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Profit and Penalty Based Real Time Scheduler for EMS

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Abstract-Since computer and internet technology continue to move forward, real-time online services are rising. This paper provides online service for emergency patient. The majority countries have implemented some form of Emergency Medical Services (EMS) in order to serve people with critical medical needs. Since the number of ambulances is inadequate to a specific geographic region and emergency calls need to be responded to without delay, EMSs have to be thoroughly managed and coordinated, which is done by operators in special call centers. So in paper will introduce several strategies to carefully place ambulances in their service range and to determine levelheaded mappings of ambulances to victim requests. It shows that continuous optimization of ambulance distribution over the region and dynamic dispatch of ambulances to incoming requests can profit both the patients and economically the provider of the EMS.At the end we simulate proposed system into 108 emergency app for EMS.

Keywords:EMS,DC,Android,Application,Sevices,Emergency.

I.INTRODUCTION:

Since computer and internet technology continue to forward real-time online services rising. Online service Provider gives guarantees of quality of services like timeliness [1]. EMS is systems that provide emergency medical care to the sick and injured and as well carriages patients to clinics for extended evaluations by a physician or doctor. The increase in populace over world in the last few decades has led to an increasing number of emergency calls. The rising number of emergency calls affecting to medical circumstances has resulted in a mounting demand of more efficient EMS [2]. Urgent symptoms such as stroke, heart attack bleeding and trauma that instantaneously require first aid could deteriorate into death in a very short period of time. Thus, quality EMS is imperatively needed and EMS response time is critical to such life-saving practices [2][3].

The growing demand of emergency medical services meet and to prevent death, it is crucial for EMS care providers to understand the dynamics of the EMS system, to standardize and reduce the ambulance dispatch time. EMS care can be provided in different forms like inpatient treatment, pre-hospital treatment to patients in the case of minor to major injuries or illness. Different countries and states have different protocols and regulations to make the emergency communications flow smoothly between the caller, dispatch center, Emergency Medical Technicians (EMTs), and hospitals. The goal of our project is to first understand and improve the EMS system [2][3].

This consists of research into several principles for EMS responders, EMS communication protocols, and EMS equipment [2].Emergency medical services in India the ambulance-planning problem contains operational decisions such as choice of dispatching procedure, tactical decisions for example where ambulances should be based and at what times they should operate, and tactical decisions likeplace location selection [3]. Any solution to this problem requires careful balancing of political, economic and medical purposes. Quantifiable decision methods are becoming increasingly important in providing public responsibility for the resource decisions that have to be made. The use of a detailed time-varying travel model for modeling travel times in the simulation, methods for reducing the computational overhead associated with calculating time-dependent shortest paths in the travel model.

An emergency patient is not able to select the optimal hospital for his emergency in an unknown area [4].

The research shows the study of variables used as reference by EMS to make decision and to create a computational model to direct the emergency patients to most suitable hospital [4][5]. The main purpose of this study is to help with emergency hospital resources management, to classify variable with significant role in decision making. An EMS has been recommended and intended to facilitate and computerize all the processes involved in an emergency [5].

Organization of the paper:

The rest of paper is organized as follows. Section II represents the related work. Section III represents the system model with specifications and the flow of the model. Section IV represents the proposed work related to EMS. Section V shows performance analysis of the proposed algorithm. Section VI represents conclusion &future work for proposed system.

II. RELATED WORK

2.1 EMS in India:

There is no single system which could show a key role in managing. There is fragmented system in different places to attend the emergencies in the country. There are different emergency numbers in India's 28 states and seven Union Territories. Hospitals in India provide different numbers for ambulance services. Clearly, it is understood that there is an improper fragmented health services in this country which terribly needs a drastic improvement compared to the developed countries. It has been found that trauma is one of the major causes of death in India. In order to avoid such preventable deaths, Indian government has planned an effective system that could provide emergency care. To address this problem, the Centralized Accidents and Trauma Services (CATS) were set up by the Delhi Government in 1990s, which was later expanded

throughout the country. Unfortunately this attempt failed despite having a toll free number, 102 [2].

Recently, many NGOs and hospitals have started to provide their own EMSs. Other organizations like Emergency Management and Research Institute (EMRI).American Association of Physicians of India Origin (AAPI)'s EMS are banned by corporate. Exception in the otherwise struggling EMS system is EMRI. EMRI was founded in 2005. EMRI is responsible for medical, police and fire emergencies through 108 emergency services. Initially, its operations were limited to Hyderabad and Andhra Pradesh with an aim of responding to 30 million emergencies and saving 1 million lives a year. EMRI also comprises a research institute, medical research, systems research and operations research. Other services that EMRI's includes is free medical advice on phone on another toll free number 104 with access to more than 200 medical doctors and several more paramedics (Emergency Numbers Around the World).

