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Covid Tracker for Medical Front-Liners- A Survey

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ABSTRACT

This paper studies the need and suggests a centralized pandemic management system for monitoring and managing the Covid-19 positive patients. The initial process of the system will be data collection from a standard medical organization and performing suitable preprocessing. Following this, is the Geocoding process of the patient's address and area wise sub clustering. Next is plotting the patient on a map for better visualization. After this the medical staff will access this data and field staff will fill up the patient's symptoms and upload it to a database. A doctor can assign the type of treatment, ambulance and hospital to the patient. Finally, tracking the patient's arrival to the hospital via ambulance and treating the patient will mark the end. Analysis and visualization on the patients live data will help the authorities in decision-making. Through all these steps, the monitoring of a Covid-19 positive patient will become very easy and convenient for the medical front liners and other concerned authorities.

Key words: Covid19, Data Analysis, Geocoding, Ambulance Tracking system, Clustering

1. INTRODUCTION

The outbreak of Covid-19 has caused critical social, political, and financial results around the globe. The pandemic has revealed escape clauses in our organization, wellbeing offices, and social texture. In this time of a global pandemic, there is a strict requirement of a management system for the people who are the warriors against these types of deadly diseases, that is, the medical frontliners. They are the ones who are directly involved in the tracking, controlling and treatment of the people affected by Covid-19. In this paper, the aim is planning a way to create a medical management system which will cater to the needs of different types of medical staff who are engaged in the battle against Covid-19. We also study the techniques of finding the geographical location and performing cluster-based classification and allocation on areas in the vicinity.

2. AIM AND OBJECTIVE

- Assisting the Municipal Corporation or any organization from the time a patient is found Covid-19 positive till he/she is discharged.
- Assisting the field workers, health centres and related officials for performing further medical processes.
- The health centres shall be informed about the continuous status of the patient from the time the patient is tested positive till the patient is allotted the hospital with the facility required for treatment.
- Studying various data analysis methods for monitoring the daily, weekly and monthly insights.
- Finding an effective and good way for performing data analysis.
- Sub-clustering of the clustered output for specific distribution of the areas.
- Finding out ways of analysing the geospatial data.

3. SURVEY AND STATISTICS

As per the survey conducted by Central Bureau of Health Intelligence in 2018, the Figure.1 depicts the Share of deaths due to communicable diseases and Covid-19 also falls under the same category.

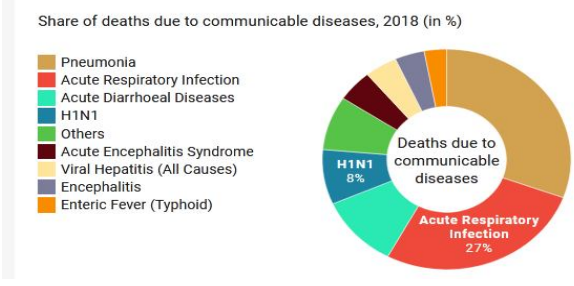


Figure.1: Distribution of deaths in 2018

Figure.2 shows the distribution of Covid19 cases among the states in India with Maharashtra having the highest number of positive cases

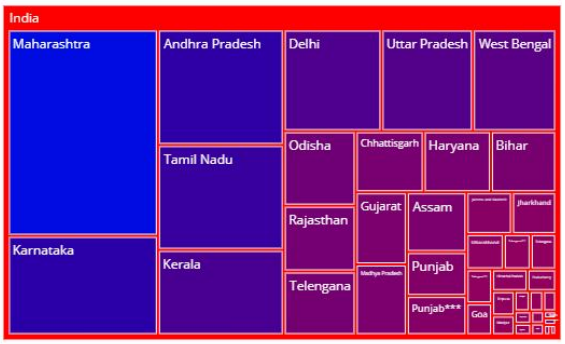


Figure.2: State wise distribution of Covid-19 cases

Figure.3 and Figure.4 Shows the rising number of Covid-19 confirmed, recovered and death cases in India till March 2021. The confirmed cases as well as the recovered rate has been increasing till now. The death rate in India is not rapidly increasing but still maybe a threat in future if not properly controlled

