Health Emergency System with Smart Traffic Management

Akash Samtani[1], Dhanraj Nimbalkar[2], Hrithik Bagane[3], Manan Shah[4], Niyati Khandelwal[5], Sanjesh Pawale[6]

[1-5]Student, Dept. of Computer Engineering, Vishwakarma University, Maharashtra, India
[6]Asst. Professor, Dept. of Computer Engineering, Vishwakarma University, Maharashtra, India

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Abstract - *Often, there is loss of lives due to delayed arrival of ambulances to either the place of emergency or the hospital. The purpose of our Internet of Things (IoT) and cloud-based project is to create a system that will enable any smartphone user who faces a medical emergency to quickly get to a nearby hospital by way of signal manipulation on the path. The user would not be required to wait for the ambulance. In our proposed system, the patient or the user with the patient would have to send an emergency request using our mobile application to a respective hospital. An authorized person will accept or reject the patient's request based on the hospital's current situation on the hospital end. On acceptance of a request, the system would use the user's real-time GPS to track the user's vehicle's location and this would be constantly updated to the cloud, which will, in turn, manipulate the signals that are on the way of the patient to the hospital.*

Key Words: **Health, Emergency, Traffic, Smart System, Ambulance, Signals, Cloud**

1. INTRODUCTION

The purpose of an effective emergency medical system is to provide timely medical care to prevent death or disability [1]. Several adverse outcomes can result from delays in arrival to the emergency department and in receiving treatment [2]. Ensuring access to emergency care is a persistent concern for health system planners and minimizing travel time in particular can make a difference between life and death. It is generally accepted that medical assistance during the first hour of trauma decreases the morality rate substantially [3, 4]. In India, reports in 2016 suggest that slow traffic was related to the death of one-third of trauma patients en route to care [5]. India is the second-most populous country globally, and in the current era, traffic has been increasing tremendously. Traffic has been a significant contributor to the increasing number of deaths every year. The government data shows that every second heart attack patient in India takes more than 400 minutes to reach a hospital, which is almost 13 times more than the ideal window of 30 minutes [6]. Our system helps to tackle this problem by providing a less congested path by managing signals based on the patient's real-time location to a hospital without having to wait for an ambulance. The overview of our system is explained in the following section.

2. SYSTEM OVERVIEW

When a user faces an emergency, a request will be sent from the user's mobile to the cloud server, which contains specific details about the patient and his/her condition. After receiving the data, a request will be sent to a hospital with the patient data. Whenever a request is sent to the hospital, depending on the condition specified and the hospital's availability, the hospital will accept or reject the request.

If the request is rejected, then the patient will be able to select another hospital. Upon accepting the hospital's request, the user will be receiving privilege and is navigated to the hospital through the map on our application.

When a user’s mobile application that is privileged as an ambulance starts moving towards the hospital, the upcoming signals in the path of it will turn green. Fig.1 demonstrates our system overview in brief.

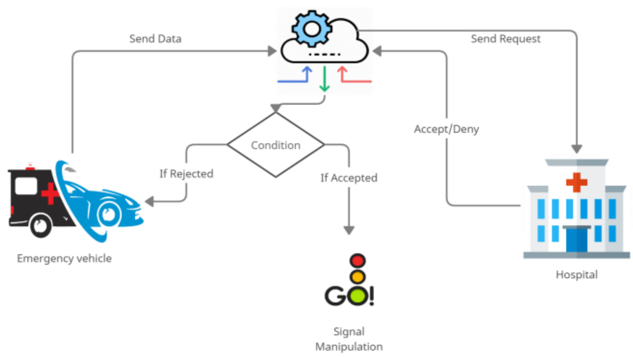

Fig -1: System Overview

3. SYSTEM ARCHITECTURE

We have four modules in line with us- with the cloud server in the middle interacting with the mobile application on one end and the web application on the other end.

Module 1: Mobile Application

The mobile application is built on Flutter which provides a single codebase for natively compiled applications. In this module, Google Maps SDK is integrated for providing real-time navigation to the hospital. An illustration of the map in our application is shown in Fig. 2. REST APIs perform communication to the cloud server.

Fig -2: Mobile Application Module

Module 2: Cloud Server

In this module, Google Firebase is used as our database. Firebase is a NoSQL database which is better suited for storing varied type of data. For authentication, we have utilized Firebase Authentication. Firebase also assets as an event listener and provides real-time synchronization of data changes.