With the extension lead of Ambulance Access for All (AAA)'s services, American Association of Physicians of India Origin (AAPI) founded Emergency Medical Services (EMS) for the city, Mumbai in 2007. AAPI has collaborated with many other organizations to endorse the growth of the healthcare sector in India, especially in rural areas. Although there are many efforts being implemented in many areas to improve the EMSs but these are the examples of fragmented system. There is lack of common emergency number across the country which is a major hurdle in creating a reliable emergency service (Emergency numbers around the world).

So in spite of many efforts implemented to improve the medical service there is still a long way to go. From the different data, it has been found that one ambulance is needed to cover a population of 50,000 to 100,000 which is not sufficient to meet the demand. It is seen that India should have more accessible and reliable emergency medical services irrespective of geographical factors. Another important component missing in the current system is that there is a need of a body to regulate the EMS in the country. Hence, it can be said that India needs to improve its medical system in order to provide better services to the Indian population [2].

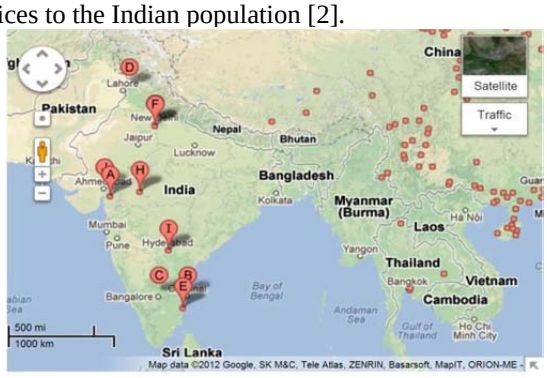

Figure 1: EMS Available City in India

So from related work conclude that India needs to improve its medical system in order to provide better services to the Indian population. India required good decision support system, technology to save the number of lives as a profit of EMS.

III. SYSTEM MODEL

When an ambulance starts to navigate through the traffic, it first requires to know the exact location of the patient. It has been found that depending on situation, locating the exact location of patient could be a serious problem. The flaws in current system are no central ambulance provider, ad-hoc emergency provider networks, no real-time position availability, Type of emergency, Find the shortest path between source and destination. So in proposed system we are removing these entire flaws using Dijkstra's Shortest Path algorithm by calculating shortest path.

The main aim to develop this model is to find the criticality of the situation. So in proposed system, first find the case is emergency, non-emergency or moderate. Then according to that the ambulance is provided. There are two types of ambulances one is basic life support system [BLS] and advanced life support system [ALS].If the case is emergency type so ALS type ambulance is provided and priority also given to emergency case first to save the patient's life. ALS ambulances; advanced life support ambulances. These ambulances are usually staffed with higher skilled personnel than BLS ambulances and respond to urgent emergency calls.- BLS ambulances; basic life support ambulances. These vehicles are usually staffed with paramedics. These vehicles are sent to non-critical calls where transport is required.

The single node shortest path problem for a graph with nonnegative edge path costs that solves by using Dijkstra'salgorithm.This is a graph search algorithm, producing a shortest path tree. If the graph fits to main memory and all edges are nonnegative and if used heaps you will get a very fast and always correct shortest path. Dijkstra's algorithm is used with certain adaptations. As an alternative of using the distance, time taken to cover the distance between the nodes is measured as the node weight making this a dynamic model.

Using the speed and distance variables the time is calculated. The speed considered is the average speed with which the vehicles are navigating the path that can be obtained from the vehicles dynamically. Since distance is time-invariant, the time taken is calculated by taking the ratio of the distance and speed between the nodes.

$$Time = Distance/Speed$$

The Dijkstra's algorithm is track at the regional DC to obtain the shortest path between the source and the destination. Just once the shortest path is obtained, the DC checks for existence of metro at that instant in the path, else the Dijkstra's algorithm is repeated to obtain the new shortest path between the source and the destination to determine the final shortest path and conveyed to the ambulance. Once the final path is obtained, it is sent to the ambulance. Any congestion among the nodes along the source and destination is informed to the dispatch center. The DC checks the location of the ambulance using GPS. The mathematical model for EMS system design is as follows:

