

A Recommendation for Safety Parameters in Google Maps Routing with case study of a route in metropolitan city Hyderabad

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Abstract—Google Maps is a leading App used by commuters all over the world. This paper studies the various features of Google Maps especially, the safety features. The paper explains ways to integrate additional safety feature to all modes of transport into Google maps so a commuter is presented with the most optimal and safe route to reach the destination from a source. An improvised version of existing path finding algorithm currently used by Google maps that incorporates some safety features in heterogeneous transportation is presented. The same is applied to a route in Hyderabad city as a case study to showcase its utility.

Keywords- safe routing; shortest path algorithm; safety flags; intelligent routing

I. INTRODUCTION

Today, the number of travelers and commuters is at an all-time high. From the everyday travel to one's office and back, to the travel to parties, vacations, business-related and so on, most people are mobile throughout the year. As a result, the use of Maps related Apps is very high. Among the various such Apps, Google Maps occupies a top spot. This is because of its various features that are attractive to everyday commuters as well as tourists alike. Google Maps caters also to the special needs of commuters such as locations of hotels, restaurants, shopping malls and theatres. Today, Google Maps also gives information on costs of travel, modes of travel, traffic conditions and blocked roads. Google Maps is also linked to several other Apps today such as weather forecast – temperature and rainfall, landscape, Vehicle Network Sensors (Uber and Ola), and hospital emergency, in addition to disaster and calamity control Apps.

As per Enterprise Apps Today [2] statistics for the year 2022, Google Maps is used by 154.4 million

users world-wide every month. It is the number one navigational App in the USA and many other countries. It uses 21 petabytes of data for its results. Users themselves contribute 20 million pieces of data every day.

II. LITERATURE SURVEY

Google Maps features are presented and their applications explained in various contexts by various researchers. There are several approaches followed to implement Google Map Graphs. References [1] and [8] explain the pseudocodes of two popular Algorithms being implemented by Google Maps – the Dijkstra and the A* Algorithms. A novel method using Generative Neural Networks to predict Expected Time of Arrival is presented in [13]. The use of A* algorithm in implementation of routing selection using Python is presented in [3]. Another Researcher has presented the use of Dijkstra using Python [4]. A system for generating routes for vehicles that includes prohibited turns is presented in [15]. Traffic problems and Congestion types, delay computations and their presentation in Google Maps is discussed in [7].

The application of Google Maps for criminological research is presented in [5]. Researchers have also studied the use of Google Maps in the academic context, specifically in libraries [6] and the use of Keyhole Manipulation Language (KML) for conversion of GIS files to enable easy web-based download. A customized presentation of Google Maps for tourists with the case study of Taiwan is presented in [14]. It combines Bayesian Networks with the Engel-Blackwell-Miniard approach for a robust solution. The use of Google Maps for landscape analysis in Belgium is studied in [16]. Reference [18] uses Google Maps as an effective aid in presenting flood information. A detailed discussion on how land use can be computed using Google Maps and presented in an

effective manner in [19]. Real-time vehicle tracking using vehicle sensors and Google Maps is studied in [20].

Reference [8] discusses a sample Map building system. The various statistics of usage of Google Maps is presented in detail in [2]. A comparison of performance of two different street Map Applications – Google Maps and Bing Maps is presented for Ireland in [9]. A study of consumer feedback that enriches Google Maps services is presented in [10]. Reference [11] discusses the socio-economic disruption by Google Maps and effective strategies historically implemented by Google Maps. A comparison of performance of Google Maps with ArcGIS is done in the context of multiple origin and destinations model in [12]. A study of probable misuse of Google Maps for illegal activities and possible preventive steps is presented in [17].

III. GENERAL FEATURES

Google Maps is one of the most popular Apps used by people worldwide today. It is used by commuters to find useful information such as real-time traffic, and route planning for walking, biking, driving, or public transportation that helps them save time and money. The various important features of Google Maps are as given in the following sections.

Travel time Estimation

Given the Source S and the Destination D, Google Maps shows the shortest path in terms time taken, the distance and the time taken by various modes of transport and the approximate cost incurred for each of them. The priority is - time taken followed by distance travelled - in that order.

Scheduling trips

Open Google Maps, set directions, pick leave now along with time of departure or arrival. The feature is available only if there is a single destination.