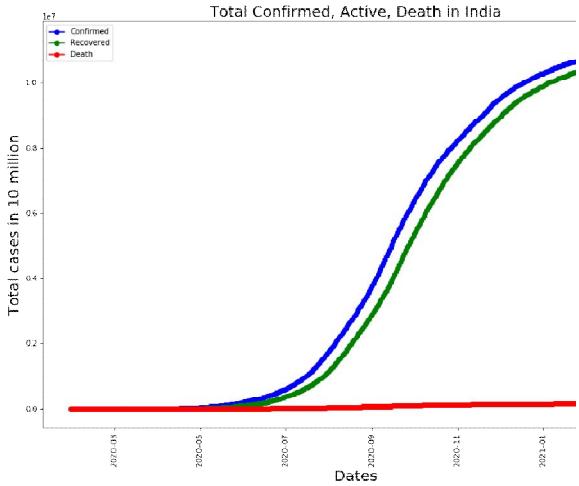


Figure. 3: Rising no. of Coid-19 cases

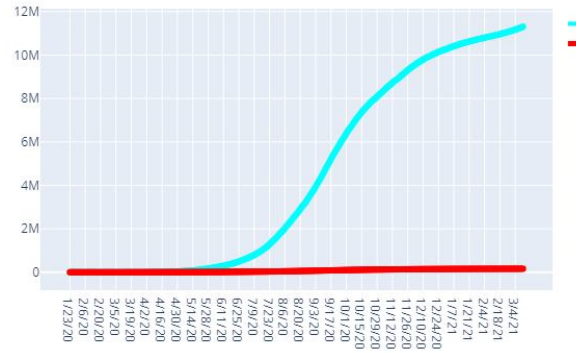


Figure. 4: Rising no. of Coid-19 cases

4. MOTIVATION

Since the beginning of the Covid-19 outbreak, healthcare professionals have truly been selfless warriors, giving everything to uphold their job responsibilities. The existing healthcare system for managing the patients is distributed, less efficient and slow. Field workers find it harder to attend to all patients directly. Even though the addresses of people in quarantine are given, their exact locations are not known. There is a need to develop an application which helps the Municipal Corporation, medical officers and field workers digitalize the entire process, analyse and derive insights based on geographical clusters and locations

5. MODULES

5.1 Data flow
5.2 Data pre-processing
5.3 Data Analysis
5.4 Geographical Representation of Patient
5.5 Tracking patient's ambulance

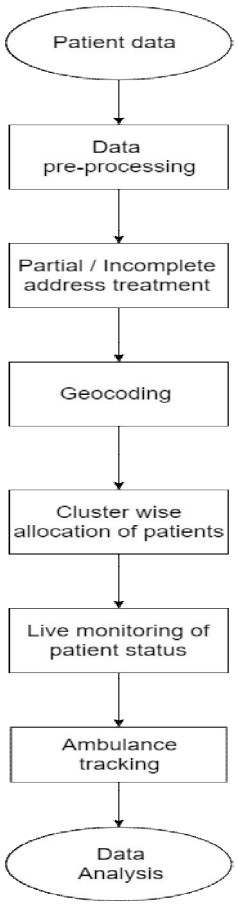


Figure. 5: Data flow diagram

5.1 DATA FLOW

Initially the Covid positive patient data will be uploaded to global healthcare organizations like WHO (World Health Organization), FDA (Food and Drug Administration), ICMR (Indian Council of Medical Research). This data can be cleaned, filtered and uploaded to the database. Almost every country or state in the world has its own medical governing bodies with their area of jurisdiction. Each of these bodies have sub clusters with their own staff. Some are certified doctors, some are employees with field jobs, and some are technical staff members and so on. This filtered data will then be given to the employees with field jobs. They can fill the necessary information regarding the patient's symptoms and upload this data to the database. This data can now be handed over to the medical heads of these governing bodies and they can take the decision regarding further medical assistance of the patient in detail. These details may include patient treatment type, ambulance type and hospital type. After these decisions are taken, the team of staff responsible for tracking the ambulances, pickup and dropoff of patients can safely admit the patient in the desired hospital. The patient will now receive the planned treatment and will get discharged after the hospital deems the patient fit for survival. There might be times when locating a patient won't be possible. For such cases, the medical governing bodies can collaborate with the police force to track them quickly. A reliable patient visualization and tracking system will be required for all of these stakeholders to work together in one platform. The visualization system should plot the patient's location on the map efficiently to locate him/her and the tracking system should accurately monitor the ambulance system so that the patients can be admitted to their respective hospitals quickly. This entire process is depicted in Figure 5.

