Bus Monitoring System Using Polyline Algorithm

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Abstract- Due to rapid growth of population, every country needs an efficient public transportation system. As the density of population is increases, it keep higher burden on public transportation like city-bus etc. Therefore there is need of smart system which provides real time information to passenger of bus. The system will manage the data about current location of bus, and by using this data the real time tracking of bus will be found out and provided to passenger for bus current status. The system is developed using technologies like GPS (Global Positioning System), Google maps and GPRS (General Packet Radio Service) [3]. The system includes mobile application, which services user by tracking the real time location of bus on Google Maps, time table for specified bus and locating the nearest bus stop. The system consist GPS enabled device like mobile phone embedded in bus, which find out its current coordinates periodically after some interval and send it to database for being processed and analyzed.

Keywords - Bus Monitoring, GPS, GPRS, real-time tracking, Google maps, location tracking

I. INTRODUCTION

Today, there is high burden on public transportation bus system due to continues speedy increase in population. So to carry out efficient public transportation in nearby future, we need smart bus monitoring system which provides real-time data for tracking number of bus efficiently [6]. The most populated cities like Mumbai, New York have bus as public transportation system, which plays vital role in public transportation. Also due to increasing number of vehicles cause traffic chaos in city, which can be eliminate if we develop a smart bus transportation system for city. The smart bus transportation system provides user the current location of bus on Google Maps, also in addition to that system find and navigate the user to its nearest bus stop. By using this system passenger can save their valuable time and money. The system is also used by central controlling authority to schedule the buses and billed customer more accurately.

The system uses the most known technologies like GPS, GPRS and Google Maps. The GPS (Global Positioning System) is used to calculate the current coordinate of bus and passenger. The GPS module is implemented on bus and client side. The bus side GPS module locates its coordinates and sends it to central database periodically for further process and analysis. The bus side module is supposed to send the current bus location after every fixed interval time. And this coordinates information with timestamp are sored in database Whereas the client side GPS module is used to find out current location of passenger and calculate nearest bus location from database. The system communicates through internet using GPRS. Google maps are used for graphical representation of location of bus on city map.[3] The system will uses already stored map of city with its various bus stops and their coordinates. This map can be used as blueprint of city which is uses to compare and then locate the bus location on city map.

This system can be made available to public to access as mobile application. The application can be installed by passenger for real time location of bus. The system will generate request for database on user's requirement. The mobile application can access the latest coordinates from database and plot them on Google Map for specified bus on user request. The database is analyzed, maintained and stored by central authority. This database is used to service the user in real time.

II. ARCHITECHURE OF SYSTEM

The system is composed of three main components: a client-side application which will run on GPS enabled mobile handset; GPS enable mobile handset embedded bus which sends its coordinate after every fixed interval time and the main server i.e. central application which will support and interact with various clients to provide service to user requests. The system is designed to facilitate the process of real time tracking of bus.

So the system is divided into three main modules, the whole implementation can be carried out in three part as -