List of places to visit

One can create a list of saved places to access most-saved locations. One can also find the schedules of public transportation for a specified route. Also, businesses such as restaurants, hospitals, resorts and parks can also be determined.

Sending location in real-time

One can share one's location in real-time. This feature can be used in real-time to show someone else the path to reach us. This feature can also be

considered a safety option to find a person if he/she is lost.

Save maps to phone

An area map can be downloaded beforehand if there is a possibility of traveling in the absence of internet, using GPS. This feature is particularly useful in areas which have frequent power cuts.

Set route options

Route preferences can be set top avoid highways, tolls and ferries. Also, one can watch live feeds of traffic cameras for a better understanding of traffic conditions.

Explore in street view

This option gives us photos of places visited in close up. The view can also be a 360 degree view. Another new feature of Google Maps is to view the indoor maps of stadiums, malls and airports to name a few, using 3-D option.

Find Co-ordinates

One can find GIS co-ordinates of a location and vice-versa using Google Maps.

IV. SAFETY FEATURES

Smart-device-using-maps

Google Safety Features currently protect ourselves us from crowds, accidents, major emergencies as well as natural disasters. These features have been added mostly during Covid-19 outbreak that affected the entire globe.

COVID-19 related features

Overcrowded places can be determined and avoided using Google Maps. Fig. 1 shows the screenshot of crowd presentation in Google Maps. The entries are – full, crowded, not too crowded and not crowded.

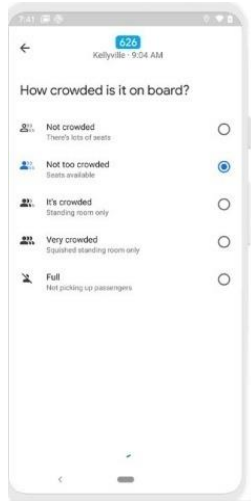


Figure 1. A Google route map showing the crowd levels at a particular time.

Online Safety Information

Google Maps gives Covid-19 related precautionary measures being taken up by businesses. It also gives information about temperature, safety and accessibility.

There is also pop-up data on progress of the 'red' event. There is also a provision to call police services.

Accident Alerts

Google Maps also has accident alerts. The routes recommended are designed to reduce sudden breaks

and accidents. The Google Pixel phone has a crash detection feature that uses the phone's accelerometer sensor, Google Maps location and other sensors to detect that the vehicle has crashed, immediately calling up police. Google Maps immediately informs all emergency contacts of the incident.

V. ADDITIONAL SAFETY PARAMETERS

Google Maps implements many safety features as discussed in the previous section. There are some cases where women or children are in majority, women are travelling alone, or people travelling with too many valuables. In such cases, one would wish to avoid streets which are isolated. There are also streets which have huge incidents of robbery or attack on humans. These streets are also to be avoided, especially when travelling at night. These are features that can be easily added to Google Maps. We take an example of a popular bus stop – Mehdiapatnam in Hyderabad, India. This bus stop is the connecting link to all places in Hyderabad. For simplicity, we take one route from Hyderabad to the other end of the city called Uppal. Figure 2 shows this travel route. The map is modified by the author so that a section of the discarded path is presented in pink color to warn commuters. Pink is chosen as a majority of other colors are already used up in Google Map conventions. This is a simple example of how Google Maps can avert major mishaps.

