School Bus Tracking System

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   Abstract- Tracking school buses and students has become an important issue due to the decision of whether it would be quicker to wait for the arrival of school bus or to hire a cab/rickshaw as the bus is late/missed to reach school. The proposed system intends to aid in the bus arrival intimation by bringing in an application that will help in successfully tracking the school bus and the child. This application is used to track the current location of the school bus by parents and the school authorities. The proposed systems also include intimation to parents about their child boarding the school bus. This system uses a GPS tracker which is in built in the android phone along with the RFID reader in the school bus. The tracker is used for locating the current geographic position of the bus and RFID (Radio Frequency Identification Device) is used to uniquely identify child that has subscribed for the intimation service. This system uses a database to store the details about the bus route, bus details and children. Although the system proposes to be used for a school bus tracking, it can also be implemented for private/public bus services.

   Index Terms- GPS, RFID, School, System, bus

I. INTRODUCTION

a. Background

Now a day's most parents are working. So it becomes difficult for them to pick and drop their child every day to school. Here the bus transport provided by the school comes into picture. Parents face the problem of waiting for the bus to arrive. The main purpose of our proposed system is to calculate and provide the parents with the estimated time bus will take to reach the bus stop and also provides the current location of the bus. In India, a child goes missing every eight minutes according to the data from national crime records bureau. Around 60,000 children go missing in a year out of which 40% of the children haven't been found [1]. The proposed system aims to provide information about the child boarding the school bus

b. Motivation

Parents have to wait for the bus to arrive, hence to reduce the waiting time we are developing this system. The main focus is to reduce the waiting time as well provide the location of bus. According to the National centre for missing children there were about 800,000 children younger than 18 years of age were missing. In 2013, there were 462,567 entries for missing children under the age of 18 into the FBI's National Crime Information Centre, also called NCIC [2]. This was one of the main motivation behind developing this system. Such systems must be installed urgently in order to reduce the number of abduction taking place.

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II. PROBLEM DEFINITION

The system addresses the problem faced by parents to wait for long duration of time for the arrival of the bus. It also addresses the problem related to child abduction which is increasing day by day. Here we are using android phone embedded with GPS tracker to track the location of the bus and thereby calculate the estimated time required by the bus to reach the destination. It is necessary to have such device to track the bus, especially the school bus as most of the children travel by bus to school which is the most convenient transport. In order to reduce the waiting time by parents and children on the bus stop the parent side android device is used to send the current location of the parent and receive the expected arrival time.

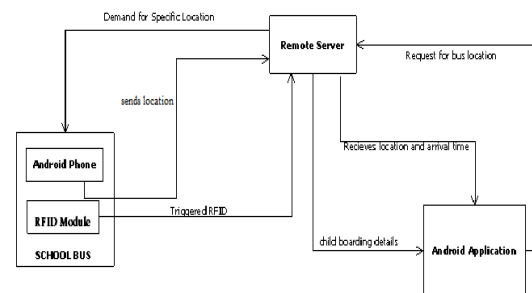**The block diagram of the proposed system is as shown in Figure 1.**

Figure 1: Block Diagram

Android phone

Here we are using android phone for tracking the location of the bus. An android phone will be placed inside in the bus we need to track. The GPS and GPRS module in the android phone is used for the tracking purpose. The android phone will be connected to the server and it will send the location of the bus to the local server where the required data will be saved in the database. Using an android phone instead of a separate GPS-GPRS module reduces the cost of the system greatly. Also it becomes far easier to use an android phone.

RFID Reader

We are also using RFID. It is a wireless device that use electromagnetic fields for automatically identifying and tracking tags attached to the object[3]. The RFID tags would be present in student's identity cards. RFID reader will detect the RFID tag which will be placed in the bus. It will help us to identify which student has boarded the bus and also when he gets down. The data will be sent to the server. It will make sure that the particular student has boarded or un-boarded the bus.

Remote Server

Now remote server is the integral part of our system. The efficiency of the system depends on the server. There are various things which should be kept in mind while using the server, like the amount of data that can be handled by it. It shouldn't be overloaded. Server is nothing but a database which stores the data of bus location and student information. The server will be accessed by the application to retrieve the required data.

Android Application

The android application is the user interface. The proposed system will require two android applications, first from the parent's side and second from the driver's side.

