Development of An Android Based Real Time Bus Tracking System

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Abstract—In this dynamic life, everybody is in an urgency to reach their destinations. In this case, waiting for the buses is not feasible. People who depend on the public transport system should know about the location of the bus for which they are looking for. With the advancement of technology, android smartphones have become universal and affordable for all. Smartphones have vast capabilities to provide rich user experiences with interactive facilities. In this paper, we propose a real-time bus tracking system for the students using Android smartphones which can be used for tracking and positioning of the buses by using Global Positioning System (GPS). This android based real time application enables the students to find out the exact location of the buses so that they will not get late or will not arrive at the bus stop too early. It provides the exact location of the student's respective buses which can be viewed on the google map. In addition, this application also gives the information like bus details, driver details, contact numbers, routes, etc. Therefore, our developed application saves the student's time to wait for the buses as they can know their current location of the buses updated every moment in the form of latitude and longitude on Google maps.

Keywords— GPS, google map, android, real-time, vehicle tracking

I. INTRODUCTION

Nowadays, buses are used rapidly as a transportation system in the different organization, e.g., school, college, university, business firm, banks, etc. But, with the increase of population, vehicles are increasing day by day which is further leading to heavy traffic. There are many reasons for heavy traffic in developing countries like Bangladesh which results in more delay to reach at the destination of the respective buses [1]. These reasons may be harsh weather, traffic conditions, etc. [2]. On the other hand, at the bus station, most of the time people have to wait for the arrival of buses because of the delay of a particular bus at a particular stop [3]. Therefore, an effective transportation system has effective movement of vehicles and people which leads to better quality of life and better economic growth of the society. Hence, the bus tracking system can be useful for passengers which will provide the location of the buses with routes using Google map at the current time [4]. Embedding the equipment in the buses to track those is important which increases the cost of the system. Hence, we use IoT based technologies to reduce the costs of processing and communication equipment [5]. Today smartphones are a very good source for tracking the vehicles (i.e. buses in this case), called mobile tracking system [6], because of giving the real-time location of the buses with the help of Global Positioning System (GPS) [7]. GPS uses satellites to locate the presence of smartphones using the values of longitude and latitude. Using those values of GPS coordinates our developed application will show the location of the smartphone used in each bus carried by the driver [8]. Users (i.e. students, teachers, etc.) can retrieve information relevant to the arrival time of buses with respect to the current location by selecting the bus number through the android application [9]. The main objective of this research is to notify the locations of the buses from anywhere for the students so that they do not need to wait for their buses at the stops for a long time and save their valuable time. To complete this, we develop an android application and demonstrate the location of the bus at the particular time.

The remainder of this paper is arranged as follows: Section II discusses the related works with the proposed system. Section III gives a brief of the technologies used in the proposed system. Section IV discusses the architecture of the proposed system and its specifications. Section V includes the step by step experimental analysis and discussion. Section VI summarizes the conclusion with future works.

II. RELATED WORKS

Bus tracking systems are developed to display the exact location of buses which can be useful for the public transport system. The system requires an internet connection and may or may not be GPS tracker. Real-time bus tracking system using GPS displays the current locations of the bus which consists of a GPS tracker, real-time server, and the user application. It provides relevant bus routes and other information to the user. Bus tracking system uses the built-in GPS service provided by the Android. A smartphone is used on each bus and gets its GPS coordinates. These coordinates are shifted to the server. Users can retrieve

information through their Android application. Then, selecting the respective bus number, users receive the arrival time of the bus with respect to the user's current location. Google map is also used to graphically plot the bus location [10] [11].

There are about 17,000 location-based applications on the marketplace. Some apps can make our traveling a little easier, a bit more fun and more memorable. But, most of the applications are hardware dependent. There is a fact of high cost as the devices they use are costly and there is more complexity in the integration of those devices in a single unit [12] [13]. To fix such problem is also costly and time-consuming. In this research endeavor, we develop a real-time android based bus tracking system which is hardware independent, less costly and easy to install.

III. TECHNOLOGIES USED

A. GPS Technology

GPS [10], also known as a space-based radio navigation system, consists of 24 satellites orbiting this earth under the management of the US government. It was primarily developed for the military purpose and later used to help general people for various applications, e.g., navigation, tracking, timing and positioning services [14] [15].

B. Android Platform

Android is a Linux based open source operating system which was founded by Andy Rubin, et al [16]. There are some important features that make android different from other operating systems [17]. These are as follows:

- Open Source
- Easy to customize the Android platform
- Support the multiple inheritance since it uses the concept of Java [18]
- Allow all graphic dimensions, i.e., 3D and 4D
- Support the low-level interface for having a Linux operating system kernel
- Support standard libraries like OpenGL, Web Kit and SQLite, etc.
- Appealing look-and-feel features including live Really Simple Syndication (RSS) feeds, weather information, etc.
- Support many more connectivity and messaging services like Bluetooth, GSM, Wifi, MMS, SMS, CDM, etc.

