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Effective Tracking of Bus Location Using Map Matching Algorithm

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Abstract: Smart phones make the world smarter. A student availing in the college bus may wait for the bus at the bus stop. Sometimes the student may be late to the stop and they doesn't know whether the bus have crossed their boarding point or not. If any path deviation occurs in the route the students doesn't know which alternative path should be taken to catch the bus to reach the destination. To overcome these problems an android application is developed for the students to track the bus location easily. This application needs student's details for verifying the authorized students and this application gets the information about the buses like bus numbers, bus routes for the students. The web server utilize the technology of Location Based Services, which helps to track the current location of the bus and it estimates if any deviation occurs in the bus route using the Client-Server technology. Each bus sends its current location to the web server. This information is stored on the server database. The students who installed the college bus tracking application can track the bus routes, bus number, bus location and the arrival time of the bus using Kalman filter algorithm. The bus location is tracked by using global positioning system and the location information is send to the students in the Google map which reduces their waiting time.

Key words: Android Application · Bus location · Global Positioning System · Google map · Real-Time Bus Tracking

INTRODUCTION

Vehicle tracking systems were primarily implemented for the shipping diligence because people wanted to know where each vehicle was at any specified time. Now-a-days, nevertheless with technology mounting at a fast pace, automatic vehicle tracking system is being used in a multiple ways to track and display vehicle locations in real-time. This paper proposes a vehicle tracking system using GPS expertise and a Smartphone application to present well again service and charge effective solution for users.

Smartphone users are now more widespread within the overall populace than owners of basic mobile phones [1]. As Smart phones turn into more familiar to people and judgment use in the day to day life, their authority on society continues to grow. The main driving force for this accelerated growth in Smartphone usage is the accessibility of a large variety of applications to meet the needs of a wide variety of users. In this project developed a Smartphone application beside with the in-vehicle tracking device. The two parts work mutually to offer the most expediency to the users as they become clever to track vehicle locations in real-time.

A vehicle tracking is a prerequisite of the most fundamental function in all fleet organization systems. A fleet organization is the management of a company's transportation navy. The fleet organization aims at improving the excellence and effectiveness of the industry by identifying major obstructions on the road and tracking real-time locations of their navy on a map [2]. Most of the vehicles tracking systems are intended by using GPS/GSM technology [4]. In vehicle tracking systems, a vehicle location is one of the most significant mechanisms. The position and time information anywhere on earth is provided by using GPS technology [5].

Systems for monitoring and tracking vehicle progress offer many opportunities for the management of transportation systems. The data composed from such systems also has the probable to provide a fuller understanding of the behaviour of travellers and the price of that behaviour both on the transport system and

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external effects. This paper reports on a research and development project to generate and reveal the capabilities of an accurate, consistent and cost effective real time data collection device, the vehicle concert and emission monitoring system (VCEMS). The VCEMS will be monitor vehicle and driver performance.

Literature Survey

Bus Arrival Time Prediction: Lei Wang, [8] proposed two phases first one Radial Basis Function Neural Network (RBFNN) mode 1, it is used to approximate the non –linear relationship in historical data. The second phase is online oriented method it is used to modify the RBFNN predict result and adjust the actual situation. The RBFNN and online adjustment predict to given a better performance. In this method Kalman filter is using to adjust the online data. This method shows the bus arrival time by using two phases. The RBFNN model gives the number of passenger getting on or off, delay, distance travel speed between 2 stops. The online filter method shows the speed of real time condition. It is unique module and it is mainly useful for urban transportation.

Real Time Bus Tracking: Transportation plays on important role for supporting various activities. Putu Wina Buana [10] proposed a real time transportation bus tracking system help to solve the problems in unexpected delays and incidents. The movement of bus transportation provides information to passenger to estimate the arrival time of bus. This method using a hybrid application technology based on web and mobile application. In real time transmission bus tracking system develops a administrator application and operator application and member application. This application helps the passenger to make efficient use of time and estimate the arrival time of bus.