5.2 DATA PREPROCESSING

The data to be received will be the raw data which needs to be converted to useful information[1]. For plotting the patient's data onto map, the data pre-processing needs to be done.There are various techniques where data cleaning can be done like directly using excel, Sql, python[6]. Also the data that will be received will be growing in volume as time proceeds so data quality management needs to be effective and essential[7].Key concepts to be treated for final data analysis will be data storage, management and processing of data.

Data cleaning has to be done which includes detection and removal of errors,inconsistencies to improve data quality[4].Certain methods include null value treatment, filling missing values, detection and treatment of outliers in data, data duplication[5].

5.3 DATA ANALYSIS

For performing data analysis and data visualization, it can be done using various tools like excel, Python , R, Tableau, Google charts.Excel has various features for data analysis and visualization [10]. Python has in-built libraries like matplotlib, seaborn, plotly altair, numpy, pandas etc. While R is very effective for descriptive and statistical analysis. Tableau is a business intelligence tool for creating attractive dashboards. Google charts is another tool for visualization like bar charts, line charts, pie charts, graphs[2][3][10].

Data analysis for various topics could be done:

1. Finding out the trend in number of positive patients[10]
2. Clustering geographical location to find out the hotspots
3. Trend in male-female ratio of positive patients
4. Age-wise, State-wise, city-wise, area-wise analysis[8]
5. Health centre based statistics and analysis for help to the front-liners
6. Vacancy check at hospitals for various kind of facilities
7. Analysing symptoms and various other features causing death or Covid-positive[10]
8. Generalized dashboard for monitoring health workers, patients, medical officers, hospitals[9]

5.4 GEOGRAPHICAL REPRESENTATION OF PATIENT

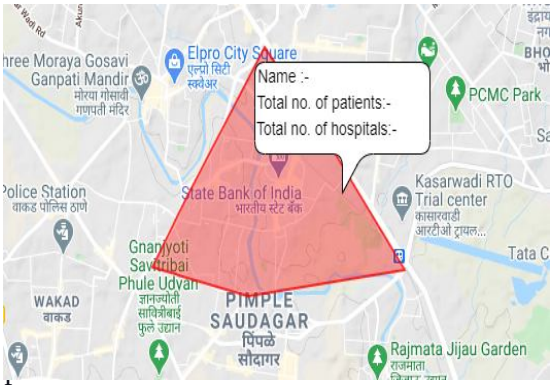
To monitor the health of a particular area, one powerful visualization tool is required which will Help all the medical and non-medical officers like certified doctors, people with field jobs and staff of the governing body. Maps are the answer for all of these. Maps help to visualize all the necessary data in one place, such as the patient's precise location, patient's name and some basic information along with the status of the disease as shown in Figure. Visualization based maps enable the medical facilities to prepare in advance and can severely limit the impact of the disease. To mark patients on the map, geographic coordinates are required. The geocoding process converts addresses into geographic

coordinates[15]. Which later on can be used to place markers on a map or position the map. To distinguish between the current medical status of the patient and the patient's past, there is a need to assign dynamic markers. It is important to know which medical facility's area of jurisdiction the patient falls under, so that the patient can get medical assistance quickly and effectively. To plot the exact area of jurisdiction of the medical facility, geographic polygons are required which include political boundaries of that area as shown in Figure 6.

Polygons function like traditional Markers which can be related to other data. When clicked, a pop-up information panel is displayed containing more detailed information about that area. It can be an area name, total number of patients in that area, hospitals under that area. In the health sector, the use of maps will be beneficial for the governing body. Because it helps them to track infection, recovery, fatality rates, and local health capacities. It will be easy to find out where the disease is spreading the most because of maps. To use maps with the application, it is required to use an API which provides services like geocoding, reverse geocoding, geofencing, roads API, direction API, geolocation API. To achieve this task, open-source or paid services can be used. Some of them are shown with comparison in Figure 8.

