Smart Ambulance System

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ABSTRACT
Emergency medical response in India is lagging behind other countries. This is partially because of lack of technology implementation at ground zero. To address the issue, we are introducing smart ambulance system. It would take India to competitive position in emergency services around the globe. Over the last few years there is a revolutionary development in the field of Internet of Things (IoT). It can be used seamlessly & widely in large number of end system where subset of a large amount of data can be accessed and processed easily and powerfully. IoT and smartphone technologies helps in building a platform which serves every smartphone user. The application collects location information from Global Positing System (GPS) hardware and uses Google Map Application Programming Interface (API) to plot details of the ambulances on the Google Map Client of the Smartphone App. Same functionality can be used for the other module which enables user to find the hospitals with the number of services provided by those in brief manner. With the help of medically equipped and technologically powered ambulance, information about patient's health details can be sent to the hospital in order to take further action. Interaction between the smartphone and the centralized database can be done using Representational State Transfer Application Programming Interface (REST APIs). The platforms that are used, capable of molding into various services that are implemented and it is believed that these technologies can make a revolutionary work in public GPS work if utilized properly.

Keywords
Hospital, Ambulance, Emergency, Public Safety, Smart City, Smartphones, GPS, REST, JSON.

1. INTRODUCTION
In today's era, there are many cities which are working on transforming themselves into Smart Cities. If the city is going to be called as Smart City, then it should have all possible advancements in the sector of smart technology. Improving efficiency in healthcare sector if one of the difficult and most challenging jobs. That includes various aspects such as getting ambulance within minimum amount of time, providing proper treatment to the patient so that the chances of surviving increases in critical condition. Traffic congestion is one of the major problems in urban areas, which have caused much hitches for the ambulance. Moreover road accidents in the city have been increased and to bar the loss of life due to the accidents is even more crucial.

We can overcome these limitations by upcoming technology like IoT[1] i.e, Internet of Things. Various hardware devices can be connected with each other via wired and wireless networking tools and software implementations. Use of various

REST APIs can help to communicate between the server and client end which is implemented in this project.

REST APIs are designed in such a way that time complexity will be minimized extensively. This is achieved by exchanging only the required data with server in order to minimize the traffic and loss of data packets in the process of transaction. With the help of cutting edge technology and keeping the goal in mind we've developed this application. It is also an attempt to participate actively in the process of transforming into smart city and make required services more accessible.

2. RELATED WORK
Google has developed API for user's ease. Google Maps gives information about hospitals nearby, with its rating and distance from user's current location. The drawback of Google Maps is that it only pins the hospitals but does not provide their detailed information. Hence user may need to access information about the hospital by going to particular hospital's website.

Smart ambulance system application overcomes this drawback and gives hospital information related to user's medical emergency. It's a protocol that gives information efficiently about the patient's health including pulse, blood pressure etc. It also tells about the respective drugs and medicines automatically. All this is informed to the doctor and the caretaker about the patient's condition. All these interactions are controlled and takes place under Ambient Assisted Living (AAL) system. This Project has a facility of delivering the prescribed drugs to the patients. A Device named Ubiquitous Drug Injector (UDI) also has designed. One More pervasive device is designed which is for patients. It receives inputs from the ambient sensor devices. It correctly infers the patient's condition. All the things done in this project facilitates in prescribing appropriate drugs for the respective diseases and saves lot of time [2].

This project has a goal to create a smart environment at the hospital and the ICU unit is the main aim. Here a small difference or the treatments given at that time can make great changes. For implementing this researchers have used ZigBee which is a wireless Communication protocol, OSGi it's a middleware called as Open Service Gateway initiative. A knoplerfish is used which is a framework for implementing OSGi. The ICU can be made more sophisticated by the use of pervasive computing devices, sensor, and wireless communication technologies. This project helps doctors to get information about his patient admitted in the ICU. All the changes in patient's physical condition can be received by the doctor remotely. Various outputs given by the monitoring systems is collected. It is then sent to the orchestration server and which hosts the web services. A camera is fixed at the patient's end. All the collected information of the live feeds of the patient is stored at the distributed database. It is then displayed in the web service according to the doctor. Hence, doctor gets information about the patient's condition and caretaker gets the information about the prescription of the patient [3].

