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Advanced Rescue Operation for Incidents and Disasters

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***Abstract:** In previous years, due to increase of traffic and roads hazardous there are a lot of accidents which causes a huge loss of lives because of various reasons. Main factors contributing to such major losses are that the accident or incident is not detected and no emergency facilities are provided to the victim at the right moment. Also, the emergency facilities are not coordinated between each other, In this paper we would suggest a system that would help saving lives by detecting the incident with the help of real- time images clicked by people or camera that would be installed on every location. The real time snapshots would undergo some deep learning algorithms to extract the services they require at the time of incident. Once the incident is verified the emergency facilities would be provided to them through our system that connects the services in no time loss. We would then calculate the shortest and the safest route to save the victim so that the victim should reach the hospital containing facilities to accommodate the incident in no time loss. Our system would be targeting the crucial problem society is facing and many emergency services are facing because of lack of coordination between them. This system would increase the life expectancy of the people by saving them with the casualties that happen and saving them with no loss of time.*
***Keywords:** Accidents, Disaster Management, Real-Time Snapshot, deep Learning, Coordination, Routing, Emergency Services, Efficiency.*

I. INTRODUCTION

The exponential growth in vehicle industry has shooted up the casualties occured due to mishaps. There is substantial pressure on the amount of resources available as compared to demand of infrastructure facilities. The number of hospitals, ambulances and other facilities need to be utilized efficiently in order to cope up with the increasing demand.

According to Times of India report of 2018, 40% road accident victims in 2018 died due to excessive loss of blood Figure[1]. The main reason for death of road accident victims is severe bleeding, resulting in hypovolemic shock. This could be prevented by speeding up the rescue operation and providing technical assistance to the subjects. First aid care teams have been prevalent in chicago since 1995. They train teams of volunteers of providing first aid to the nearby victims. However, first aid is not sufficient in many casualties and non-professionals cannot be trusted for saving person's life. Hence, it's not an appropriate solution. We have been working for one year to come up with a system that could automate the entire rescue services. The system consists of mobile applications connected to remote database servers.

II. RELATED WORK

Previously many authors have worked on aiding rescue services focusing on bottlenecks in relief operations, such as emergency facility location, vehicle routing, evacuation planning, etc [06]–[09]. The advancement of information technology with Cloud, machine learning and robotics enables to automate a variety of operational tasks in decision-support systems (DSS). Wallace and Balogh [02] demonstrated a system for automating decision making in rescue operations. They focused on planning and controlling the rescue operation using their system. DSS is meant to take decisions using available information without human intervention. DSS for rescue operations must deal with unsuitable and adverse environments. Oxendine, Sonwalkar & Waters written an article discussing on the disaster response and evacuation planning for the borough of Manhattan, New York City, New York [14]. They primarily use mobile application data for solving the challenges of achieving evacuation planning objectives for any densely populated city stem. It provided for shortest path and network routing functions but lacked in automation of the rescue operation.

The figure[1] shows TOI report of the major issues of death in India. The death due to excessive bleeding can be majorly reduced by bringing advanced rescue operations as purposed in this paper. Some countries found a major problem and have came up with many technological advancements to eliminate this problem by providing radio frequency channels to communicate and trying to make route for ambulances so that no occurrence of loss of life could be possibly because of not proper medical emergency services. But under-developed and developing countries are still facing this issue because of different factors. The rescue operation becomes inefficient and victim often reaches late to the hospital.

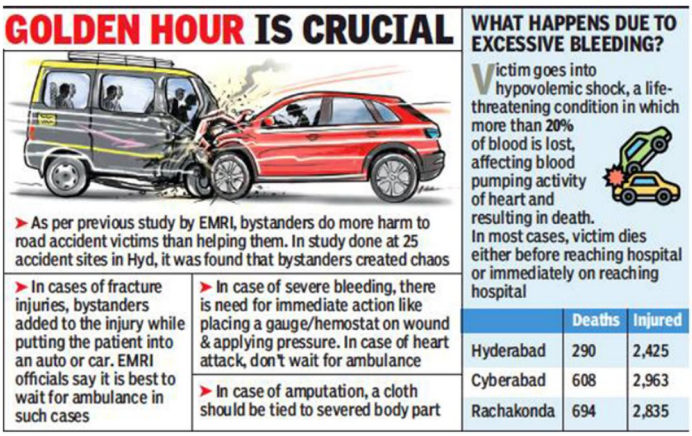

Fig. 1: TOI Report of death causes in 2018

In current system when any incident occurs the major time in the First or crucial Hour is on Rescue. On an average the system takes 75% of time on providing the services needed to accomodate the victim and only 25% time is left for Hospital Treatment. [3] which reduces as traffic and services aren't available with the nearby hospital this is the main factor that is taking lives of people.