Example:

- Google Maps Platform,
- Mapbox API,
- Bing API,
- Nominatim,
- OpenStreetMap API — (free),
- Yandex Map API,
- TomTom maps.



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lygonrepresent area of jurisdiction of health organization

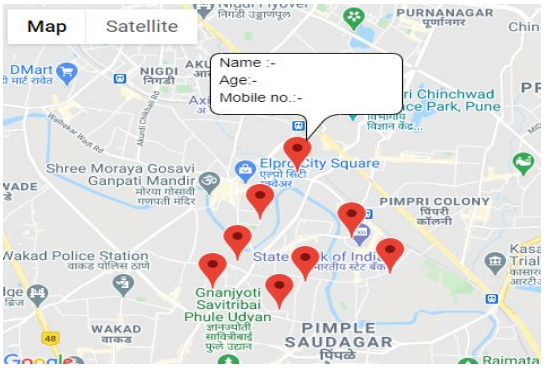

Figure 7: Marker represent location of patient with information

Feature	Google Maps	TomTom go
Routing	Google maps provides better routing service	Little bit behind in terms of traffic, but the ETA was similar as google maps most of the time.
Voice navigation	Google Maps comes with 59 voice options.	Offers over 100 voice options in many languages.
Transit options	Provides more number of transport modes	Provides fewer number of transport modes than google maps
Offline navigation	Provides offline navigation	Provides offline navigation
API Transactions	$200 monthly free credit	2500 free transactions per day for all APIs

Figure 8: Difference between Map Competitors

5.5 TRACKING PATIENT'S AMBULANCE

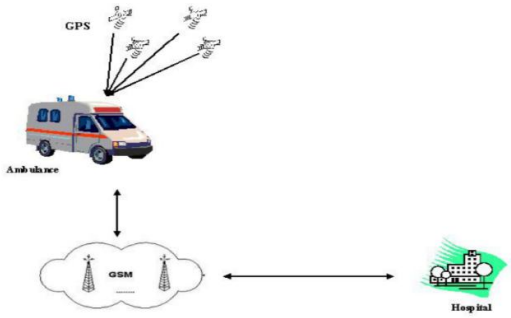

Figure. 9: Ambulance Management System

In this thesis the present research scope is considered and issues encountered by emergency service providers on the road are analysed. Nowadays there are a number of GIS systems being advanced for routing of ambulances using GPS. This is demonstrated by Figure 9. The affair of deceiving the adjacent ambulance and abbreviated path for each setback are very important to cut down the travel time, so we used GIS & GPS for location determining and decrease travel time. GIS is an elementary technology for every aspect of emergency management: ready, response and recovery. GIS gives us the capability to generate maps, link data, depict scenarios, arrange durable ideas, and derive adequate results. It is an equipment used by governments, institutions and businesses that are looking for innovative ways to fix their obstacles. It stocks data as a set of classes that can be associated in a sync through a common site, which is latitude and longitude, zip code or a name of a road. The intent of the ambulance management system is to show all city transmits as accessible service for ambulance routing to reach a patient immediately. Discovering the precise direction amidst two points, which is the patient's position and hospital or ambulance position, can be done by using the GIS network. These systems are convenient and have an important part in dealing with the routing issue. However currently the roads are so choked that it is challenging for the Ambulance drivers to ride and reach the location. The idea is such that it gets the patient's location from the database and locates the nearby ambulance using real-time technologies such as GIS. The proposed idea designs the quickest route from nearest ambulance to the patient's location, and from there to nearest hospital. Traffic congestion on streets during rush hours is considered, and the quickest route on both major and minor roads is created. Transit of a patient to a hospital looks simple but in actual it is difficult and gets more difficult during rush hours.

