Consortium (C2C-CC) [4] have proposed Car-to-X cooperative communication systems. This system aims to improve the traffic efficiency of transport networks by providing information, both to the road authorities as the owner of the transport network as well as the rider of vehicles.

The system will provide the route guidance and navigation through a vehicular wireless network. The communication system applied to this application in the form of notification messages between interconnected vehicles with the roadside infrastructure. This system assigned to coordinating an amount of navigation data and providing those data for all vehicles that involved in the system. All interconnected vehicles will aware of the changes of road conditions and situations. This system worked by collecting the traffic data and predicting some traffic events, such as congestion, accident, road repairs, etc. Those information are gathered by continuously monitoring the movement of traffic flow in the road areas through a control station that managed by the road authorities.

III. PROPOSED SYSTEM

In our proposed system we are trying to implement a system which include various module for enhancing and managing the traffic for the emergency vehicles. It includes the application where the client or a driver enters his/her source and destination location to find the shortest path with minimum traffic to reach the destination location easily. Further the message is pass on to the administration office where the actual algorithm is used for distance calculation. After finding the shortest path the message is pass on to the traffic police of the shortest route for clearance of the traffic. As well as the message is also sent to the driver to show that the shortest path is selected to reach to the destination.

Architecture:

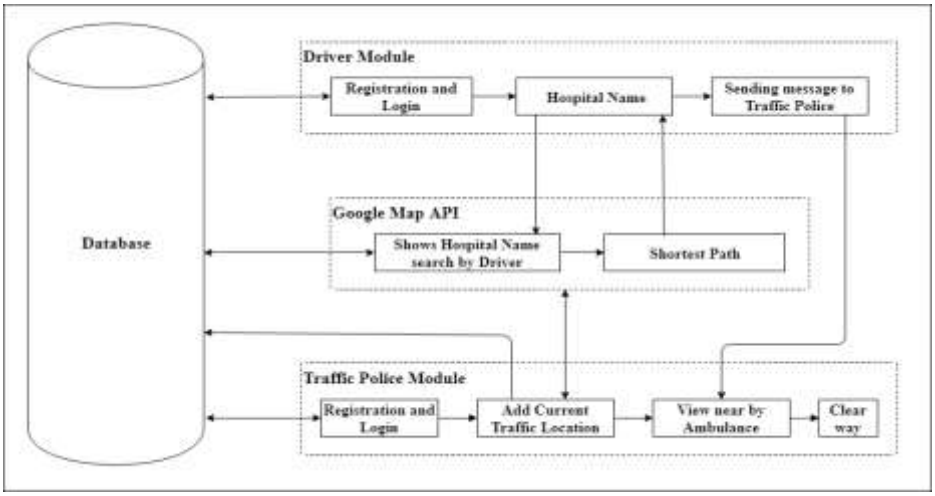


Fig 1- System Architecture

1. *Login Module:*

   This module includes registration and login process of Driver and Traffic Police, through which they manage the route selection process.

2. *Administration Module:*

   This module includes the further processing of module where after getting the source and destination route request from driver. The actual algorithm is used to choose the correct short route with minimum traffic and after processing, message is send back to driver and traffic police.

3. *Database:*

   To store all the registered driver and traffic police details that are required for selection of route and management of emergency vehicle.

Algorithm:

The haversine formula determines the great-circle distance between two points on a sphere given their longitudes and latitudes. Important in navigation, it is a special case of a more general formula in spherical trigonometry, the law of haversines, that relates the sides and angles of spherical triangles. For any two points on a sphere, the haversine of the central angle between them is given by,

$$\operatorname{hav}\left(\frac{d}{r}\right) = \operatorname{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1)\cos(\varphi_2)\operatorname{hav}(\lambda_2 - \lambda_1)$$

Where,

hav is the haversine function:

$$\operatorname{hav}(\theta) = \sin^2\left(\frac{\theta}{2}\right) = \frac{1 - \cos(\theta)}{2}$$

- d is the distance between the two points (along a great circle of the sphere; see spherical distance),
- r is the radius of the sphere,
- φ_1, φ_2: latitude of point 1 and latitude of point 2, in radians
- λ_1, λ_2: longitude of point 1 and longitude of point 2, in radians

On the left side of the equals sign d/r is the central angle, assuming angles are measured in radians (note that φ and λ; can be converted from radians to degrees by multiplying by $180/\pi$).

