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Proposing a Mobile Application Interface for Obstacle Free Routing

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Abstract: There are number of applications available for providing navigation services, like Google Maps, waze, HERE and MapQuest. These applications are for road network transportation facility, but there is a need of mobile application development for railway network too. From past years, it is been observed that any collision between train and human have always resulted as a loss of properties as well as human being. To save society from these kinds of accidents, there arises a need of developing obstacle free routing application. Here considered obstacle is railway tracks. In this application, the obstacle is calculated in such a way that using heuristic approach the arrival time is predicted before the arrival time of train. Thus the accidents can be reduced.

Keywords: Obstacle, Routing, OpenStreetMap, Railway

I. INTRODUCTION

Kubota et al. [1] discussed that the roads are networks that connect social infrastructure facilities and accommodate vital services. In particular, roads should be safe and kept in good condition because they accommodate lifeline facilities and the delivery of emergency services.

Yusoff et al. [9] also stated that the transportation is the main infrastructure in every country and an important component of national economies. It is used to enable vehicles to travel safely and as quickly as possible. Both roads and vehicles are a major part of calculating journey time accurately. In spite of having various routing mechanisms, Indian population is lacking safe journeys. The injuries and deaths due to accidents are inescapable in the modern way of living. The accidental deaths are mostly due to the road traffic accidents, but the deaths due to railway fatalities are also not negligible, especially in the areas where railway traffic is higher.

Ramesh Nanaji Wasnik [6] stated that a train accident is defined as a "collision, derailment or any other event involving the operation of on-track equipments." Train accidents can cause devastating damages and personal injuries including even death of the persons.

According to an article in well known magazine Forbes India, unmanned level crossings spell danger. The counting of these tracks were 13,530 in India during 2011-12. Though Indian Railways does not divulge the actual number of deaths at unmanned level crossings, a back-of-the-envelope calculation could help us understand the gravity of the situation. According to a high-level safety committee set up by the government of India earlier that year, Indian Railways recorded the huge number of deaths almost near to 15,000. Experts said almost 70 percent of these took place at unmanned railway crossings.

Sheikh et al. [5] showed in their paper that the authorities as well as the public always thought of vehicular accidents especially attention on pedestrian and occupants, no one emphasizes about railway accidents which was also a major cause of unnatural deaths.

Thus software developers need to pay attention towards this serious issue. The government can eliminate the danger altogether by shutting down the unmanned crossings, making them manned or constructing roads either above or below the railway tracks. The railway ministry is considering these options. But more deaths are likely to slip past the bureaucratic red tape. The objective of this research is to proposing a routing system that is: Obstacle free routing. In this paper, the considered obstacle is railway tracks.

II. ANALYSIS OF OBSTACLE FREE ROUTING

Traffic simulation is a mandatory area in managing the traffic. There could be various aspects by which simulating the traffic in any country could make its transportation better. This kind of management improves the safety of people residing in any country, keep delivery of goods on-time and the roads become congestion-free. Road safety includes some techniques by following those, the accident rate could be reduced. Various kinds of people navigate daily on roads like cyclist, pedestrian, travelling on public transportation like train or bus, or on their own vehicles people travel too.

According to **Kubota et al. [1]** if road are well maintained, then journey time can be predicted more accurately and minimize the occurrences of road accidents.

In the fight between man versus trains, it is always been observed that the trains always win without any doubt. These vehicles like trains or any other motor-vehicle even on road lead to damage the life of people. Thus the ideas should be

think of and should be implemented as life savior, so that every day the count of people died due to these accidents could be decreased.

Trains are frequently involved in accidents that critically injured passengers and innocent bystanders. These accidents are indeed disastrous and catastrophic due to the speed that trains travel. Indeed, a train accident can definitely result in loss of one's life or his or her property as well. Accidental railway fatalities were the commonest accounting to the 158 (91.32%) cases, while the suicide seen in only 15 (8.68%) cases whereas none of the homicidal cases were recorded in the record [6]. The flaws in this railway industry are majorly due to the lower budget. The railway ministry itself states that many a number of projects are pending or been closed due to lower finance available. The under investment railway department is still feeding its customers. The biggest challenge facing Indian Railway today is its inability to meet the demands of its customers, both freight and passenger.