1.3.4.1 Parent Side

Parents can start the application and select either search bus option or the alert option. In the search bus option the parent will be able to see the current location of the bus and expected arrival time of the bus. On selecting alert option, parents who have subscribed for the service will receive information about their child boarding and un-boarding the school bus. A message or notification will be sent to the parents when the child boards the bus and when he reaches the school. Here the application accesses the server to retrieve the required information. And uses the data acquired from the server to inform the parents.

Driver Side

When the driver starts the application he enters the bus number which he would be driving so that the database can store the location received from a particular android device in its appropriate bus details. He also has to select the Bluetooth module for verifying the tags.

Database

Database is needed in this system to store following information.
1. School bus and student related information.
2. Location of the bus and various stops taken by the bus.

Scope / assumptions

The proposed system has limited scope and is a small scale project. The project will be implemented for limited number of buses and routes. The RFID tags are used to identify the students boarding and leaving the bus, since their range of detection is limited it will be installed in the bus only.

Features

1. Calculating the estimated arrival time of the bus.
2. Tracking the bus i.e. providing the location of the bus.
3. Notification of child boarding the school bus and arrival at school to the respective parents.

Issues / limitations

The main drawback can be the load on the server. The server may not be able to handle the load.

III.   CLASSIFICATION OF VEHICLE TRACKING DEVICES [4]

a.   Passive Device

"Passive" devices stores GPS location, speed, heading, vehicle details, direction etc. The device is removed and the data is downloaded to the computer for evaluation when the vehicle arrives to a predetermined point back. Passive devices store limited data and the data doesn't expire.

b.   Active Device

"Active" devices store the same information as passive devices. But it immediately sends the data via cellular or satellite networks to the base station or to a computer of the data centre for evaluation. Active devices can store unlimited data for a certain amount of time.

c.   Hybrid Device

Some hybrid devices have both active and passive function. With hybrid device, the data is sent to a base station if the network is available and if the network is unavailable, the device stores data and send it later when the network is available.

IV.   VEHICLE TRACKING METHODS [5]

a.   Automatic Vehicle Location (AVL)

AVL system is an advanced method to track and monitor any remote vehicle with the device that receives and sends signals through GPS satellites. The components of AVL are Global Positioning System (GPS) and Geographic Information System (GIS) which provide the real geographic location of the vehicle. AVL system consists of PC-based tracking software to dispatch, a radio system, GPS receiver on the vehicle and GPS satellites. Among the two types of AVL, GPS-based and Signpost-based, GPS-based system is widely used.

b.   Assisted GPS (AGPS)

In AGPS system is used to improve the performance of GPS receivers as it provides information about the satellite constellation directly to the GPS receivers. AGPS uses both mobiles and cellular networks to locate the accurate positioning information..With unassisted GPS, locating the satellites, receiving the data and confirming the exact position may take several minutes.

c.   RFID system

RFID is an automatic identification method using devices called tags to store and remotely retrieve data. RFID uses radio waves to capture data from tags.

d.   Related Work

There is substantial amount of work done in the field tracking of vehicles. Following are some of the existing systems.

e.   Nextbus [6]

Nextbus uses Global Position Satellite (GPS) technology and advanced computer modeling to track buses and streetcars on their routes. Taking into account the actual position of the transit vehicles, their intended stops, and the typical traffic patterns, Nextbus estimates the bus arrivals with a high degree of accuracy. This estimate is updated constantly as the vehicles are tracked. Along with the estimated time Nextbus also provides a live map to show the dynamic location of the bus.

Advantage:
Allow passengers enough time to get to their stop.

Disadvantage:
Traffic and emergencies can affect the accuracy of predictions
Nextbus supplies only the predictions

f. NYC MTA Bus Tracker [7]

MTA tracker allows riders to take advantage of the Metropolitan Transportation Authority's vehicle monitoring service; MTA Bus Time. MTA tracker also includes the ability to download route schedules. It allows riders to define alerts for MTA routes and stops, get a notification when a vehicle on a specific route is approaching or arriving at a particular stop.

g. IITM Bus Tracking [8]

This android and web application allows the users to get a dynamic location of all the buses in the IITM campus which travel to and fro from hostel to main gate.

Advantage:
Halting of the bus is clearly indicated.

Disadvantage:
No estimated arrival time given.
All the systems on bus tracking just give the real time location of the buses but fail to give information whether the child has really boarded the bus. Our proposed system overcomes this problem.

