Review of Smart Tracking System for School Busses

**Abstract:** Millions of children need to be moved from home to school on a daily basis. For parents, safe transport for the children is one of the main concerns. Therefore they need a reliable management system for the school bus. Children, parents and also school administration may have several consequences because of not having that kind of management system. Several types of research introduced several technologies for bus tracking which are RFID technology, GPS technology, android based applications, Arduino uno technology, and Wi-Fi technology. This paper is to review the usage of these technologies to develop a smart school bus tracking system.

**Keywords**: school buses, child safety, tracking system, android application, arduino uno technology, Wi-Fi.

1. What is Tracking System

A tracking system is a system used to monitor the data of objects on the go. It is becoming an important tool for industries that want realistic information. The term ‘tracking’ has become the most popular these days. Millions of people are using the devices which embedded tracking systems, for security purposes and to make day to day work easy. The interest of using tracking devices becoming increase and many research papers have been published. Some of them have discussed technology, issues, highlighted the features and analyzed usages, etc. Real-time tracking and management of vehicles is a field of interest for many researchers. And also a lot of research work has been done for the tracking system.

**Vehicle tracking system** combines the use of individual vehicles location in automatic vehicle location with software for a comprehensive picture of vehicle locations. Modern vehicle tracking systems commonly use GPS technology for locating the vehicle as well as other types of automatic vehicle technologies are used. Vehicle information can be viewed on electronic maps via the internet as well specialized software. [1]

The paper presented by P. Verma describes the Real-time tracking system that provides an accurate, user-friendly Google map based tracking system. The application monitors the location and route of the vehicles. This monitor location observation can be done in any remote location. System has used the Global Positioning System (GPS) which will receive the coordinates from the Satellites among other critical information. The system is a microcontroller based that consists of a global positioning system and the global system for mobile communication (GSM) [2].

1. Why Smart Tracking System for School Busses

School bus companies have one of the most important jobs as well as the biggest responsibilities. They are responsible for transporting children safely back and faith to school. They are also responsible for updating parents about any delays that prevent their children from returning on time.

There are many benefits that GPS tracking has to offer for school busses. They involve the safety of the mind of their parents and the monitoring of the operation every time.

GPS tracking for school buses is about so much more than creating more fuel-efficient bus routes and provides a wealth of other benefits that can’t be ignored when it comes to school bus transportation [3]

* Keep parent in the loop

One of the important benefits is the opportunity to keep parents in the loop. It is possible to track school bus location to know when to have children ready in the morning to go to school.  Likewise, it lets parents know when they should be waiting to pick them up after school. It can also be set to send out notifications or alerts to parents if there are delays from traffic, weather or any other reason.

In according with journal of traffic and logistics engineering, their system will enable parents to receive instant SMS alert when bus is within 10 minutes of the designated pickup and also drop off points by reducing the time the child spends on the street.

The system will also notify parents via SMS when the child boards and alights from the bus or enters/leaves the school [4]

* Monitors driver behaviors

Breaking safety rules like speeding, hard braking, etc. places children at risk. The school buses managers are responsible of the safety and security of children, so they need to address the problem suddenly.

The paper presented by R.Abilash describes there is a provision for the bus administrator to send alerts to the authority in case of emergencies like tire puncture, engine problem. If there is any variation in the accelerometer readings, a precautionary SMS is sent to the authority and parent suspecting of an accident. [5]

* Improved scheduling for schools

By knowing exactly when school buses will arrive and leave, school administrators and teachers can create better and more effective schedules for their students. This allows for better time management and more fluidity of the school day. [3]

1. Existing technologies use for school bus tracking

Currently, most of the school don’t have a digitally monitored school bus. An attendant is appointed to look after the children for their safe pick up/drop. The school authorities and parents have no means to track the bus or even communicate with the attendant a couple of times. Hence, there are arise concerns for the safety of the children.

In some modern schools, their exists attracting system that use techniques of virtual fence known as **Geofencing** that compares the entity position with a predetermined zone or a point of interest, checking if the entity is within or outside an area.