The book by Indian Railways – Lifeline of the nation "A White Paper" [4] gives information that apart from the quantum of investment, quality of delivery was also an issue. Cleanliness, punctuality of services, safety, quality of terminals, capacity of trains, quality of food, security of passengers and ease of booking tickets were issues that need urgent attention. Indian Railways was striving to enhance its market share and improve the quality of service so as to ensure that rail travel is an experience beyond other modes of travel. This can be achieved by eliminating capacity bottlenecks which constrain growth, improve productivity of assets and efficiency of operations and optimal employment of its resources including human capital. The high density networks of the Indian railways were facing acute capacity constraints coupled with a low passenger fares thereby leading to increases in freight tariffs to cross subsidize passenger revenues. However, that only enables recovery of costs and did not leave enough resources for investment in network expansion and replacement of assets.

Today there are a number of applications provided which deals with showing path for cycle route, pedestrians, blind persons etc. More deeper to this navigation system, indoor or outdoor mapping navigation systems or systems that deal with augmented reality are also in use by developed countries.

For real-time tracking systems, augmented reality based navigation systems are developed providing various kinds of indoor/ outdoor mapping applications. In these applications considered obstacles are steps/ stairs, any doors or anything on floor which could lead to help blind casting their life in a better way by listening to the audio instructions. These mobile navigation applications addressing the progression of user-generated and crowd sourced content from static data contributions to dynamic place-based services and the enabling role of assistive geo-technology in providing access and help to blind, visually-impaired and mobility-impaired individuals. Different user profiles are available to check the indoor/ outdoor paths and then comparison is made with POIs available nearby. These are also used by persons who live in multilevel buildings to keep an eye on the different floor.

A number of concepts are there for developing routing applications. One of them in shortest path routing problem. This problem ensures that the selected path is for those who want result in very short time. Rather than long routes, the bypass paths are selected. Dijkstra's algorithm, travelling salesperson problem or A* search algorithms are used in these techniques. Out of these all techniques all pairs shortest path algorithm is more specifically optimize to use. Here example is for robotics application, shortest path algorithm is used. To travel fast and to visit all the possible nodes near to that robot, this path selection mechanism is used.

Bergman et al. [11] gave Hidden Markov Model. They gave the result as revising number of tracks having a limited effect on routing. **Eckle at al. [2]** explained irregularities by exploring corresponding data sets visually. Country wise data sets should be taken for comparison according to this research. The 2D to 3D evolution by **Goetz and Zipf [3]** discussed 3D globe and introduced the height as parameter for some feature. **Skoumas et al. [7]** generated shortest path in popular areas defining closeness of areas like near to or next to some place. **Luxen and Vetter [10]** used OSM data and generate shortest path by draggable routes and round trip planning. This was based on hand held mobile devices. **Aridhi et al. [8]** gave MapReduce approach for providing high quality solution in acceptable computational time.

III. IMPLEMENTATION

The problem that is seen through the above analysis is always being ignored in the transportation system. Thus the dummy of the obstacle free approach is developed to remove this lag from the transportation system. The system uses the railway API that leads to provide the real-time data from the railway database provided by IRCTC.

A. Problem Formulation

From past examination of country India's traffic situation, there is a lag in the system that there does not exists such systems that are for common man. It is been observed that for developed or foreign countries, there are many transportation facilities provided for civilian. But in this case, India is not having much developed applications or systems.

For convenience of ambulances or some emergency, there is no such service provided in India. Sometimes system fails so badly that even loss of human occurs due to obstacles on road like congestion etc. If application will be able to judge that obstacle before some time, then navigator can get aware and thus could help society in some way.

B. Methodology

The above given problem could have solution with multiple techniques. The idea here is to check the point where maximum accidents between man and train can occur and then suggesting the navigator before reaching to that crash point. The alternative path is also shown at the end for that navigator.

The use case is taken here for one path of train and the navigator crosses that train path at some point.