Smart Bus Tracking System: Süleyman Eken [11] proposed a smart bus tracking system that any passenger with a smart phone can scan the QR (Quick Response) codes that was placed in a bus stop. The user can view the bus arrival time and also view the bus route on the map with their geographic and non-geographic attributes. In this method used c4.5 statistical classifier algorithm for to estimate the bus arrival time to minimize the passenger waiting time. The Google maps are useful to display the current location of bus on the map to give the route information. If the user get registered the system it show the bus route and arrival time via SMS and E-mails. This method helps the user to avoid unnecessary waiting time spend in bus stop.

Predicting Bus Arrivals Using One Bus Away: Catherine M.Baker [12] proposed a one bus away prediction to improve the experience of riders in the area by providing real time arrival time of bus. This application provides good accuracy of arrival time of bus. This method used K-Nearest neighbours to predict multiple values. And it is help to decrease the root mean square error. This method use two methods first measure the nearest neighbour trajectory vehicle. Second, support varying length nearest neighbor queries. This technique use to measure the history based travel time predictions for vehicles and used to compare the prediction accuracy. In this paper incremental algorithm is used for efficiency.

Easy Tracker: Automatic Transits Tracking: James Biagoni [13] proposed a automatic system for transits tracking to predict the arrival time prediction using different algorithm that use GPS traces data collected to determine routes. This proposed method consists of collection unit in vehicle and number of online algorithm and batch data process. Online processing matches vehicle to routes and perform arrival time prediction. This method is helps to reduce the cost and complexity. In additionally online algorithm is used to predict the arrival time and determine the bus route. This method also introduces a easy tracker system to reduce the cost and complexity for service. It provides accurate transits tracking and real time arrival time prediction.

Bus Monitoring System Allows Polyline Algorithm: Every country needs an efficient public transportation system. So vishual Bharte [16] proposed a technology GPS. The Google maps and GPS are also including in this method. The system include mobile application the user can able to track the real time bus location on Google maps and also find out the nearest bus stop by using mobile phones. The data can transferred over GPRS (*General Packet Radio Service)* and the location tracked by using GPS that is early available in mobile application. The system is easy and simple for user to get information from Google map.

Development of Bus Tracking System: For the most part, every individual sits tight for the transport entry. Because of overwhelming movement, the general population feels awkward to contact with their neighbours. The application brings and message benefits over telephone require more cost. Portable based transport following framework was proposed in [17] which help to recover the transport area without calling or aggravating the individual going in the

transport. Here the general population boarding the transport and the organizer of the transport ought to have an Android cell phone with web association. The GPS which bolsters GSM will report the vehicle data to the server. The data from the server is conveyed to the client to track the transport area. The upside of this strategy is that it has high adaptable. The drawback is that the traveller does not get the correct area of the transport. Framework can be valuable for short separations. Long separation following won't give exact area of the transport.

Situating For Smartphone the Rate Adaptive

Method: In this system Yamuna investigates, present RAPS, rate-adaptable arranging system for cutting edge cell phone applications. It relies on upon the observation that GPS is all things considered less correct in urban reaches, so it suffices to turn on GPS similarly as frequently as essential to achieve this precision. This structure [18] uses a social affair of techniques to distinctly choose when to turn on GPS. It uses the region time history of the customer to gage customer speed and adaptively turn on GPS just if the surveyed helplessness in position outperforms as far as possible. It moreover profitably evaluates customer advancement using a commitment cycled accelerometer and utilizations Bluetooth correspondence to diminishing position insecurity among neighbouring contraptions. Finally, it uses cell tower-RSS boycotting to recognize GPS detachment (e.g., inside) and go without turning on GPS in these cases. We survey RAPS through genuine trials using a model execution on a present day propelled cell and show that it can grow phone lifetimes by more than a part of 3.8 over an approach where GPS is reliably on. The burden of this procedure is the GPS does not work suitably in urban districts and by using Bluetooth office the long partition can't be taken after. It was perceive zone in little partition.

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Proposed Work

Objective of Proposed System:

- To track the arrival of the bus location more accurately.
- To predict the arrival time of the bus from the boarding point.
- To alert the students if any bus route changes without proper planning.