C. Firebase Server

Firebase is a web and mobile application developing platform that provides tools and services to develop real-time apps. It was developed in 2011 by Firebase Inc. and in 2014 acquired by Google. It provides a backend and real-time database as a service. It is a cloud-hosted database system [19] [20].

D. Google Map

Google map is a free software that renders 3D graphics of earth using satellite images around the world. It is a version of Google earth that shows the maps and can be embedded into web pages through Google maps API [21].

IV. SYSTEM DESIGN AND SPECIFICATIONS

Our proposed and developed android based system provides the students to find out the exact location of the buses from anywhere. The bus routes are shown on the user interface displaying the position of the buses using google map. Accordingly, user can plan and start. The advantages of the developed system are to:

- Provide the exact position on Google map
- Show the details of the buses from anywhere
- Provide details like bus number, drivers' contact number, bus route, stops, etc.

Figure 1 shows the architecture of the developed system. The system consists of a client and a server interface. The developed android application is used on both driver and user module. The user can track the location of buses controlled by a driver on Google map from the server using GPS. Admin maintains and updates all relevant information like bus routes, driver number, number of buses, etc. on the server.
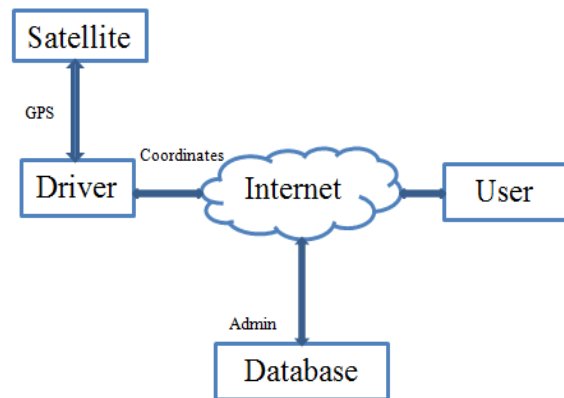

Fig. 1. Block Diagram of System Architecture

The developed system contains the three modules:
  a) Driver
  b) User
  c) Admin

a) Driver Module

This module is designed for the bus driver. The authorized bus drivers can use this module by providing their unique login credentials. They need to start their location services before driving. The current location of the bus will automatically be updated from the driver's mobile to the server every moment in the form of latitude and longitude. Figure 2 shows the flow diagram of the driver module.
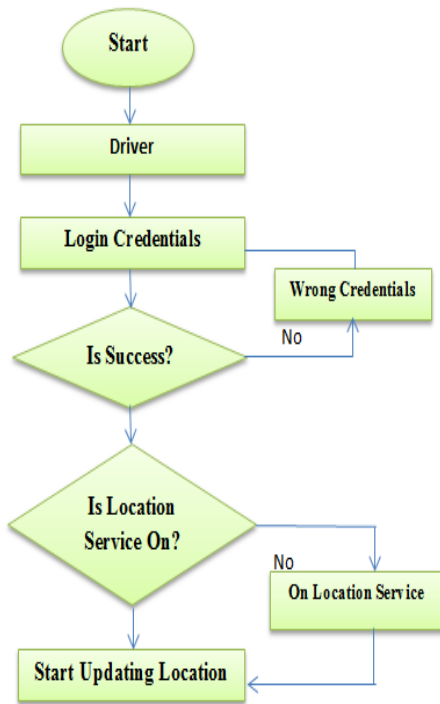
Fig. 2. Driver Module

b) User Module

This is the most important module and the soul of the system. Users of this module need to click on the user button. They can access the details of all the buses through their smartphones. Here, they will get all the buses and driver-related information offline too. Students can track the location of their buses from any location. A student must make sure that their location service is active. Figure 3 represents the flow diagram of user module.
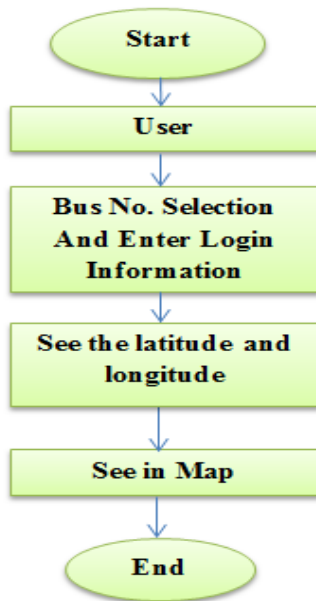