Apache server hosts our PHP application which processes the signals that needs to be coordinated according to the patient's location and intimates the signal controllers to perform appropriate actions.

Module 3: Hospital Website

The web portal communicates with the cloud server for the user's data and real-time location. The hospitals will accept/deny the request according to the doctor's availability. The hospital can accept/reject the request by clicking the Accept/Deny button that pops up on the website. The hospital's response will be sent to the cloud server. If the request is accepted, the hospital will track the user's location via the Google Maps API.

Our system will also have a hospital sign-up page where various hospitals can register themselves to be a part of this system by entering their name, contact number, hospital specialty, etc. An administrator will verify the hospital within one to two working days on submitting the form.

Module 4: Signal Manipulation

The apache server requests the signal controller to make a particular signal green. Upon this, the requested signal is turned green by the signal controller. Once the patient passes through the signal, the server requests the signal controller to reset the regular movement of signal rotation. Fig. 3 shows the connections between the logical signal controller and relay.

Fig -3: Signal Controller

4. IMPLEMENTATION

The proposed algorithm is designed to describe the operation of the system. Our emergency response system will trigger road traffic clearance based on the user's live location on their way to the hospital.

During a case of emergency, the user will be required to fill in the patient's essential details and the situation in the mobile application. This data is then sent to the server. Based on this data, the server filters the list of hospitals eligible to serve the patient. This data is then sent back to the user's application. Then the user is required to select the desired hospital from the list of available hospitals fetched from the server. On selection of the hospital, a request is sent to the selected hospital's portal. Now, the operator of the hospital's portal reviews the details of the patient, depending on which the request is accepted or denied. On denial, the requester is asked to select another hospital. Else, on acceptance of the request from the hospital, an e-challan is generated by the server.

The requester is shown the fastest route to the hospital with all the signals on the way. The cloud server will send the user's real-time location (latitude and longitude) to the apache server. Before encountering a signal, distance is dynamically calculated with respect to the traffic at that signal received by Google Maps. As soon as the user's vehicle reaches the dynamically calculated distance, the server will trigger the signal controller to turn that signal green.

As soon as the vehicle has crossed the signal, a request is sent to the server and in turn, to the signal to continue with a regular rotation of signals. In this way, the emergency vehicle passes through the traffic with no or minimum waiting time, thus reducing the number of deaths during the hospital travel.

Once the patient reaches the hospital, the genuineness of the case is checked. If the situation was a real emergency, the hospital's portal is used to waive off the generated e-challan. If the case is not genuine, the user will not be able to further request 'green-corridor' unless he pays a hefty penalty for misusing the system. The data flow diagram demonstrated in Fig. 4 shows the flow of data between the different processes and entities.

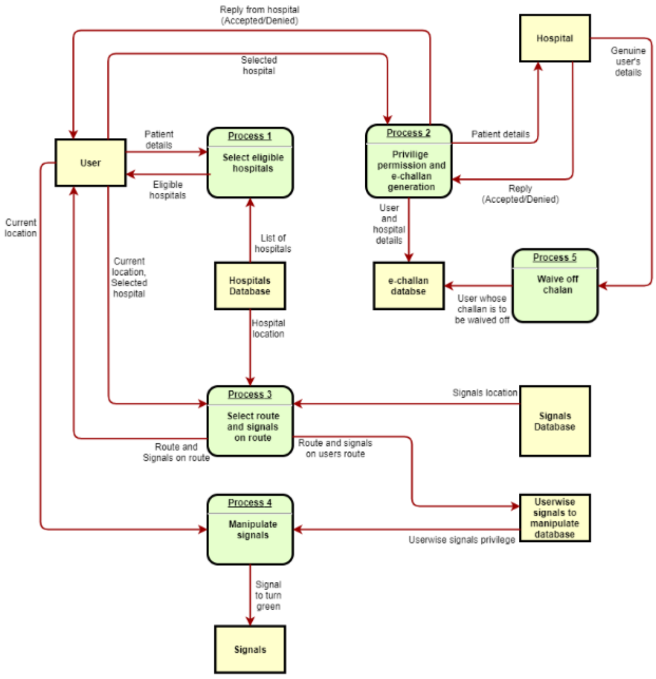

Fig -4: Data Flow Diagram

5. RESULTS AND DISCUSSION

When there is a medical emergency, the requester can click on 'Send Request' to the hospital. The requester can select the patient details. To make this process very quick, the requester can add the details of a person who might need emergency service in the future. After selecting the patient details, the requester can choose the type of emergency. The requester also can add patient details at the time of emergency if it is not listed. The requester has to select the hospital from the list, which will be displayed according to the emergency type and requester's location. At last, the requester will confirm the details and send the request to the hospital (displayed in Fig. 5).