$$\text{System } S = \text{Android } A$$

$$\text{System } S = \{S`, I, \beta, O\}$$

$$S` = \{\text{GPS}, \text{Google Earth}\}$$

$I = \{PD, SD\}$
$\beta = Function$
$O = Output$
$I1 = PD \rightarrow Places\ Directory$
$I2 = SD \rightarrow Smart\ distance$
$[1]\ I1 = \{'Ambulance'\}$
$\beta 1 = I1 \rightarrow O1$
$O1 = \begin{Bmatrix} Phone\ no, Address, Map, Distance \\ emergency\ type \end{Bmatrix}$
$[2]\ I2 = \{Source, Destination\}$
$\beta_2 \rightarrow cal$
$cal = \{Source, Destination\}$
$R = \{R_1, R_2, R_3 \ldots\ldots R_n\}$
$D = \{D_1, D_2, \ldots\ldots D_n\}$
$R = Route, D = Distance$
$Mindistance = Min\{D_1, D_2, \ldots\ldots D_n\}$
$O2 = \{MinDistances\}$
$[3]\ I3 = \{Ambulance\ Driver\}$
$\beta_3 = I3 \rightarrow O3$
$O3 = \{Reach\ to\ Victim\}$

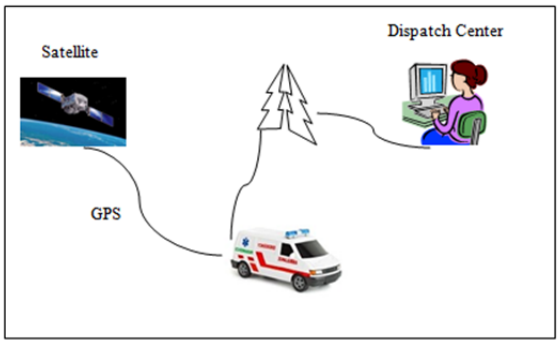

Figure 2: Proposed System work

Ambulance dispatch policy:

- **Locating ambulance to base station.**
- **Finding shortest path between ambulance and incident happen.**
- **Check the availability of ambulance If not available then select ambulance which is nearest to scene.**
- **Speed of ambulance and according to that time required to reach scene.**
- **At constant speed the time required to reach scene.**
- **The time necessary to reach scene at varies speed.**
- **Check severity of emergency.**
- **Reallocate the ambulance before reaching to base station.**

IV. Proposed Work

The System is proposed to function in case of emergencies in the world. Various emergency handling services are present worldwide to cater to the emergencies faced by the common man. The USA has its particular system by the name 911.At present; India does not have a similar well-defined emergency-handling approach.EMS is developed keeping in mind the lack of any such system in India. It is slightly based on 911 systems, but suited more to India. All the ambulance dispatch policy mentioned in proposed system is implemented into 108 emergency app. The common man can make use of this system in case of any emergencies. The system works is such a way, that victims will receive help in the form of ambulances depending on the circumstances. This system drives to and responds to emergencies on time.

4.1Architecture

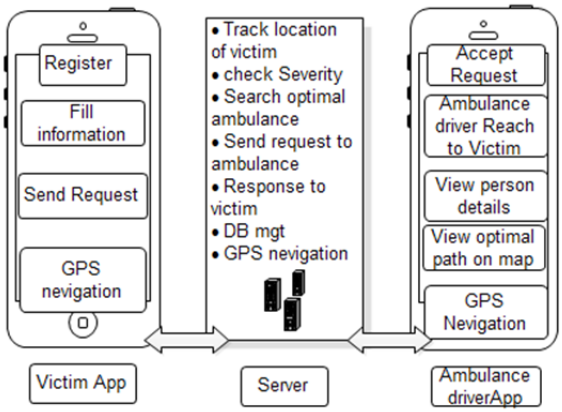

Figure 3: Architecture of EMS

System architecture is divided into three parts victim or user side and server side and ambulance driver side.

Victim application:

User raise the issue in case of any emergency from his android application with description and nature of issue severity. At the time of app installation victim register one time. User's location tracking is done with the help of GPS. All the details of user like priority, title, description, and current location report is send to the server for further service. Serverrespond location based emergency contact no's to the user application. In victim application there are buttons to send request according to severity of emergency like non-emergency, moderate case and emergency case.

Ambulance driver Application:

Ambulance driver gets notifications on his Android application with emergency issues. Ambulance driver can also view the person details and his/her location that has raised the issue. Driver can view the optimal path on google map with marker to reach the victim who raised the issue in case of emergency. After resolving the problem, admin can marked the issue as solved with certain remarks.

Web server:

Web application is useful for generating the reports such as, area wise issues report, priority wise issues report, location wise issues report. At server side dispatcher find location of victim then find ambulance which is nearest to scene. Dispatcher gives response to victim and ambulance driver. Dispatcher also tracked the location of ambulance driver and incident happen until the case is solved.