Our system solves these problems by eliminating different factors that cause delay in providing services such as we are detecting accidents by an automated and a manual data gathering systems and verifying it by our accurate deep learning algorithms also, by connecting all the nearby ambulances so that the ambulance reaches the spot of incident in no time. As well as, connecting hospitals so that the victim gets the best hospital to accommodate and save the live of the victim

III. SYSTEM MODEL

Our system consists of application that run on mobile devices that is used to gather data such as the location of the emergency services and location of victim, automating the system and informing services to rescue the victim and bringing co-ordination in the system by use of different applications and cloud based centralized server to process the gathered data deploy different algorithms on deep learning and calculation shortest path also, to save information for future use.

The system consists of three applications

A. People's Application

This application is made for the users to manually register any incident that needs an medical support. Any person passing by the incident can just register a incident by just clicking a real-time snapshot.

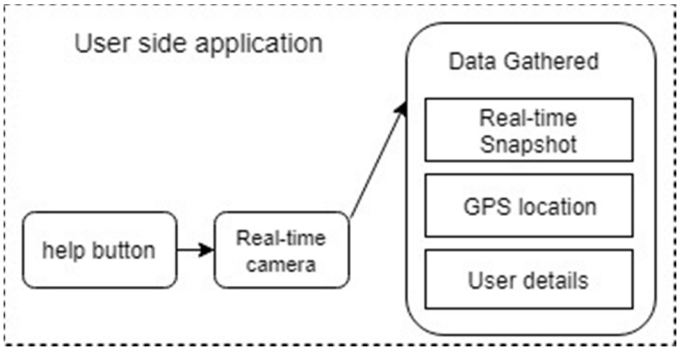

Fig. 2: People's application model

Every person needs to register on the application providing some basic information about the user. When the person clicks help button the app redirects the user to the real time camera to take the real-time snapshot of the incident. the real time snapshot along with the data such as the GPS location the IMEI number of the phone from which the request is send for future use. All the data gathered is send to our cloud server for processing and assigning services needed for the incident. The user can also track the services that are assigned to the victim and make sure the victim is saved in the no time loss. All the data gathered is send to our cloud based server where all the processing of the data takes place and the data is also stored for future purposes.

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Firstly, The cloud server uses PostgreSQL to save all the data gathered from the user's application. PostgreSQL is an powerful open-source Database Management System which would help to integrate with python and other languages. When the data is inserted, the image undergoes deep learning algorithm to determine the services needed for an incident. The deep learning algorithm is based on tensorflow library which will use different techniques to classify the image into three categories the categories are divided according to the the services that are available with the system. The services are ambulance, fire brigade and the police, the algorithm verifies different parameters that are extracted from our training data. The algorithm is trained on number of images that include different factors and parameters to determine and increase the accuracy of the system. If the image is verified and the services are determined then it updates the database with the services needed. Otherwise the user is informed on the application that the image send cannot determine services so that the user can click an image on a different angle so that our system verifies it and notify the user with the services assign to it.

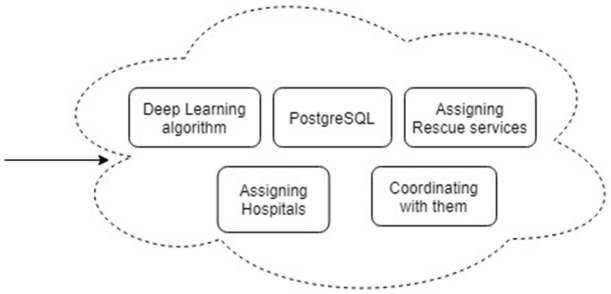

Fig. 3: Components of System

After the services are assigned, the algorithm determines which ambulance or fire brigade is near to the incident spot and available to serve any request with the help of google maps API and assign is to serve the request. By the time the services reaches to the location of incident it notifies hospitals to serve the request and the hospital with all the facilities is assign to the request.

B. The Rescue Application

The rescue application is provided to the services that need to be integrated with our server such as ambulance, fire brigade and police.