Proposed System Architecture: An Android application is developed to provide all required information about bus it gives necessary information about all the buses travelling in that route. The bus location is displayed on map also.

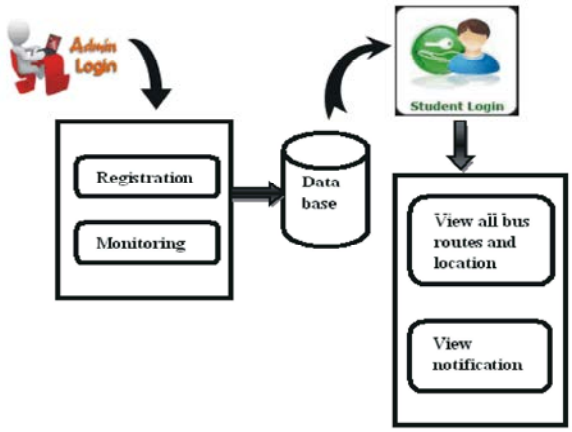

Fig. 3.1: System architecture

Input will be a bus number and output will be details of the bus location with map. The details about bus information will be stored in the database and can be retrieved whenever it is needed. It will be easy for the user

to access and track the bus location. Whenever the latitude and longitude values get changed then the location information will be updated to server database, so that all changes in the bus timings and the routes are recorded. The tracker will track the location of the passenger as well as the bus so that approximate time required by the bus to reach the stop will be calculated.

Modules: This application contains the three modules

- Admin module
- Student module
- Bus Tracking module

Admin Module: In this module is used to enter the student details such as student name, register number, date of birth and course source point, destination point etc. This student details can be added, updated or deleted. This module deals with bus location details such as location of bus. When the administrator selects the bus number from the dropdown list, the location will be display. This module can utilize the technology of Location Based Services, which is used to track the current location of the bus. The system uses Global Positioning System [GPS], to find information about the location of the vehicle that is to be monitored and then send the latitude and longitude to the monitoring centre through satellite. At the Administration application is used to display the vehicle on the Google map.

Student Module: This module deals with bus location details such as location of bus. The student selects the bus number from the dropdown list; the location of the bus will be displayed. The user can easily to track the bus location as well as the approximate bus arrival time. In this module, students are added to this application. Users with this application can track the bus routes and bus number from source to destination and the current location of the bus. Admin send the notification for bus route gets changed. The admin send this notification to the particular bus students.

Kalman-Filter Prediction Algorithm: Kalman-Filter Prediction Algorithms is a linear recursive predictive update algorithm used to estimate the parameters of a process model. Starting with initial estimates, the Kalman filter allows the parameters of the model to be predicted and adjusted with each new measurement. Kalman filter algorithm works conceptually as follows, the historical passenger arrival rate is obtained from the data.

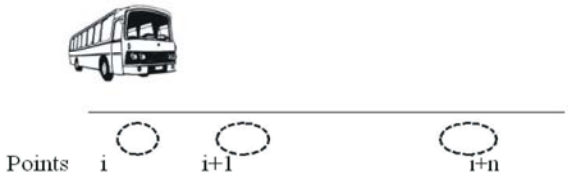

Fig. 3.2: Schematic of a Bus Route with Several Stops

Assuming that bus n is currently at stop i

$$AT_{n(i+1)} = DT_{n(i)} + RT_{n(i,i+1)}$$

where: $AT_{n(i+1)}$ is the predicted arrival time of bus n at stop i+1 $RT_{n(i,i+1)}$ is the predicted running time between i and i+1 from Kalman Filter prediction algorithm $DT_{n(i)}$ is the actual departure time of bus n from stop I.

Bus Module: The bus should have installed the College Bus application. Using the Latitude and longitude the current location of the bus can be found out and the current location is updated to the server. Corresponding to the bus movement the change in latitude and longitude are updated in the database for every minute. Updated latitude and longitude value in the database is used to find the exact location of the bus using Google map. GPS System is fixed in Bus which can send the GPS location continuouslyIn this module the updated latitude and longitude value in the database is used to find the exact location of the bus using Google map. Android application should be installed in all the buses for sending the location and timing information to the server. Reverse Geocoding is point location (latitude, longitude) to a readable address or place name.