The Importance of communication during the disaster times is understood well by this project. Emergency situation includes disasters like fire, medical emergencies, accidents, earthquake, floods or any other natural calamity. The project works on enabling ad hoc smart phone based communications at the emergency time over WIFI, to avail the service the person in trouble shall call EMS(Emergency Management System) designed by this project. Requests are received by the server. Lent server system principle is used the server responds to the client's request. Client and rescue application is developed as an android application. Server is implemented as a web based application. The system is tested using various GPS enabled android Phone [4].

The health status of the wireless sensor networks is relatively opaque to the network administrators, and they are deployed to monitor the environment. This project provides detection of failure and symptom alerts also. The project is divided into 2 parts as, energy efficient protocol and distributed failure detector module. Energy efficient protocol is used for delivering state summaries. The failure detector is robust to packet losses and attempts that the reports of failure will not exceed a specific rate on negative side. The findings are evaluated by implementing for tiny OS platform on Mica2 notes on a 55-node network, and find that the project gains 8090% reduced bandwidth usage as compared to standard data collection methods [5].

3. ABOUT SMART AMBULANCE SYSTEM

3.1 Overview

The system is divided into two modules depending on their functional & behavioral implementation. Both modules work on the principle of IoT [8] with the help of REST APIs. First module is used to find locations of ambulances within the 5km radius from user's location. Also the same module is used to find hospitals and their services within radius of 10km of user's current location.

Here user's location is traced using GPS hardware device. The location is retrieved in the form of double value as latitude and longitude. E.g. 19.54526, 73.87099. This is the format of the latitude and longitude. This location is transmitted to the server by executing POST request. Depending on the user's location, server processes the data and matches with records stored into the database. After processing of such data the result of user's query is sent back to the user in form of JSON format.

Smartphone application reads the response of the server and retrieves the required information and places it on to Google map client of smartphone device or displays in a listed format depending on the user's preference. A marker is used to pin point the location of retrieved data is knows as Pin. To differentiate between pins that are used for pointing hospitals and ambulances we've used custom pins. It makes easier to understand the difference even to naïve user. This can be done using Google Map API's functionality. There is a set of predefined markers that are made available by Google in their Google Map API. But for user's convenience custom pins are used. That API guideline is also provided in Google Maps documentation.

3.2 Architecture

We've tried to keep the architecture of the system as simple as possible. As there won't be need of any security model the architecture complexity is automatically reduced. Following diagram states working of module one.

Diagram Fig. 1 suggests user sends requested to server regarding the required service i.e. either hospital information or ambulance details.

The second module is used to send live information about the patient's health to the desired hospital selected by the user (Fig.3). Using various smart devices support enabled hardware components, the readings will be recorded by the system which will be available inside the ambulance. The app will send the data in the form of live feeds so that hospital management can make necessary pre-requisites till patient reaches the hospital. It is said that treatment given while taking patient from source place till hospital is most crucial in case of any heart related problem and emergency. Thus Hospital administrative person can guide which actions should be taken until patient it reaches hospital.