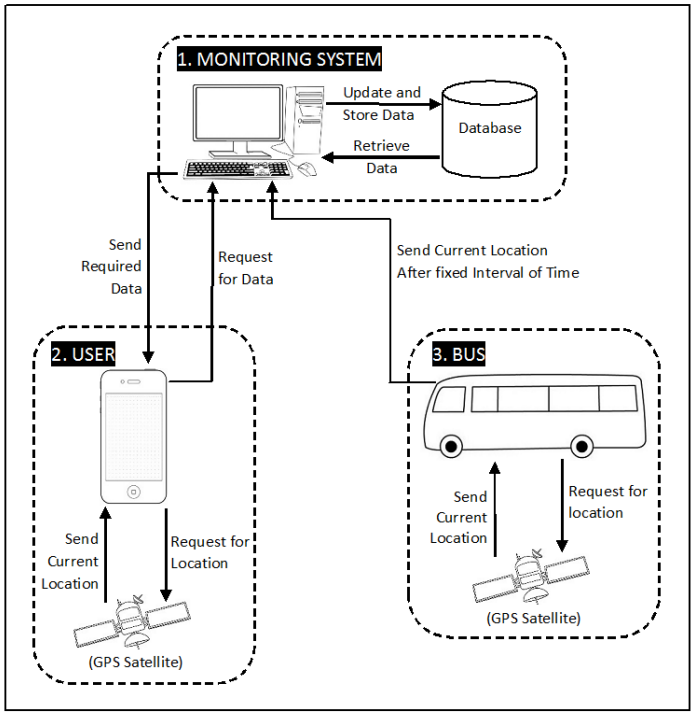

Figure 1: Architecture of Bus Monitoring System

The bus module consists of a GPS enable mobile phone which is programmed to obtain its coordinates using GPS chip present in mobile device, and then send it to central dedicated server. The mobile device is programmed such that it start obtaining its current location as bus start and send this coordinates with timestamp to server. The program calls process repeatedly after some interval time. When the bus module gets coordinates i.e. longitude and altitude then this coordinate with timestamp is compared with the previous one and if there is difference then these coordinates sends to server over GPRS network (internet) [2]. The format for location details to be send to server is ID, longitude, latitude, timestamp (DD-MM-YYYY HH:mm:ss i.e. 24 hrs. format) etc. Here ID is taken for identifying the each bus among the various buses. Each bus has given one unique identification number.

The user side module is nothing but an interactive mobile application which services the various function of system to passengers. The user side module is run on GPS enable mobile phone which takes input from passenger. On user's request the application fires a query to central server for accessing the information stored in central server database. Each service provided to passenger required to access information from server and then process it, the output is presented to user. Also user side application provides function of finding nearest bus stop which required GPS on user side. For finding nearest bus stop, the module is programmed to find the user's coordinates first using GPS chip present in mobile phone and finding the nearest coordinate by comparing with the blueprint of city's various bus-stops. The user side application required shortest path algorithm to find and show the shortest route from source to destination. And for highlighting the route application uses Google encoded Polyline algorithm. The communication with server is carried out over GPRS.

The most important module is the server in this system which acts as central repository of system. The server is used to stored and maintain the whole information database of system. Server acts as intermediates between bus module and user module. The server consists of SQL database. These database consist of some static information about bus details, routes details, blueprint of city's bus-stops etc. Server sends request to bus module and accept the bus coordinates with timestamp and then stored it, process it and maintain it. Server service the user module by providing information required by it. For real time tracking of bus, system required to feed the user application with latest coordinates of bus. The server acts as back bone of the system.

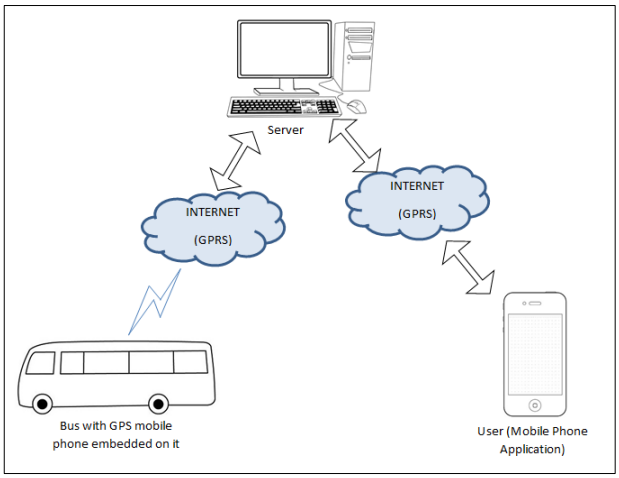

Figure 2: Communication Structure of system

III. ALGORITHMS

This system is developed by using two algorithms. First one is the Dijkstra's algorithm for shortest path first. This algorithm is used for finding the shortest path between the two points which have various numbers of paths in between. Second is the Google's Encoded Polyline Algorithm. This algorithm is used to highlight or show particular route between two points on Google map.

1) Shortest Path First

Shortest path first is used to calculate the shortest route between two given points. In projected system, the Dijkstra's

algorithm for shortest path is used. This algorithm is used to find the shortest route to reach the nearest bus stop. [4]

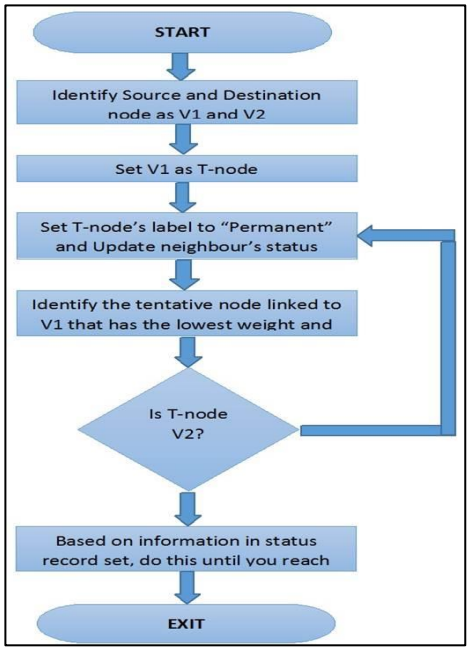

Figure 3: Flowchart for Shortest Path Algorithm

The inputs to this algorithm are nothing but the two coordinates. One coordinate is for user current location and other point is the nearest bus stop location coordinate which is found out by the server. The user's coordinate act as source node and bus stop's coordinate given as destination node, which cause algorithm to find out the shortest path from source node to destination node.