Those techniques do not permit full coverage of the course, making difficult to determine if the bus is travelling in a planned path. [6]

Another approach to track the school bus is by a web-based application, which gives real-time location of bus on Google Maps to the remote users.

Firstly GPS receives the satellite signals and after that the position coordinates with latitude and longitude are determined by it. The location is set with the assistance of GPS and transmission mechanism. Once receiving the data tracking data can be transmitted using any wireless communications systems. GSM/GPRS is generally used to transmit the data. [7]

A box called black box contains RFID reader, GPRS transmitter and GPS in installed within the bus. As the bus approaches the bus terminal with associate RFID tag interact with reader. This connection produces data and it is sent to the monitoring Centre via GPRS. The interface between RFID and the other sensors like GIS, GPRS, and GPS and updates the RFID bus information and the data is stored in the database. The GPS module activates and provides the location of the bus, the information from GPS and RFID are sent to database through GPRS. However the RFID is not cost effective and also the poor connectivity to the network through GPRS in the remote locations [8, 9]

Taibah University developed an android app to improve the transportation services for bus for its students. It reduces the time for students waiting for bus, thereby to stimulate share the updated information of the buses to the drivers and students. The application runs only in android devices such as smart phones. It would give the students about the exact time of arrival and leave the buses on route.

This app would only be used by students and drivers of Taibah University. Any amendment within the time table of the buses would be updated in the app. Regular alerts would be sent just in case of delays or cancelation of buses. Bus locations and routs are shown on maps using Google maps. The application is designed and tested wherever the users assured that the application gibes the real-time service and it is very helpful for them. The major usage is GIS and GPS systems installing in every bus. It may be hard to implement GIS in every bus to track the real time tracking and send the data to the server [10]

**Drawbacks of existing systems**

* It is not comfortable for user
* Need proper time management system
* Not use of internet of things
* Need speed of data transmission

1. Proposed Systems for School Bus Tracking
2. **Smart tracking system for school busses using RFID technology**

The proposed system uses RFID (**Radio Frequency Identification**) for identifying the student and convert to database. Each student is issued with a unique RFID card (Smart Card). The student’s parent mobile number is stored in the microcontroller. The system consist a RFID card reader, the reader communicates to microcontroller through SPI **(Serial Peripheral Interface**) protocol. Whenever student pick his/her RFID card, system checks the validity of card.Once the RFID card matches with the database stored into the system, it opens the Bus Gate and allows student entry into the Bus as well as at the same time system sends SMS to student’s parent about their entry into the School Bus. The SMS features implemented in the system through SIM800 module, which works in GSM (**Global System for Mobile**) mode.

TheSIM800 module communicates to microcontroller throughout (**Universal Asynchronous Receiver/Transmitter**) Port. At school once student gets down from the Bus, he/she needs to pick the card again.

At the time system sends a SMS to student’s parents along with the position information of the bus. The positioning information of bus is detected using GPS (Global Positioning System) module.

The information is read in the microcontroller and decoded by the microcontroller. The similar process repeats once student gets into the bus from school to home [11]

The system will be designed to monitor children ridership in a safe and non-intrusive way. It will use a combination of RFID, GPS (Global Positioning System), and GPRS (General Packet Radio Service) technologies. Each student is issued one or more unique RFID card(s) to carry. The card will be embedded in the school bag for each student. As the student’s tag is detected by the reader installed in the school bus upon entering or leaving the bus, the time, date and location is logged and transmitted to a secure database. It will requires no action on drivers or students, other than to carry the card and will deliver the required performance without reaching the normal loading and unloading process.