GPS System is fixed in Bus which can send the GPS location continuously to the web server. The user can install this Application.

Map Matching Algorithm: The fundamental attributes of the Map Matching Algorithm incorporate the utilization of yield from the GPS Extended Kalman Filter (EKF) Algorithm, it including position, speed and time. Data on the vehicle direction is utilized to keep away from sudden exchanging of mapped areas between detached street joins.

The MM process is shown diagrammatically in Figure 3. The three data sources described above are the link and node data and the positioning data. The process is initiated with nodal matching to identify a correct link among all the links connected with the closest node to the GPS point and the determinations of the physical location

of the GPS point on that link. The next step analyzes whether the next GPS point can be matched to the link identified at the previous step and then determines its physical location on the link. It is vital to carry out the first step carefully and reliably, as there could potentially be many candidate links.

Algorithm Step by Step: The algorithm uses the following steps to assign the vehicle on the correct link and to determine its position on that link.

- Find the closest node from the first GPS point (i.e., initial point).
- Check whether the next point is an outlier. If not, then select all the road segments that pass through the closest node, otherwise take this point as the initial point and go to step-1.
- Using the weighting formula, choose the correct link. These two points (i.e., initial point and its next point) should be matched to this link.
- Determine the vehicle position on the correct link for each of the two points.
- Check whether the next point is an outlier. If yes, then go to step-1 and take it as the initial point. If not, map this point on the same link and determine its position and continue this process until the above conditions are true, otherwise go to step-1.
- Repeat step-5 until all points has been matched.

Implementation and Result

Admin Module: In this module admin enters the student details in database and monitor the bus location in Google map. In case the bus number gets changed, Admin send notification to those particular bus students. The student information about register number, student name, department, course, year of study, semester, date of birth, email id, mobile number, is a bus student, source and destination. These details stored in the database.

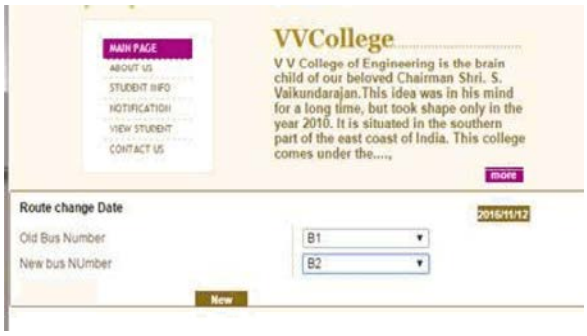

Fig. 4.1: Bus number changes notification

The above figure shows if bus number gets changed admin send a notification to the students. This page contains old and new bus numbers.

Above figure shows the notification for bus route number can be changed. The admin send this notification for the particular bus students.

Bus Module: In bus module initially installed the college bus application. This application is used to update the bus location changes in server.