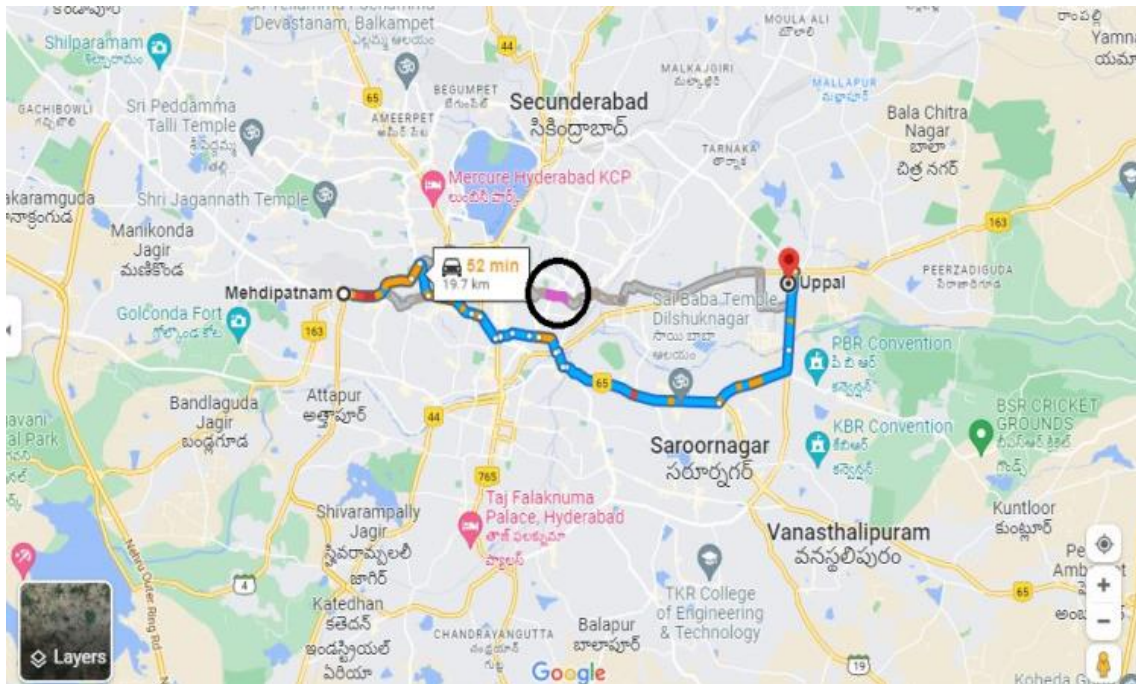


Figure 2. A recommended Google route map from Mehdiapatnam to Uppal in Hyderabad City, India. A pink segment is added to the discarded route (circled in black) to indicate danger zone.

At present, two cases of significance are identified. One – the *Danger* case, and, the other, the *Isolated* case. The determination of the first – Danger can be done on Google Maps using crime data. The same requires mapping to crime records available with the police department. The statistics of crime, however, are available on public domain. A simple data structure can be added to existing Geological pin data that maintains the number of

crimes streetwise. A predetermined threshold value can be set. Also, a time-zone can be set for consideration of crimes. If number of crimes within the pre-determined time zone exceeds threshold, then, the street may be flagged as *dangerous*. Google Maps already has a crowd detection module. The crowd determination algorithm can be used with additional code to flag for *Isolated* streets.

VI. A CASE STUDY

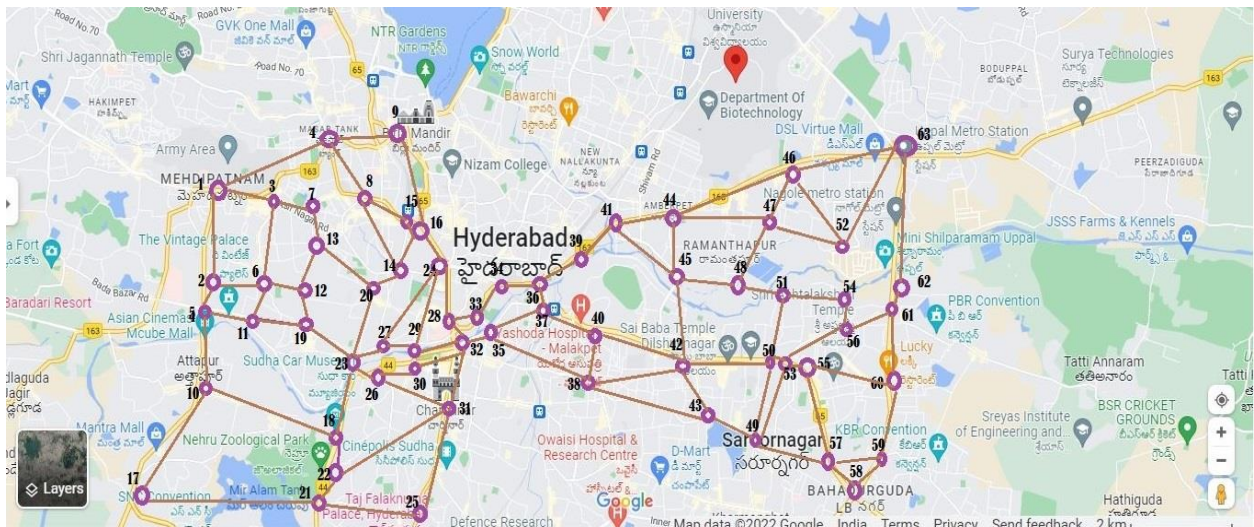


Figure 3. A route map superimposed on all possible Mehdiptanam-Uppal routes.