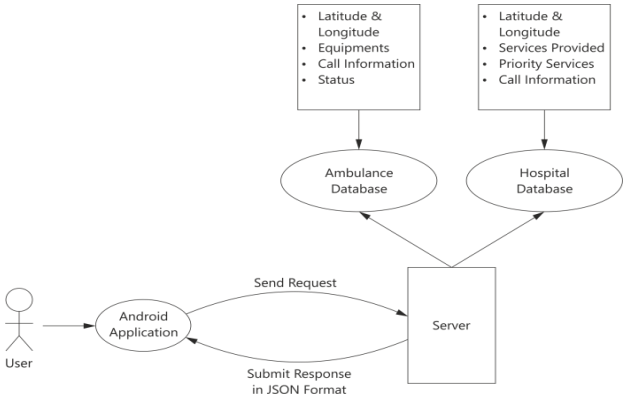

Figure 1: Module One: Finding Ambulances & Hospitals

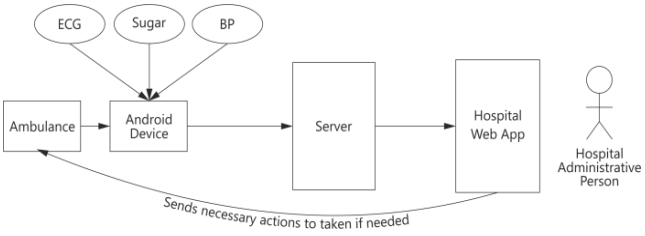

Figure 2: Module Two: Sending patient's information to the hospital

3.3 Design and implementation

The implementation of this system is divided into server client architecture in order to make small size application and keep all the data available centrally. Thus client is nothing but a smartphone having the application and the server side used for handling user requests and respond by processing them.

3.3.1 1.User application

This application will initially be based on Android & iOS. On launching the app first device will automatically detect the location of user using the GPS devices [6]. Later depending on the user's requirement/need user will choose option of finding nearby ambulances or hospitals or just view services provided by hospitals. This query is sent in the JSON format to the server. Server will process on it and respond accordingly. The response from server will also be in JSON format [7]. Smartphone app will read the data from response and plot the coordinates or information according to the user's request.

3.3.2 2.Server end

Server end is designed keeping ease of work in mind. It is designed using PHP. When server will receive a request from device, it will parse the data and extract result from the database. This result will be placed in the JSON format and will be returned to the device which made that same request. Every JSON request will send data depending on request URL type. Every request will be in the form of POST/GET query.

3.4 JSON(Javascript object notation)

JSON is a data interchanging format and is selfdescribing. It is a rift of the JavaScript programming language. JSON acts as a syntax directed translators. With the help of high level grammar leaning operations, it helps to understand significant parts of the application JSON acts as a very important aspect considering sending and retrieving information. Using JSON, we can store information or data in and organized manner. It helps in transmitting data between the server and web application and vice versa.

It is in text format and this helps in computing language independency. Hence, it works as an ideal tool. It has 2 basic same parts namely

i. Key

ii. Value

Where they both together are used as a pair In JSON, the key denotes a string which needs to be enclosed between quotation marks, whereas value can be anything such as string, numbers, Boolean expression, and array or can also be an object.

3.5 Why use JSON over XML

i. Simplicity:

JSON is simpler to understand than XML. Since JSON has smaller grammar, it has more capability than XML for mapping onto the data structure

ii. Extensibility:

JSON needs not to be extensible. Since it does not require defining new tags or attributes to represent the data. While in XML, the case is opposite. Comparatively, JSON has a better and simpler structure compared to XML and is more easy and faster to process. Even though software is available for the programmer to handle XML, some additional software or code is required. While in JSON, less specialized software can also be used. JSON notations features which are simpler and no additional software's are required.

Access rate of JSON is faster than XML as it uses fewer words compared to XML.

3.6 Mathematical Model

Let set H be the set of number of hospitals

$H = \{h_1, h_2, h_3, \ldots\ldots\ldots\ldots, h_n\}$

Let set A be the set of number of Ambulances

$A = \{a_1, a_2, a_3, \ldots\ldots\ldots\ldots, a_n\}$

Let set U be the set of number of Users

$U = \{u_1, u_2, u_3 \ldots\ldots\ldots\ldots, u_n\}$

Let set S be the set of number of Services

$S = \{s_1, s_2, s_3, \ldots\ldots\ldots\ldots, s_n\}$

Let Result for search of Hospital queries be R_h

$$R_h = u_1 \cap h_1$$

Let Result for search of Ambulance queries be R_a

$$R_a = u_1 \cap a_1$$

4. ADVANTAGES

It's beneficial for the users in case of emergencies as it saves time which gets consumed in searching for the ambulance by other means.