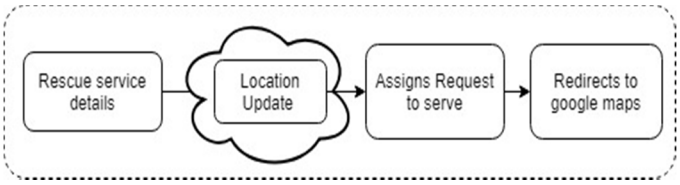

Fig. 4: Rescue application model

Rescue service are required to register with us by providing some basic information about the services like the name, phone number, vehicle registration number etc. When the rescue unit logins to the application, their status is kept as busy if they are serving other requests. If they are ready to serve any request from our server then the location of the unit is updated on every change of position that makes sure that the server gets exact location every moment. After the location is updated the server finds for any request in the area of 3-5 km's and assigns to it. when any request is assign to the rescue unit then he can redirect to the google maps for the route to the location of incident. This makes sure that the rescue unit reaches the location of incident as quick as possible with the optimum path.

C. Hospital Application

The hospital application is developed to maintain coordination with the medical emergency services. This application is provided to the hospitals with are registered with us for serving our request. They can register the hospital by providing some basic details about the hospital.

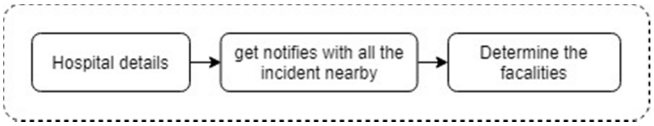

Fig. 5: Hospital application model

Whenever an emergency rescue unit is assigned to the request the image is forwarded to all the hospitals that are within 5-7 km radius. Viewing at the image the hospital could judge whether the required facilities are available to serve the request or not and accordingly would accept or reject the service. When the rescue unit reaches the incident spot all the response from the hospital are gathered and the nearest hospital which accepted the request is assigned to the ambulance. This enables the victim to reach the incident spot with no loss of time and with proper facilities the life of the victim could be saved.

IV. RESULT AND ANALYSIS

We have achieved 89% calculated accuracy on our dataset and algorithm that we have implemented and tested on our dataset applying deep learning algorithm. On the basis of 85 submitted incidents, we noticed the following results:

70 True Positives- The number of real snapshots that were verified as true.

6 True Negatives- The number of fake reports that were not verified.

5 False Positives- The number of fake reports that were verified as true.

4 False Negatives - The number of real snapshots that were not verified.

Accuracy is also used as a statistical measure of how well a binary classification test correctly identifies or excludes a condition. That is, the accuracy is the proportion of true results (both true positives and true negatives) among the total number of cases examined. As calculated from the given data,

Accuracy= 0.894.

Precision is the ratio of correctly predicted positive observations to the total predicted positive observations. Here, Precision=0.93.

Recall is the ratio of correctly predicted positive observations to the all observations in actual class. From the given data, here, Recall= 0.945.

Recall rate is really important as it is impacted by the real snapshots that were not verified. As this rate is above 0.5 and approaching 1, it is close to optimal. However, we have also kept a help option to submit request for manual processing to help every victim.

We are working on solving such cases where our algorithm can be at its maximum precision and every life is saved.

The applications tested in real time environment recorded that 40% time is saved in providing the facilities to the victim as compared to without using our system. We are working on offline support with duplex call service so that proper medical support is provided at the areas where there is no internet accessible.

A. Snapshots

1) Peoples Application: The person can manually register by clicking Report Accident button on the first screen when they log in to the system.

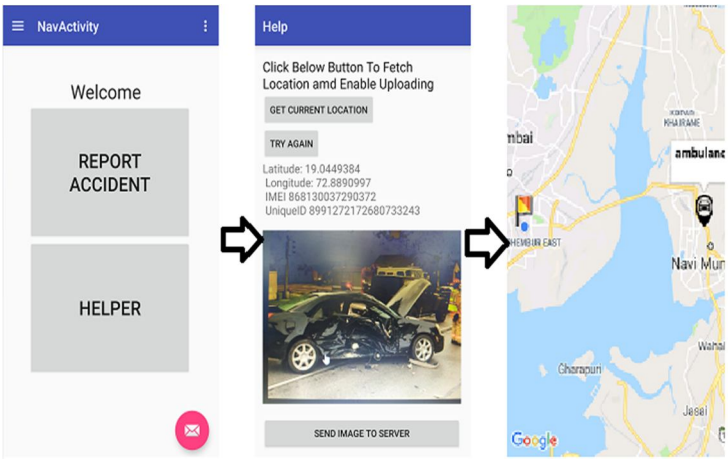

Fig. 6: People's application user interface

B. Ambulance Application

The registered ambulance can log in to the system and it would display all the incidents assign to it and it can route through google maps for the route.