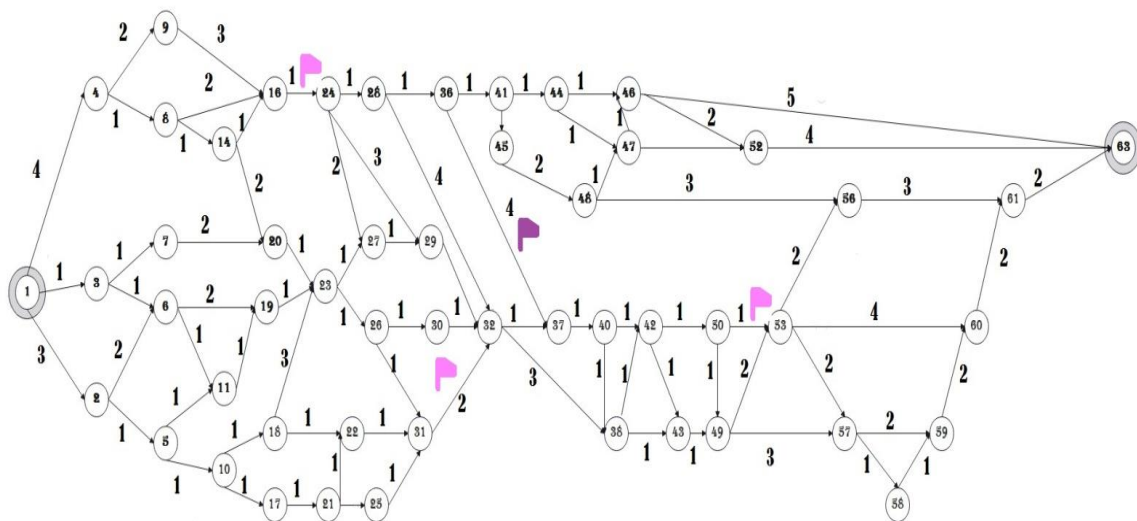


Figure 4. Graph extracted from Figure 3 showing all routes from Mehdiptanam (node 0) to Uppal (node 63). Paths that are dangerous, as calculated from Crime Statistics are flagged Pink and those that are Isolated are flagged Brown.

Google Maps with source as Mehdipatnam and Destination as Uppal is taken as input for this exercise. The graph of possible prominent places in between is then superimposed on this map (Figure 3). For ease of computing, names of places are replaced with unique numbers. A total of 63 nodes are obtained, inclusive of the start and destination points.

A reduced graph is obtained from this after removing additional nodes with single incoming and outgoing paths in the graph. We do this to simplify our path discovery process. For example, nodes 12, 13, 15, 33, 34, 35, 39, 51, 54, 55 and 62 are removed.

For all the remaining nodes, two additional pieces of information are added - i.e., *Danger* and *Isolated*. For every edge (street or path) connecting nodes i and j , $danger[i][j]$ and $isolated[i][j]$ are initialized to 0. In the graph, all dangerous places are marked with a pink flag and all isolated places with a brown flag (Fig. 4). The paths $16 \rightarrow 24$, $50 \rightarrow 53$ and $31 \rightarrow 32$ are determined *dangerous*. Thus, in our data, $dangerous[16][24] = 1$, $dangerous[50][53] = 1$ and $dangerous[31][32] = 1$. The same values are also assigned for the reverse cases of edges $24 \rightarrow 16$, $53 \rightarrow 50$ and $32 \rightarrow 31$. Similarly, path $36 \rightarrow 37$ is determined *Isolated*. Therefore $isolated[36][37]$ and $isolated[37][36]$ are assigned '1'.