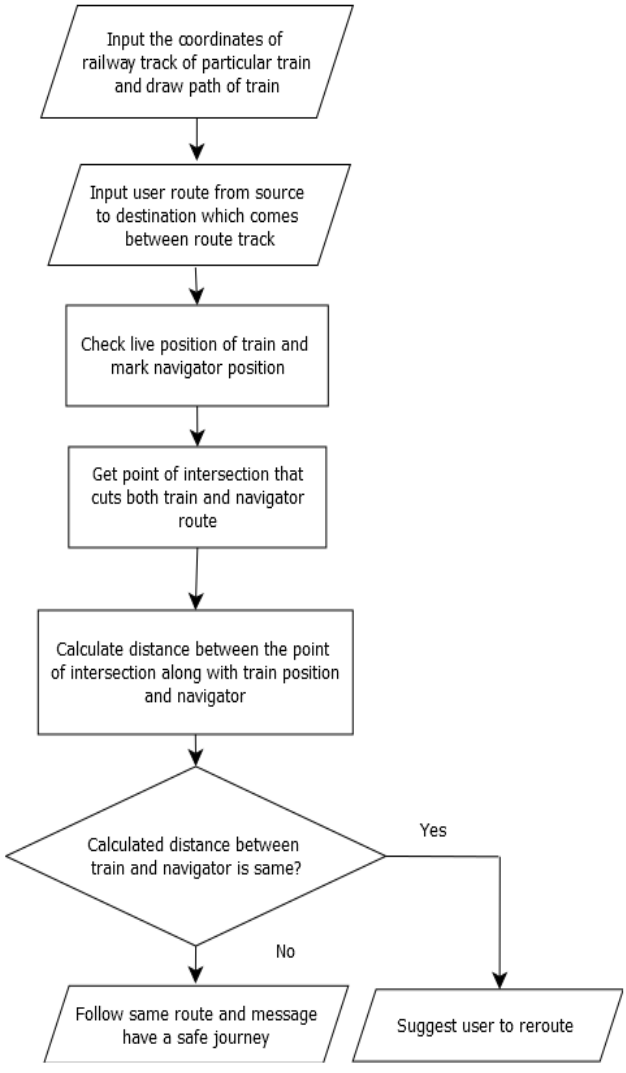

Fig: Flowchart for proposed work

The various steps in flowchart are implemented as follows:

1. **Draw Train route:** Taking train number 12618 in this case, the railway track is drawn. The route is drawn by taking the coordinate values of each station that comes in between the train source or starting station to the train destination station. The line is drawn as a polyline in grey color and is created as:
   - var line_points = [[28.5889199, 77.2534471], [9.9685857, 76.28926539999999]];
   - var polyline=L.polyline(line_points,polyline_options) .addTo(featureGroup);
   - var drawControl = new L.Control.Draw({edit: { featureGroup: featureGroup}}).addTo(map);

2. **Draw navigator path**: As the path of train is drawn, thus same way the navigator path is drawn in green color. It is created in the way that it intersects the train path at some point.

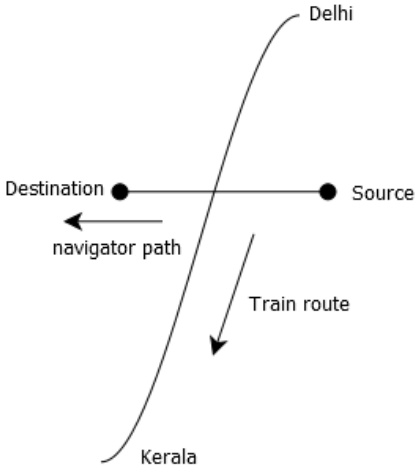

Fig: Drawing polyline for train as well as navigator path

3. **Marking current train position:** Current position of train here is taken from the railway API response. It is shown in red dot appearing on the train polyline.
4. **Marking navigator position:** The navigator's position could be drawn anywhere on the navigator path polyline.

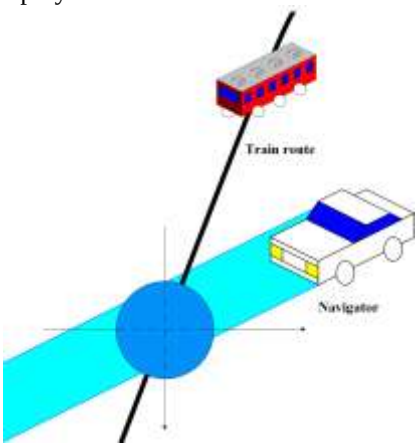

Fig: Intersection point and position of train and navigator vehicle

5. **Find the intersection point for both train as well as navigator:** The point where both the paths or train and navigator paths cut each other is taken as intersection point. This is the most crucial point as

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per accidents are concern. It is shown as blue solid circle.