The system will enable parents to receive instant SMS alerts when bus is within 10 minutes of the designated pick up and drop off points reducing the time the child spends on the street and parents time also. The system will also notify parents via SMS when the child boards and alights from the bus or enters the school and leaves the school. Parents will take the appropriate action because they have accurate answers to boarding status and times. If a child is still inside the bus for a predefined time after the vehicle's engine is turned off, and doors are closed, an SMS message will be sent to the school authorities and responsible parties. [12]

1. **Smart tracking system for school busses using android based application and GPS**

Android based application consists of 2 modules, An administrator, the one who manages the school bus and the parent, who can query about the location of the bus anytime needed. The details of the student and authorities are first registered and stored in the SQLite database; this will help to maintain a systematic record and is easy to fetch data whenever required. The proposed system mainly aims to provide remote tracking of school bus and simple mode of communication. To make the interaction easier, we have made use of SMS mode of alert mechanism. So that the application is benefited for both android and non-android users.

The administrator must use of administrator application module, so that he/she can interact with the parent/authority through SMS along with GPS for location tracking. For an android user, he/she must make use of the parent application module and can interact with the bus administrator trough a query SMS along with the help of GPS feature to know the location. For a non-android user, the alert SMS will be sent frequently when the bus reaches the pickup /drop point or when the bus reaches to school.

The proposed system involves intimating the parent. When the bus is about to approach the pickup/ drop point and also when the bus reaches the school. There is a provision for the bus administrator to send alerts to the authority in case of emergencies like tire puncture, engine problem. If there is any variation in the accelerometer readings, a precautionary SMS is sent to the authority and parent suspecting of an accident. The parent can also query the bus administrator about the current bus location or inform the administrator if the child is going to be absent on that particular day [5]

By developing android App user can input the data such as bus number and route they need to enquire. The server will send the details about the bus, location, time to reach etc. Immediately it will inform if the bus cancelled. [15]

In accordance to Atharva College of Engineering researchers of school bus tracking system, they going to design web based application to the users who want real time information about the estimated time of arrival (ETA) of buses at the bus stops. They use this technology to give control to the server to share the calculated ETA to bus passenger through any convenient way. [16]

The system is operated by GPS which is attached to the school bus. This system uses Automatic Vehicle Location (AVL) by using AVL the geographic location of a vehicle can be determined and this data can be transmitted to a remotely placed server with helping of GPS and transmission mechanism, the location is determined. The proposed system provides the current location of the bus accurately. Bus pursuit technology is an advantage for tracking and monitoring a bus. The proposed system consists of three necessary modules:-

1. Bus unit
2. Central control unit
3. Client-side application [18]
4. **Smart tracking system for school busses using Wi-Fi**

The bus is tracked by installing a special device or Wi-Fi module (ESP8266) in the bus. Wi-Fi module works in any conditions, anywhere in the world, 24 hours a day with power supply which can be supplied from bus. To use Wi-Fi module there are no subscription fees or setup charges. To calculate the position the latitude and longitude of the bus terminal will be loaded to the module. This device receives the latitude and longitude and sends the data at regular intervals to the cloud. Then the cloud analyses the data. To receive signals in the appropriate place the Wi-Fi module is connected to get connected with the router. Now the device is capable of receiving the latitude and longitude values of the location of the bus. At any point of time the router gives the location values. Now the bus unit has the coordinates with timestamps which is then compared with the previous coordinates and if there is any difference then the coordinates are updated and sent t cloud(thing speak). The location details are stored in cloud in the form at such as ID (bus number), longitude, latitude, timestamps etc. To identify each bus uniquely among the various buses here list picker in mobile application is used for identification.

In accordance with instructables journal, they going to demonstrate school bus tracking system. By using that the can find current location of school buses over internet. But their project is only working on local server range. First they send a few data to local server with a hyperlink. It carries contemporary bus location coordinates. Then they will redirect to the vehicle place in Google map by way of clicking at the same hyperlink. [19]

Each bus has its own Wi-Fi module with unique API key of the Thingspeak cloud. Cloud is the most important module in this system which acts as central repository of system. In this system the whole information is stored and maintained by cloud. Cloud is the intermediate between bus module and user module. This database consists of real time information about bus it includes bus routes, actual arrival/departure time and real time location of bus. Cloud provides service to the user module by providing required information to it in the mobile application. [13]