Fig. 3. User Module

c) Admin Module

Figure 4 shows the flow diagram for the admin module. This module is designed for the bus administrator for updating the information. Admin can log in to the admin account after authentication and authorization. He can enter new route details and also he has the options to add or remove a route. The authority has the right to update the driver's name, driver's contact number, routes, stops, etc. If the admin wants to send any information to the driver, then he can send the message to the driver's mobile.
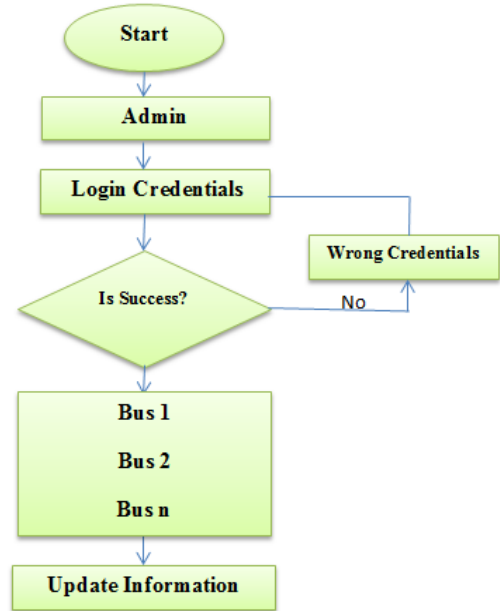

Fig. 4. Admin Module

V. EXPERIMENTAL RESULT AND DISCUSSION

When a driver enters into the driver module, Figure 5 will be appeared for the driver to enter his login credentials. The location of the bus will be shown on the screen as latitude and longitude and it will automatically be updated in every 5 seconds (shown in Figure 6).
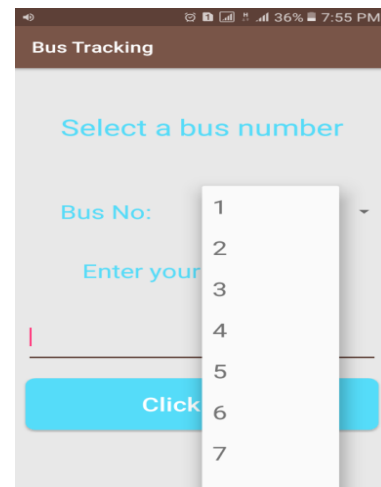

Fig. 5. Driver's Bus Selection

Fig. 6. Bus Location

To search for a bus location a user has to enter the bus number and login credentials. Then, the map will be displayed which will show the current location of the bus. They can get access to the details of all the buses through their mobile phones. Here, they will also get the bus and driver-related information as shown in Figure 7.

Fig. 7. Drivers' Details

When the application is launched, home activity shows the user module. When a user selects this module, another activity will be opened where the user will select the bus number and enter the login credential shown in Figure 8. Then, the map will be displayed which will show the current location of the bus as shown in Figure 9.
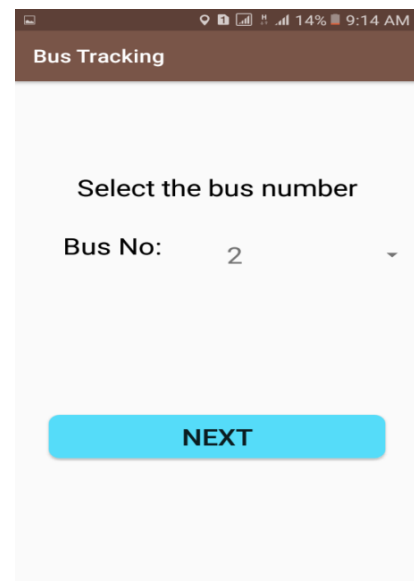

Fig. 8. User's Bus Selection

Fig. 9. Bus Location on Map

VI. CONCLUSION AND FUTURE WORKS

In this research study, we design and develop a real-time bus tracking system using GPS tracking technology which needs only a smartphone and a real-time server. Our application consists of two fundamental concepts: first it collects the real-time location information of buses via GPS technology and secondly updates the location information in the database server. The bus-side, server-side and client-side modules provide all the expected functions. Since this application does not need any external hardware except a smartphone which is available to anyone in the world, the overall cost is very low or no cost needed for tracking the bus location. It provides nearly accurate data in real time that makes possible for the user to track the buses.

In near future, we would like to enrich our proposed application by adding the following features.

- Designing a reliable server with a user friendly API
- Distance and time calculation between two places
- Anti-theft system for cars and bikes
- As a vehicle management software for transport companies

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