Fig: Mobile interface showing obstacle free route

6. **Calculating the point of intersection:** The point of intersection is calculated by making a circle with radius of some units (like radius = 1000 units).
7. **Distance measurement:** The distance between both the vehicles is measured by calculating the distance from center of circle to both the markers that is train as well as navigator vehicle. Let the distance be D1 and D2 respectively for navigator and train.

- D1 = Distance from circle center to navigator
- D2 = Distance from circle center to train
- Distance between train and navigator =(D1 - D2) in kilometers.
  One can do it manually by checking latitude and longitude coordinate values of both markers and then using some geolocation distance calculator it can be measured or by using distance Between function which returns result as distance variable.
- **float**[] distance = new **float**[2];

Fig: Message suggesting navigator to re-route

8. **Obstacle free route information:** The distance that is being measured between the train and navigator is taken for decision making. If there is same distance from marker to the intersection point of both locations, then the chances of accidents are more. So the navigator is get alerted by sending message to reroute. Otherwise the same path can be followed by navigator.
9. **Alternative path:** The routing is if not obstacle free, then alternative path is being suggested, which appears as yellow color line in the mobile interface.

IV. RESULTS AND DISCUSSIONS

A. *Results*

The above prototype is been created by taking some values so that the logic become clear for obstacle free routing. Here, heuristic approach has been used to calculate the intersection point between both the paths. Then calculation of intersection point and the distance of both the vehicles that is train as well as the navigator vehicle is measured. Then the distance is measured from the intersection point or the center of the circle to both train as well as navigator marker. If the difference between both the vehicles is more, then there will be no any problem of crossing the railway line. But if the difference is not much, then there exist the chance of clash between both. Thus alternative path as well as re-route message is shown to the navigator.

B. *Discussions*

Here the test case is taken for particular train 12618 that is formerly called MNGLA LKSDP EXP (12618), that runs daily from station code NZM to station code ERS or in simple words Delhi to Kerala. This train travels with the super fast speed and reaches destination in 3 days. The reason for choosing this train was that it deals with 48 big cities and many more sub localities or inner villages of our country India. Total distance travelled is 3066km in 3 days. For this test case, the line is drawn from the mid of this train route. The route for navigator is taken in the Madhya Pradesh. The navigator starts from Maharajpur upto Talera area. The path is drawn with green color so that it differentiates the train route color, which is gray in color. Thus, the point where both the routes are cutting each other is marked with a circle. The reason for choosing this circle is because it is the draw feature given by leaflet library of Mapbox, which helps in calculating the distance. The radius of the circle is 50000 units. Then the distance is taken truly as:

- Location.distanceBetween(23.25656,79.2865,23.970062, 78.00164,distance);

First the latitude and longitude values of the marker and then the center of the blue circle or radiusCircle is written and thus the distance comes out in form of the units. It is written in kilometers by converting unit points into kilometers. It is considered that the both vehicles are moving with the same speed almost. The difference in the image is 20km. it means navigator reaches the intersection point before arrival of train at

that intersection points. Even there could be possibility of train halts increased in between stations in train route. Thus here navigator marker showed a message “Have a safe journey” else there would be message as suggestion “Reroute your path else you would have to drive safely, because there is a train nearby.” In this work the aim was to describe the mechanism of obstacle free routing. It is one of the essential services which should be provided by major commercial companies that provide routing facilities by introducing new features almost every-day by their applications. Here, the case is that the user is visiting some location A to location B. While moving from one place in driving profile, there comes train in between the path. Just before the arrival from that railway track, the warning message gets generated that the train is at some specific distance. The navigator can reroute as well. Thus there comes the possibility of choosing the better path and making journey safer.

V. FUTURE SCOPE

The system has been developed with various features in it. Still it lacks some advance features, which could be taken for advance research. There is a biggest lag that the railway location with the GPS tracker is not shown by using movable markers over internet. Thus the real-time location was not possible to implement. It is just a numerical display shown over this interface that the train is at this much far distance and could reach by some time. But there is no such information source exist which could provide the graphical view of the train. if provides , then those web portals had not their APIs. The Indian government needs Rs. 5 crore or more invested projects to show the real-time location of the train.

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