4.2Deployment Observation

Once the app is developed, deploy that app in any android os mobile. After deployment some testing issues observed because other test can also be done as the number of users increases. So following states are observed:

- The proposed app was in simple English.
- The app is easy to install in any android os mobile and installation is completed in few minutes.
- The registration form is simple to fill.

- Users are prompted with messages for invalid inputs.
- Labels in form give simple description and buttons have simple and well known commands. So this gives minimal design.
- The design used is consistent in terms of user interface
- Ensured that instructions were understandable.
- Used a medium-size font and screen resolution is also support for any mobile.
- Victim app informs victim if SMS was successfully sent.
- Response to the user request is also given in few minute by the dispatch center (server).
- The proposed design is simple and can be easily extended.

V. PERFORMANCE ANALYSIS

Performed our experiments on an Android based OS with GPS tracking system. The calculations desired for a single event on graphs with hundreds of thousands of nodes stayed well below a second and are thus appropriate for real world use. Furthermore in application implemented a GUI to envision the current state of the system.

To compare the performance of different scenarios, measure different values: like the total number of saved patients, then the average response time, i.e. the time it took for an ambulance to arrive at a patient after the request sent in, and the total distance driven summed over all ambulances. Consider following scenarios:

Scenario 1: Suppose at a time two different request came in server so which request first served is depend on severity of emergency. There are two ambulance bases with five ambulances overall. The ambulances are circulated all the way through the city and both ambulance bases are to a certain extent close to the city. Incident is happen at same time and distance from base station. Only one ambulance is available. So priority given to emergency case first.

Table1:Performance analysis of scenario1

	Distance from Source to Destinati-on	Time Required to Reach	Type of Emerge-ncy	Priority
Amb1	**12**	**12**	**Non-Emerge-ncy**	**2nd**
Amb1	**15**	**15**	**Emerge-ncy**	**1st**

Scenario 2: Consider the scenario of speed of ambulances. At constant speed the time required to reach the scene and at varies speed the time required to reach the scene. There are two ambulances at base station. With varies speed of first ambulance is 100Km\hr and second is 50Km\hr.The distance of first ambulance is 12 Km and second ambulance is 15 Km.Assume that the time required is 1 min for 1km.

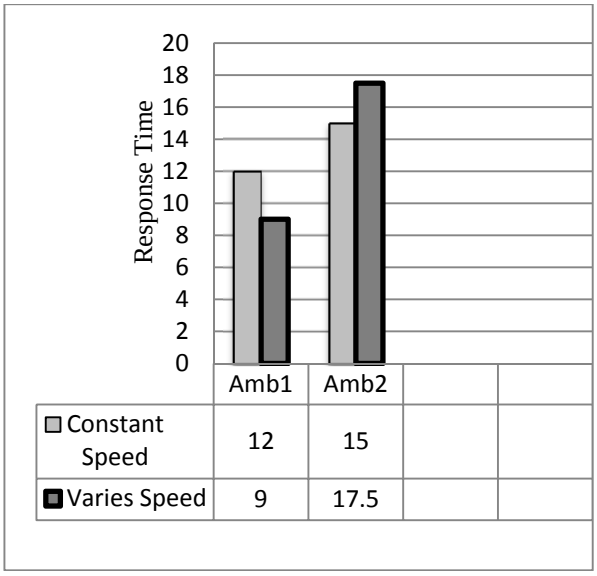

Figure 4: Response Time on The Basis of Speed

If adding the option to reassign ambulances could significantly improve performance of all strategy. For example for low intervals between requests the average response time for in case of emergency is less than required original time in minute's i.e shorter with reassignment. Also the number of saved patients improves (up to 30%).

VI. CONCLUSION AND FUTURE SCOPE:

In this paper investigated the problems related to emergency medical services management. Introduced a new dispatching method, and changes to where and when ambulances should be allocated. Proposed work shows that all flaws of current system are eliminated. The main aim to find criticality of the situation is implemented so save the number of patient which is main profit of EMS service.

So introducing new strategies like which type of ambulance is provided i.e. ALS or BLS and reassignment of ambulance and emergency type improves the number of saved patient's up to 30%.

In current practice, EMS decides optimal ambulance based on 'distance'. So using shortest path algorithm decreases the time required to compute shortest paths in the networks. The EMS should guide an emergency patient to nearest and appropriate hospital and ambulance. Sothe number of Patients life saved. Future work includes the enhancement of our strategies with other redeployment algorithms and the incorporation of detailed emergency plans for larger accidents.

Traffic congestion problem is also the main factors to implement in ambulance dispatch method. Implementing this application using Ad-hoc network currently.If resources permit, can implement this using cloud computing techniques as a future work. This would give leverage to global access by expanding the scope of the application from an ad-hoc network to, say WAN.

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