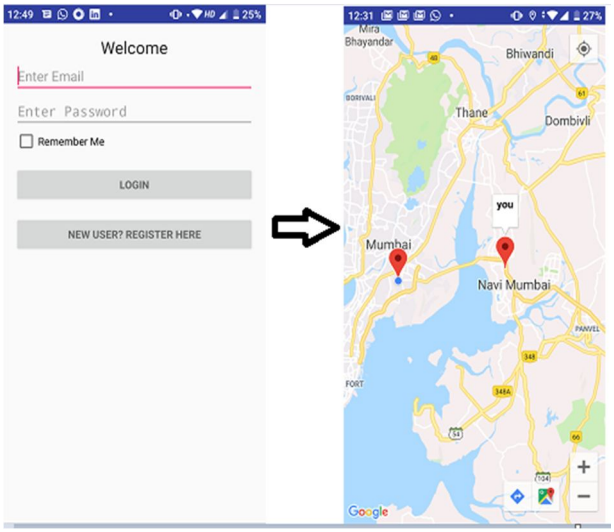

Fig. 7: Rescue application routing

C. Hospital Application

In the hospital application, when the registered hospital logs in to the system, it creates a list of all the incident that have been reported by People's application. The hospital staff can give a response of accept and reject by clicking at every incident or request number.

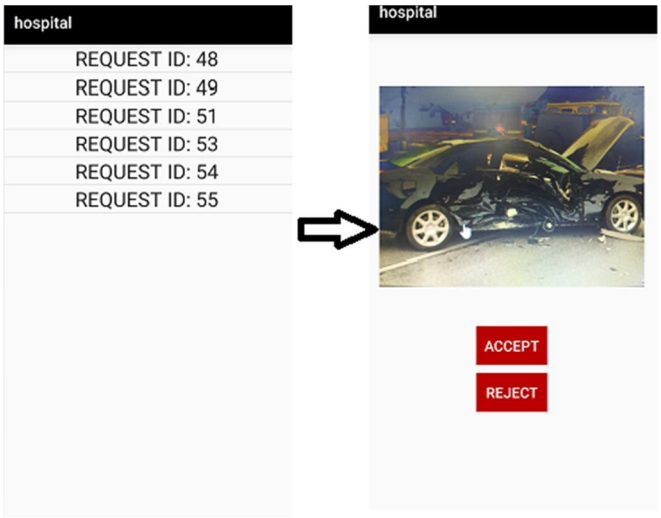

Fig. 8: Hospital application user interface

V. FUTURE IMPLEMENTATION

A. Surrounding Information

The data regarding the surrounding environment of the victim is very crucial for the rescue services. Though well- trained, the rescue services could be provided information about the wind pressure, humidity, temperature, precipitation and visibility.
Most of this information could be fetched from location of victim using official sources as IMD(Indian meteorological department) and sent to the server. This plays an important role in remote areas prone to climate changes as Rajasthan.

B. Managing Hospital Resources

Automating the process of accepting victim's request on the basis of available resources improves the processing time of victims request. The number of resources including doctors, beds, medical equipments, blood,etc can be managed using inventory system. This system would eradicate human error and decrease the burden on the managerial staff of the hospital. It also reduces the delay of manual acceptance of victims request.

C. Integrating Law and Order Services

The data recorded about the victim is of high importance with respect to intentional accidents. The location, photograph, time, etc serves as a source of decisive evidence in criminal cases. With proper permissions of the government, the support to launch an e-fir could be given in the application. This could be quite crucial as this would eradicate the need of going to police station in the golden hour period.

D. Real Time Accident Detection

The cctv's around the accident prone areas could be installed with this software to detect real time accidents. It requires image processing algorithms to run 24*7 to verify timely images as accidents. It could automatically inform the nearby rescue services with the accident notification. Although costly, this will provide an insight on reason of accidents and ultimately reduce mishaps.

VI. CONCLUSION

In this thesis, we have put forward a working solution to improve the efficiency of current rescue services in India.

It consists a dedicated server, cloud database, the people application, and a set of internal intelligent support services that automates the tasks of rescue operation.

For allocating proper type of rescue services, we develop a new algorithm based on deep learning, which successfully categorizes the accident based on the image passed to our server.