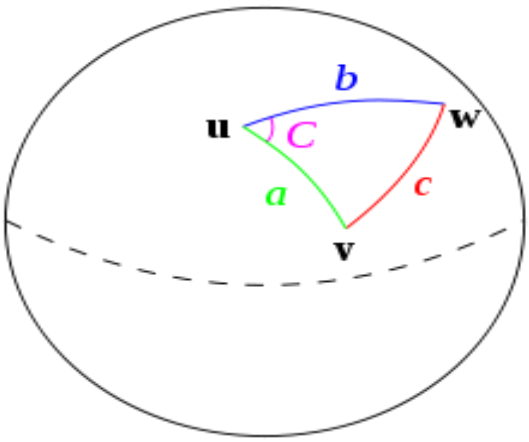


Fig 2- Spherical triangle solved by the law of haversines

Given a unit sphere, a "triangle" on the surface of the sphere is defined by the great circles connecting three points u, v, and w on the sphere. If the lengths of these three sides are *a* (from u to v), *b* (from u to w), and *c* (from v to w), and the angle of the corner opposite *c* is *C*, then the law of haversines states:

$$\operatorname{hav}(c) = \operatorname{hav}(a-b) + \sin(a)\sin(b)\operatorname{hav}(C)$$

Since this is a unit sphere, the lengths *a*, *b*, and *c* are simply equal to the angles (in radians) subtended by those sides from the center of the sphere (for a non-unit sphere, each of these arc lengths is equal to its central angle multiplied by the radius of the sphere).

In order to obtain the haversine formula of the previous section from this law, one simply considers the special case where u is the north pole, while v and w are the two points whose separation *d* is to be determined. In that case, *a* and *b* are $\pi/2 - \varphi_{1,2}$ (i.e., 90° − latitude), *C* is the longitude separation $\Delta\lambda$, and *c* is the desired *d*/*R*. Noting that $\sin(\pi/2 - \varphi) = \cos(\varphi)$, the haversine formula immediately follows.

To derive the law of haversines, one starts with the spherical law of cosines:

$$\cos(c) = \cos(a)\cos(b) + \sin(a)\sin(b)\cos(C)$$

Haversine formula:

$$a = \sin^2(\Delta\varphi/2) + \cos(\varphi_1).\cos(\varphi_2).\sin^2(\Delta\lambda/2)$$

$$c = 2.\operatorname{atan2}(\sqrt{a}, \sqrt{(1-a)})$$

$$d = R.c$$

where φ is latitude, λ is longitude, R is earth's radius (mean radius = 6,371km)

note that angles need to be in radians to pass to trig functions!

JavaScript:

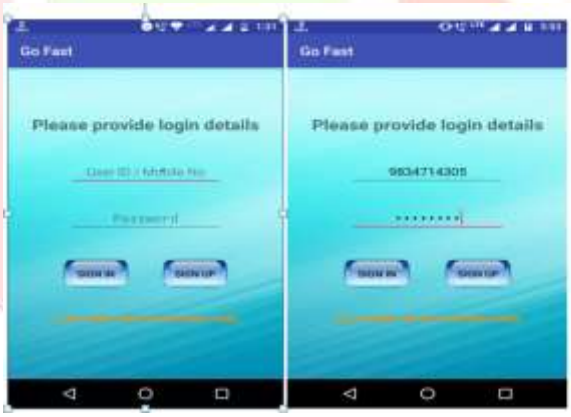
```
var R = 6371; // km
var dLat = (lat2-lat1).toRad();
var dLon = (lon2-lon1).toRad();
var lat1 = lat1.toRad();
var lat2 = lat2.toRad();

var a = Math.sin(dLat/2) * Math.sin(dLat/2) +
        Math.sin(dLon/2) * Math.sin(dLon/2) * Math.cos(lat1) * Math.cos(lat2);
var c = 2 * Math.atan2(Math.sqrt(a), Math.sqrt(1-a));
var d = R * c;
```