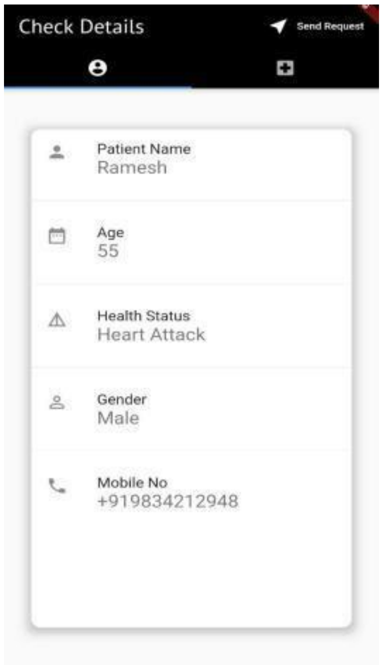

Fig -5: Mobile Application

When the requester sends the request to the hospital, the hospital portal operator will get a pop-up that shows the patient's details and asks to accept or deny the request as shown in Fig. 6. When the hospital portal operator accepts a request, the requester will get the privilege to reach the hospital quickly. The hospital portal operator will also be able to check the live location patient, so all necessary things will be arranged before the patient arrives at the hospital.

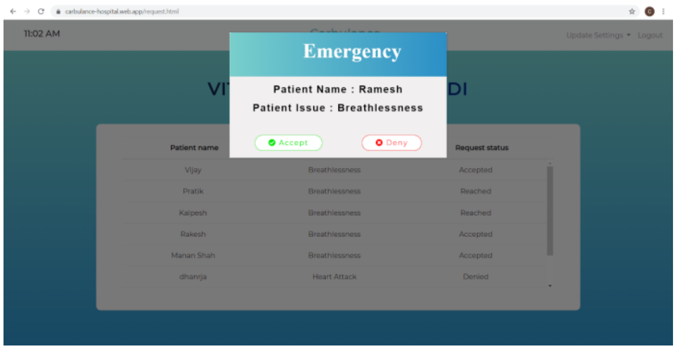

Fig -6: Web Application

The route to reach the hospital will be displayed along with the requester's current location in the mobile app. The patient will travel faster as the proposed system will manipulate the signals to release the traffic.

Fig -7: Proof of Concept Model

6. CONCLUSION

The management of traffic in emergencies plays an important role. Transportation of a patient to a hospital seems quite simple, but it is difficult and complex during peak hours. We defined a system that will prioritize your vehicle as an emergency one and provide them with a congestion-free path by manipulating the signals to reach the hospital as soon as possible. This system will also reduce accidents that often happen at the traffic signal intersections because other vehicles have to huddle to give way to the privileged vehicles. It provides transportation unit information and patient health information, which helps further emergency treatment for doctors. It sends the current location using GPS to the cloud server. In turn, the server manipulates the signal and sends location and status information to the hospital. Hence, the patient reaches faster to the hospital, reducing the chances of mishap.

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BIOGRAPHIES

Mr. Akash A Samtani pursuing B.Tech in Computer Engineering (Vishwakarma University, Pune)

Mr. Dhanraj J Nimbalkar pursuing B.Tech in Computer Engineering (Vishwakarma University, Pune)

Mr. Hrithik N Bagane pursuing B.Tech in Computer Engineering (Vishwakarma University, Pune)

Mr. Manan K Shah is pursuing B.Tech in Computer Engineering (Vishwakarma University, Pune)

Ms. Niyati Khandelwal pursuing B.Tech in Computer Engineering (Vishwakarma University, Pune)

Prof. Sanjesh Pawale, Asst. Professor, Dept. of Computer Engineering (Vishwakarma University, Pune)