V. HARDWARE AND SOFTWARE REQUIREMENTS

Hardware

a. Android Phone

Android is a mobile operating system (OS) based on the Linux kernel and currently developed by Google. With a user interface based on direct manipulation, Android is designed primarily for touchscreen mobile devices such as smartphones and tablet computers. Android is the most popular mobile OS.A developer survey conducted in April–May 2013 found that 71% of mobile developers develop for Android. [9]

Due to large number of developers and android being open source as well as free of cost, we are using android phone for developing our project.

b. GPS and GPRS

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites [10].GPS devices have capabilities such as including streets maps, displayed in human readable format via text or in a graphical format. It also has turn-by-turn navigation directions to a human in charge of a vehicle or vessel via text or speech. GPS provides us with the roads or paths available traffic congestion and alternative routes and the shortest route between the two locations [11].

General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3Gcellular communication system's global system for mobile communications (GSM) [12].GPRS transmitter and receiver are used to send the GPS location.

We are using an android phone which is equipped with an internal GPS receiver and a GPRS transmitter to reduce the cost of GPS and GPRS module.

c. RFID [13]

Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. RFID consists of tag and readers.

Tag

A radio-frequency identification system uses tags, or labels attached to the objects to be identified. RFID tags can be either passive, active or battery-assisted passive.

Readers

RFID systems can be classified by the type of tag and reader:

- A Passive Reader Active Tag (PRAT) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only).
- An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags.
- An Active Reader Active Tag (ARAT) system uses active tags awoken with an interrogator signal from the active reader.

We will be using RFID for identifying child boarding and un-boarding the school.

Software

a. MYSQL

MySQL is the most popular Open Source Relational SQL database management system. It is one of the best RDBMS being used for developing web-based software applications written in c and c++ [14].

We are using XAMPP which is a free and open source cross-platform web server solution stack package, consisting mainly of the Apache HTTP Server, MySQL database, and interpreters for scripts written in the PHP and Perl programming languages [15].

b. PHP

PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language. While PHP originally stood for Personal Home Page, it now stands for PHP: Hypertext Pre-processor, which is a recursive acronym [16]. We will be using PHP to connect android device and the MYSQL database.

c. JSON

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write and easy for machines to parse and generate. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others [17]. We will be using JSON to send queries from the android devices to PHP page.

d. ECLIPSE

Eclipse is an integrated development environment (IDE). It contains a base workspace and an extensible plug-in system for customizing the environment. Written mostly in Java, Eclipse can be used to develop applications [18]. We are using eclipse to develop our android application.

VI. ARCHITECTURAL DIAGRAM

RFID Module

Figure 10: School bus tracking architecture

WORKING

The school bus has the RFID module fitted in it. The RFID readers read the tags that are swapped to it and sends the tag number to the android phone of the driver in the bus via a Bluetooth device. The driver side application receives the tag no and sends it to the database where the details required to send the message are selected and returned. The sms is sent from the driver's phone to all parents. At the same time in the background the location details are also sent to the system.

The parent side application is need to check the current location of the bus and to register for sms service.
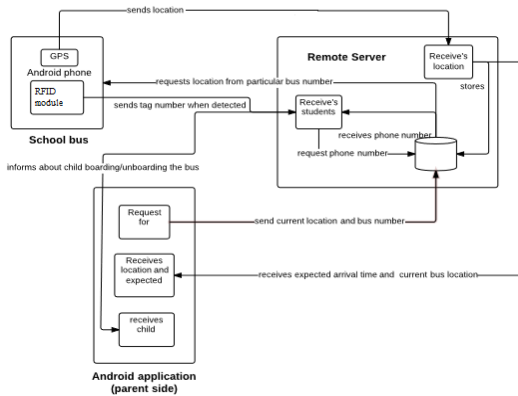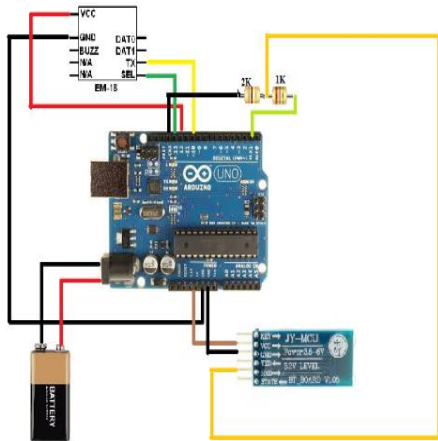
VII. CONCLUSION

Hence we conclude that with the available technology with little modifications we can track the school bus. The above designed method can not only be used for tracking the school bus but can also be used for tracking any kind of vehicle.

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