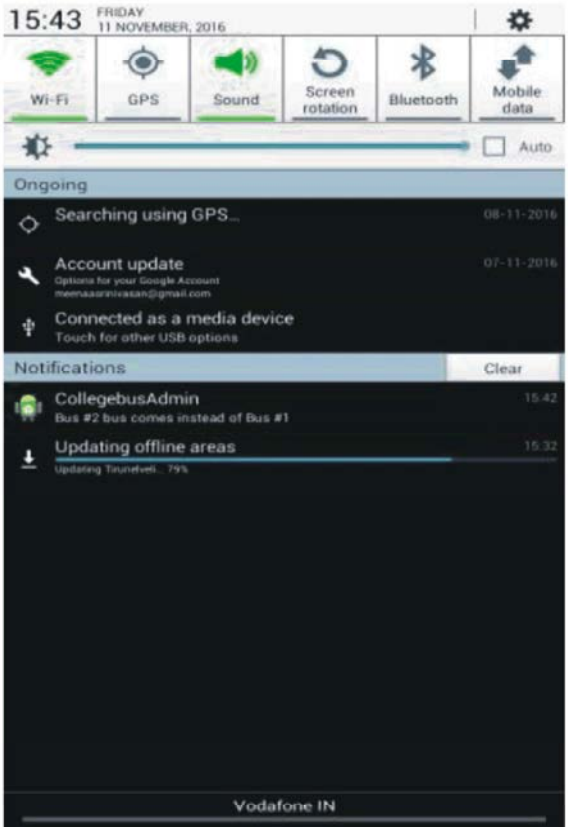

Fig. 4.8: Insert bus number in bus device

Student Module: The student can login to the application using his/her registration number and date of birth to view the bus location.

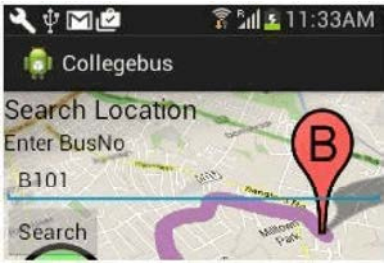

Fig. 4.4: bus route changes notification viewed by student

Above figure shows the notification for bus route gets changed. The admin send this notification to the particular bus students.

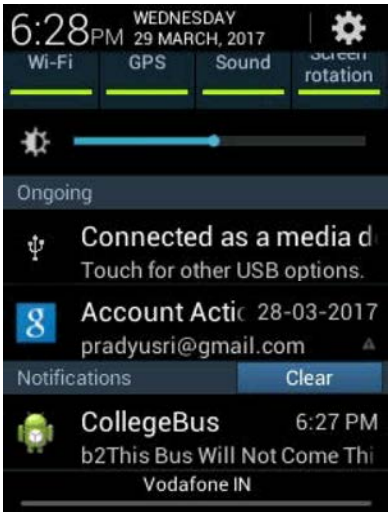

Fig. 4.2: Notification page in student App

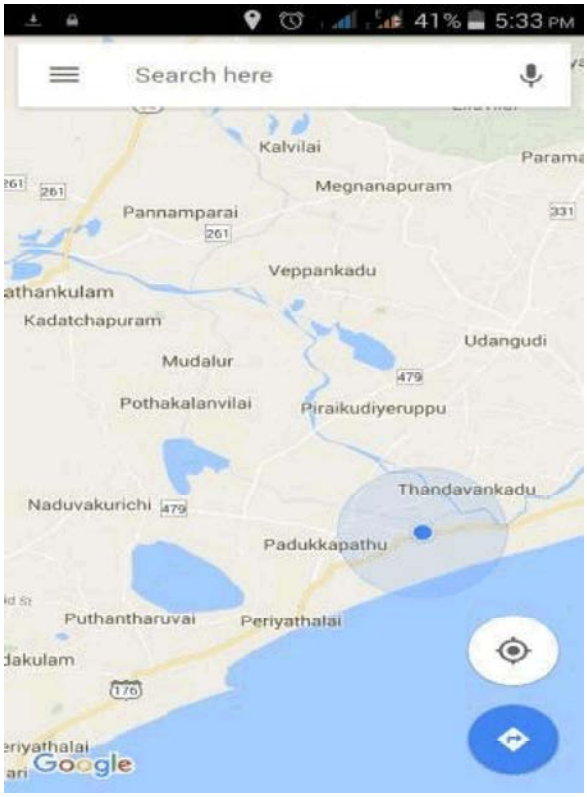

Fig. 4.5: Student view bus location in Google map

Figure shows the student can view the bus location using Google map that was displayed in the Google map.

CONCLUSION

In this proposed system, an Android application is developed to maintain the student details and to track the bus location. By using this application the student can get the location of the bus and if any changes occur in the bus number immediately the notification is send to the student to alert that the bus number was changed. When the student login to this application they can see the available notification and the bus location in the Google Map. Further when the people waiting for the bus at the bus stop and if any bus route changes then immediately the notification is sent to the particular person who are waiting for boarding the bus. So that, the particular person can takes necessary actions to reach their destination without any time delay.

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