Our system automates the task of locating victim and coordinates with rescue services in real time. It also allocates the appropriate hospital to victim after confirmation with a set of nearby hospitals. Thus, it reduces the burden on victims helpers by supporting the rescue operation. It also helps rescue teams with updated information about the victim. The results show that the system contributes greatly in assisting the users and improving the rescue efficiency.

Our system targets general population with the help of easy to use android application. We are currently developing more customized and personalized system for the hospitals and upgrading the existing algorithm to improve the efficiency without degrading the response time. We expect that our system have a broader application and play an important role in future disaster rescue operations.

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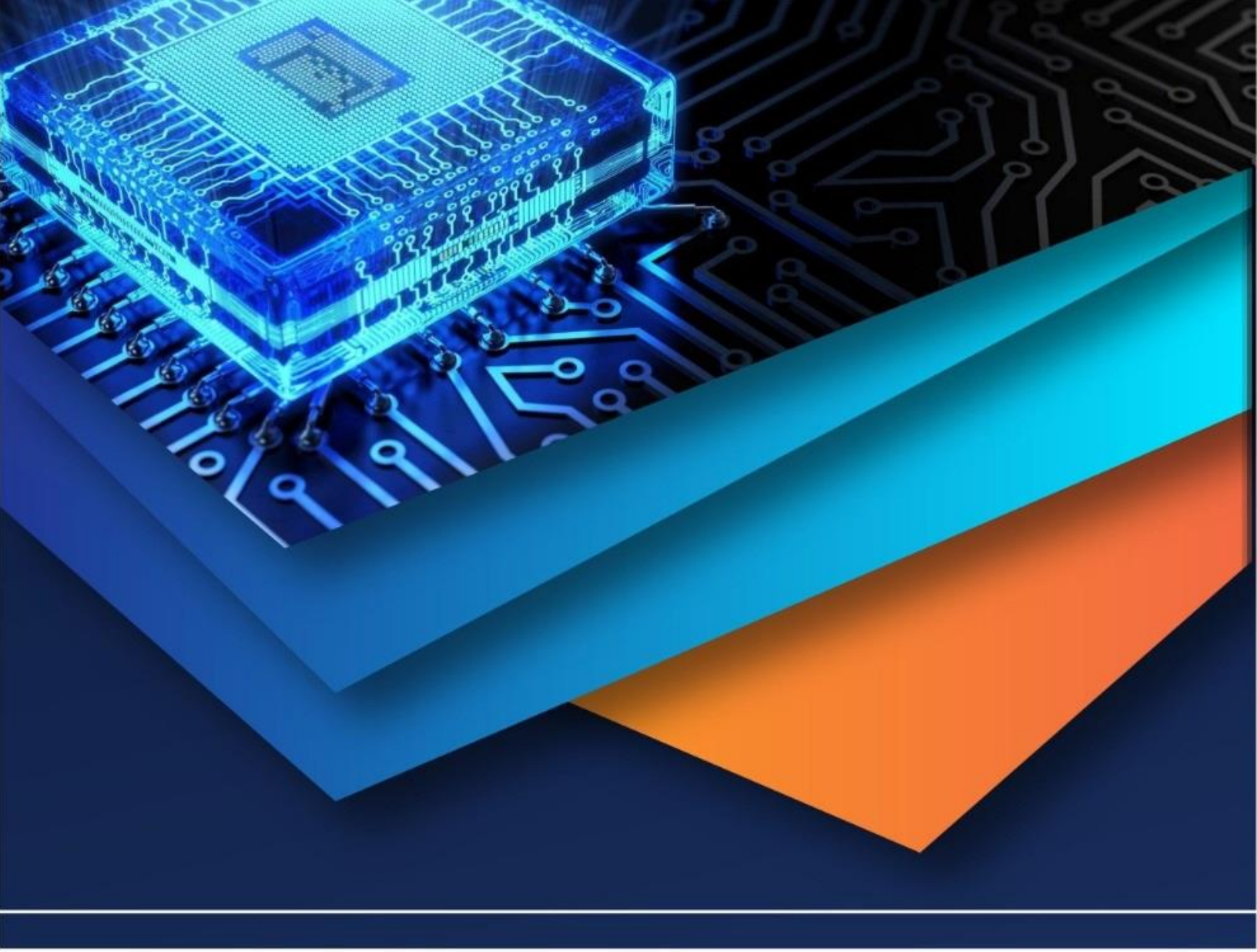

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