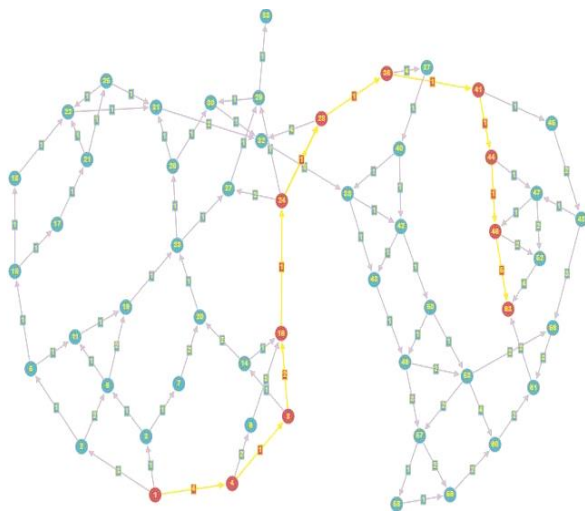


Figure 5. Output of Dijkstra's Algorithm without considering safety parameters to determine the best route from Mehdipatnam (Node 0) to Uppal (Node 63).

In the graph, two data structures are added to store flag information. The flag information is Boolean. For instance, edges (paths) and nodes (places)

which can be dangerous are marked with danger as '1', the remaining are marked as '0'. Similarly, all places with scarce footfall are marked with Isolated flag as '1' and the remaining are marked as '0'. The weights for the various edges, representing the approximate distances of various places (in kilometres) from each other, are tabulated. For the sake of simplicity, the assumption is that all roads are one-way - which means in the distance matrix, if $A[src,dest] = n$, $dist[dest,src]$ is not marked 'n'.

We now apply a modified version of Dijkstra's Algorithm, which is the basic algorithm used to implement Google Maps, incorporating two additional parameters - *danger* and *isolated* to ensure that paths not dangerous or isolated are selected. This is in stark contrast to the Covid Algorithm in Google Maps that looks for less crowded places to avoid infection. The Algorithm is implemented with and without the safety parameters to show the contrast in results. The result of implementation of the routing algorithm without safety parameters is presented in Figure 5. The shortest path is $1 \rightarrow 4 \rightarrow 8 \rightarrow 16 \rightarrow 24 \rightarrow 28 \rightarrow 36 \rightarrow 41 \rightarrow 44 \rightarrow 46 \rightarrow 63$. The *dangerous* edge $16 \rightarrow 24$ lies in this route.

For implementing the Algorithm with safety parameters, we set all edges that are flagged (i.e., either dangerous or isolated) to very high weights to prevent their selection. The result of applying this modified version is given in Figure 6. The shortest safe path is determined as $1 \rightarrow 3 \rightarrow 6 \rightarrow 19 \rightarrow 23 \rightarrow 26 \rightarrow 30 \rightarrow 32 \rightarrow 38 \rightarrow 43 \rightarrow 49 \rightarrow 53 \rightarrow 56 \rightarrow 61 \rightarrow 63$.

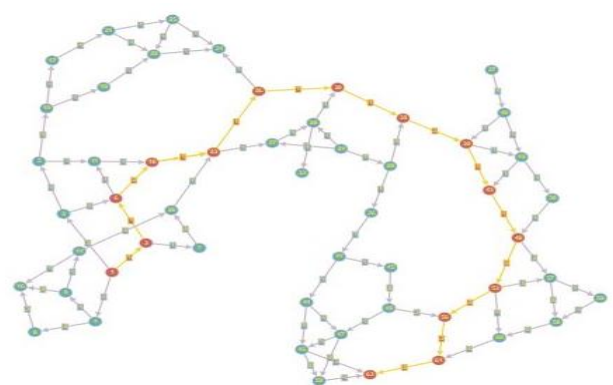


Figure 6. Output of Dijkstra's Algorithm with safety parameters to determine the best route from Mehdipatnam (Node 0) to Uppal (Node 63).

VII. CONCLUSION

This paper explains on the various features offered by Google Maps with special focus on the safety features. Two additional parameters are proposed to enable commuters have a safe journey. A case study of a sample source and destination points is presented to show the efficacy of adding the two proposed parameters using Dijkstra's Algorithm.

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