Case Study:

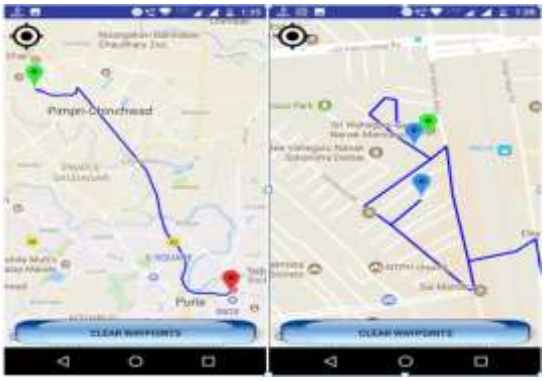
Step 1: Fill up the Driver and Traffic police Registration Form.

Step 2: Please provide login details of Driver.



Step 3: Driver insert Hospital Name.

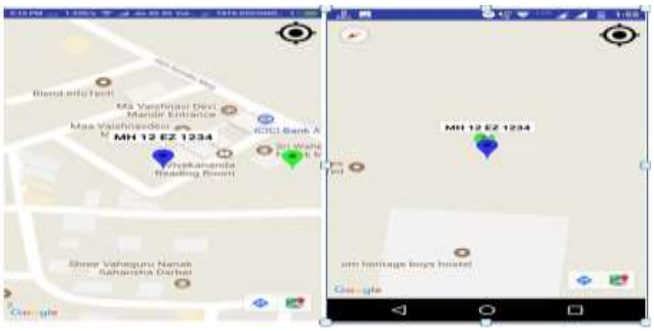
Step 4: Google Map shows single shortest path to Driver and Driver can also select another Way Points.



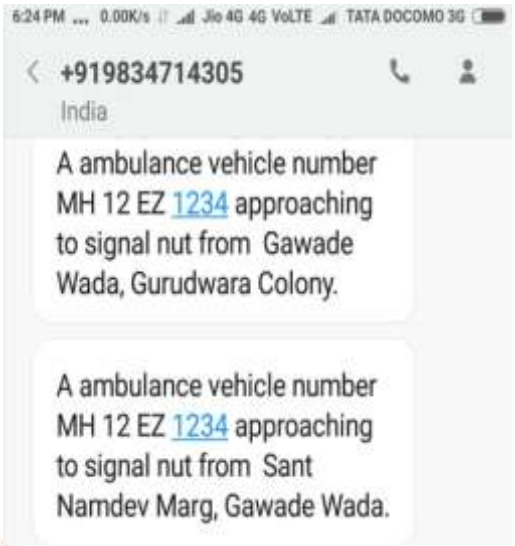
Step 5: Please provide login details of Traffic Police.

Step 6: Traffic Police insert his current location.

Step 7: Traffic Police gets the information of Ambulance within the range of 400 Meters.



Step 8: This is the Text Message which contains Ambulance Current Location and is sent by Driver to Nearest Traffic Police.



IV. RESULT

1. Ambulance driver can select shortest path using his android application with the help of Google API.

2. Traffic police can get notification regarding ambulance on specific route with the help of GPS.

3. So he can clear the traffic on road before ambulance reach on it route.

4. Time saving.

V. CONCLUSION

1. This system can be useful for enhanced route guidance and navigation for the emergency vehicle.

2. The utilization of route guidance and navigation method by using machine learning algorithm and cooperative communication can be used to manage traffic mobility, in particular to find a fastest route solution for the emergency vehicles by avoiding the congestion of certain area in advance.

3. Route guidance and navigation method can also optimize the infrequently route used as an alternative route to reach the destination faster even though the route is not the shortest path.

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