2) Google's Encoded Polyline Algorithm

An Encoded Polyline algorithm is developed by Google for highlighting the path between two points. On Google Map, to show route we have to use Encoded Polyline algorithm. To show the whole route we required all intermediate points between source and destination point to be highlighted. So for calculating the various intermediate points we required the Encoded Polyline algorithm [5].

An encoded polyline is a set of coordinate pairs (of a line or shape) which have been converted to an ASCII string to significantly reduce the overall size of the data. Encoded polylines are used store large sets of coordinate data to project a line or shape on a map, typical a Google Map. The encoded polylines are created from sets of coordinate pairs and are fed through an algorithm. What the algorithm does, is take the difference between two coordinate pairs, multiply it with 1e5 and then the rounded values are converted into binary values, after that the algorithm converts that binary value to ASCII characters. Each ASCII character holds eight bits of data, so the savings adds up. And the whole ASCII string given by the algorithm at the end is nothing but the details of various points of route. The following figure shows the step by step process of encoded polyline algorithm with example.

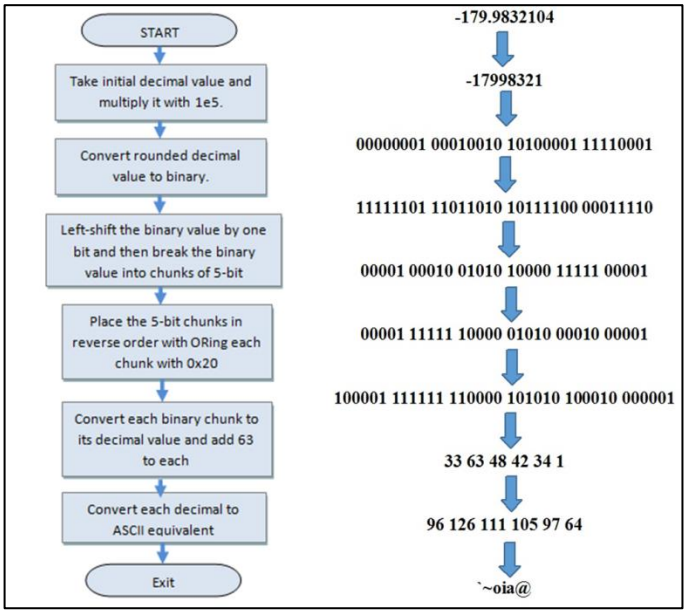

Figure 4: Google Encoded Polyline flowchart with example

IV. COORDINATE CALCULATIONS

The system required coordinate calculation for finding the nearest bus stop. In this, the system required to find out the nearest coordinate to the user's current location coordinate. System has the blueprint of city's bus-stop, which contain the coordinate information of all bus stops [1]. System has to compare all these coordinates to user's coordinate. For that, following formula is used

$$\text{Min}(S\text{-}D_i) > T_r$$

Where,
S - User location coordinates
D_i- bus stop coordinates
T_r – Threshold value

V. FUTURE WORK

In the future, we plan to integrate the system with some additional feature like, sending massage from bus to central authority about other information including ignition status, door open/close status and passenger count etc. We also try to integrate the traffic status in system for more accurate results. The work also includes providing and showing current location

of all bus on map to central authority. Also for more accuracy, in future we plan to use IRNSS in India.

VI. CONCLUSION

This paper presents the low cost and fast system for bus tracking system. The system is developed by well known technologies GPS, GPRS and Google Map. The developed system not required special hardware for GPS. In this system we use GPS enable mobile phone for tracking bus which cost very less. The system transfer data over GPRS (internet) through xml language using http protocol and locations are tracked using GPS available in mobile phone which are embedded in bus. The system is easy and simple for user to get information visually shown on Google Map. User is freely get the application for live tracking of bus which provide interactive interface environment. So by using this application passenger can just wait or they may reschedule their journey according to bus availability. So this paper presents a system which provides high practical value in the modern fast era. The system has high practical value and cost efficient.

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