Information about the hospitals provided helps in getting the appropriate hospital which is suitable for the patient's treatment.

Sending patient's health information to the hospitals helps the hospital staff to get things ready required for the treatment. Here the patient need not to wait in any case. Hospitals information is directly provided through maps and hence there is no need to visit the particular hospital's website for information. Live feeds will help for better medical procedures which helps in saving patient's life in an effective way.

Sectors	Probable Smart Solutions	Sectors	Probable Smart Solutions
Water Supply	Solutions that improve reliable and efficient water management at the city level, reduce wastage of water, identification and prevention of leaks, metering, increase supply to areas that are deficient, recycling and reuse of waste water, water quality monitoring	Transport/ Traffic Management	Solutions to promote creation of walkable/ cycle-friendly and safe localities, reduce congestion, reduce air pollution, boost local economy, promote interactions and Transit Oriented Development (TOD), improve public transport and last mile connectivity
Electricity	Solutions to monitor supply and quality of power, usage, avoid wastage, enhance usage of energy efficient appliances	Education	Solutions to increase enrolment of students
Sewage/ SWM/ sanitation/ SWD	Solutions that promote decentralized and community level solid waste management, handling construction and debris waste, e-waste etc. Enhance availability and excellent maintenance of community and public toilets	Citizen Participation	Use of ICT, especially mobile-based tools, to enable citizen's involvement in governance, accessing information on civic issues, monitoring implementation of projects, providing feedback etc, to ensure transparency at various levels.
Affordable housing & Slums	Smart solutions to ensure that beneficiaries are identified correctly and intended beneficiaries are able to access affordable housing, including rental accommodation and night shelters	Governance	Making governance citizen-friendly and cost effective —provision of online services to bring about accountability and transparency, especially using mobiles to reduce cost of services and providing services ;video crime monitoring
Health	Solutions to increase access to health services especially for urban poor, health awareness, alerts and emergency services	IT connectivity & digitization	Make available benefits of new technologies, especially information and communications to all citizens for civic services and e-governance
Environment & Solar Power	Solutions for innovative uses of public open spaces, green spaces mapping and management, tree census, biodiversity conservation and management, pollution control and environmental quality monitoring, Pune gets a number of good	Safety & Security	Enhancing urban safety and security through effective urban planning, community-based consultative planning process design and governance. Solution to overcome three specific threats to urban safety and security i.e. crime and violence,

Table 1: Chart showing things to be included in smart city initiative [9]

5. CONCLUSION

In this paper, an idea is proposed for saving a patient's life in a faster way possible. It is beneficial for users in case of emergencies as it saves time. With this Application, the ambulance can reach the patients as location is given through the app and can provide necessary equipment required for the patient's health.

Information about the hospitals provided helps in getting the appropriate hospital which is suitable for the patient's treatment. The live feed data sent through the ambulance to the hospital helps in keeping track of patient's health details and reach the hospital without any time lag. Sending patient's health information to the hospitals helps the hospital staff to get the necessary pre-requisites regarding the patient's treatment.

Hence it reduces the time complexity and helps to provide faster medical services.

Future scope of this project can be planned by using some of the similar concepts used in this project. In order to save lives there are many other factors which can be taken into consideration. Traffic is one of the most serious issue faced in day to day life. This can create delay for the ambulance to reach the hospital. Traffic police can help in this if they know the ambulance's current location in advance. For the same, traffic police will be provided with an application which shows the current location of ambulance through GPS. Henceforth, traffic police will be able to clear the traffic in prior making way for the ambulance.

6. ACKNOWLEDGMENTS

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