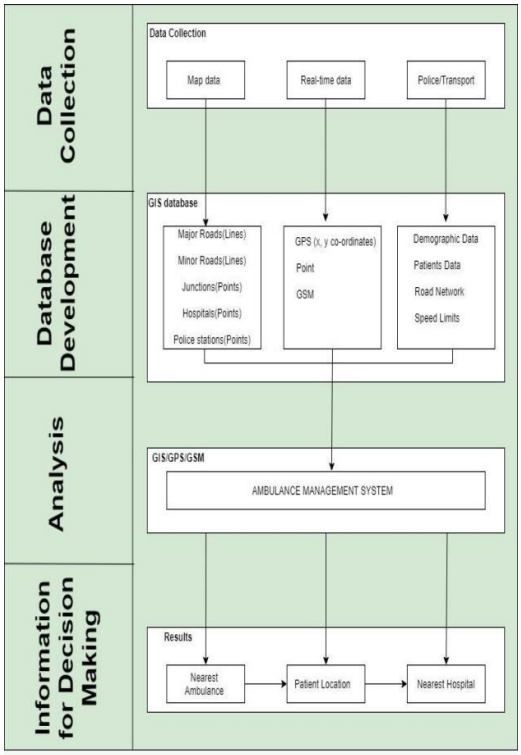

Figure. 10: Architecture diagram of ambulance management System

The proposed Ambulance Management System as shown in Figure 10 and Figure 11 is an assimilation of GIS and location information used for solving the routing problems during normal & rush hours such as:

1. To analyse the casualty and the road network.
2. To analyse the ambulance positions on the route chain in actual time using GPS coordinates.
3. To analyse a rapid route through which one of the ambulances can purview the patient's location.
4. To analyse the ambulance which can instantly serve the patient in comparison to other ambulances.
5. After analysing the quickest passage from the nearby ambulance to the patient's location then the quickest passage from the patient's location to the adjoining hospital is calculated.

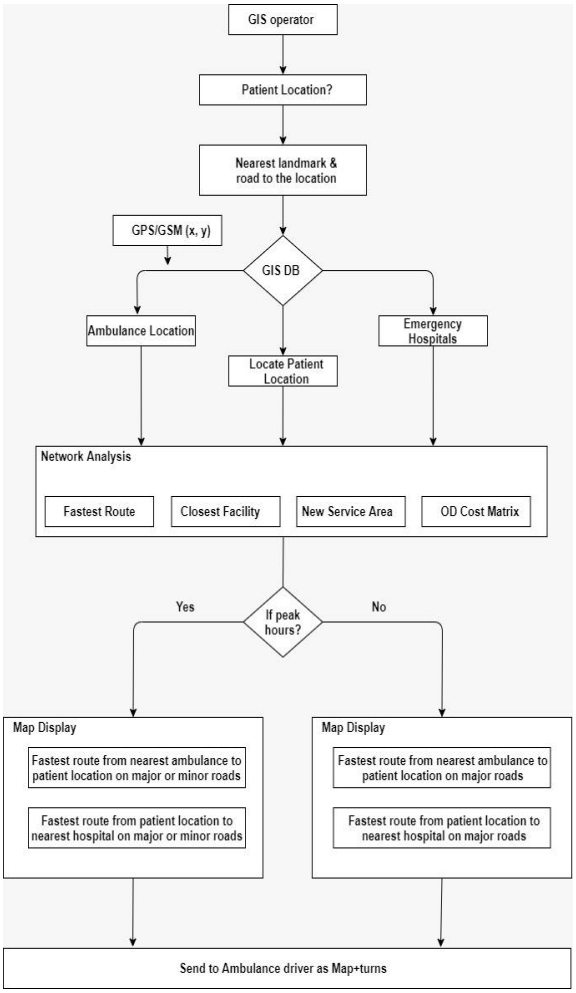

Figure. 11: Flowchart of ambulance management system

6. CONCLUSION

In conclusion, this paper clearly depicts that a medical management system of such type is highly required in this need of the hour. It can play a vital role in the early subdue of this deadly disease. Implementation of such a system need not be too complicated. An online tool or an app which can be accessed by all the medical staff is enough to cover all the modules covered in this paper.

7. ACKNOWLEDGMENT

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