‌In current system management of school buses become a main problem. Implementation of smart bus tracking system using Wi-Fi journal provides the relevant information such as route details, arrival time, and destination. Also surveyed some commuters and the bus terminal officers to understand the problems in tracking system using Wi-Fi. [20]

1. **Arduino Uno Board for sending an alert message**

By designing the bus tracking system necessary to know about various programming languages to ensure the communication between microcontroller and GSM SIM. Module to store and retrieve vehicle location’s into the web on Google map. For that the data should send to the database from the satellite by using Arduino IDE. [17]

By sending an alert message to student’s cellphones about the current location of buses students could able to reach on time.

GPS

RTC

Arduino Uno

WI-FI

**Steps for Proposed System**

Step 1:

GSM, GPS interfacing and interacting with Arduino board

Step 2:

Evaluating the signal transmitted by the GPS and after get the latitude & longitude values

Step 3:

Collecting locations data of bus stops as well as saved

Step 4:

Comparing the current values from GPS receiver with saved values and generating messages using AT commands

Step 5:

Delivering an alert message to the students mobile [14]

1. Conclusions

Here I reviewed the most recent papers and research directions on school bus tracking system. This review paper presents problems in school bus transportation in current system, Importance of smart school bus tracking system, the modern technologies that they are going to implement to track school buses.

1. References

[1] Petropedia.com. (2019). *What is Tracking System? - Definition from Petropedia*. [online] Available at: https://www.petropedia.com/definition/8031/tracking-system [Accessed 25 Dec. 2019].

[2] Verma, P. and Bhatia, J.. (2013). Design and Development of GPS-GSM Based Tracking System with Google Map Based Monitoring. *International Journal of Computer Science, Engineering and Applications*, [online] 3(3), pp.33–40. Available at: https://pdfs.semanticscholar.org/c19f/c9aa2d5d57139ac75869aa12d113f3e288a2.pdf [Accessed 25 Dec. 2019].

‌[3] Truway. (2018). *Benefits of GPS Tracking for School Buses - Truway*. [online] Available at: https://truway.io/en/benefits-of-gps-tracking-for-school-buses/ [Accessed 25 Dec. 2019].

‌[4] Shaaban, K., Bekkali, A., Hamida, E.B. and Kadri, A. (2013). Smart Tracking System for School Buses Using Passive RFID Technology to Enhance Child Safety. *Journal of Traffic and Logistics Engineering*, 1(2), pp.191–196.

[5] IRJET  Journal (2019). *Smart Tracking System for School Buses*. [online] Academia.edu. Available at: https://www.academia.edu/33518652/Smart\_Tracking\_System\_for\_School\_Buses [Accessed 26 Dec. 2019].

[6] International Journal of Scientific & Engineering Research, Volume 6, Issue 5, May-2015 Vehicle Tracking System with Smartphone Integration S Om Prakash, R Karthikaeyan 7 Abstract Need for reliable (2015). *International Journal of Scientific & Engineering Research, Volume 6, Issue 5, May-2015 ISSN - PDF Free Download*. [online] Docplayer.net. Available at: https://docplayer.net/5247604-International-journal-of-scientific-engineering-research-volume-6-issue-5-may-2015-issn-2229-5518.html [Accessed 26 Dec. 2019].

[7] Kumbhar, M., Survase, M., Mastud, P., Salunke, A. and Sirdeshpande, S. (n.d.). *Real Time Web Based Bus Tracking System*. [online] *International Research Journal of Engineering and Technology*. Available at: https://www.irjet.net/archives/V3/i4/IRJET-V3I4128.pdf [Accessed 26 Dec. 2019].

‌[8] Neha Shinde and Saniya Ansari (2017). Intelligent Bus Monitoring System. *International Journal of Computer Applications*, [online] 168(3), pp.27–30. Available at: https://www.ijcaonline.org/archives/volume168/number3/27857-2017914352 [Accessed 27 Dec. 2019]

[9] Sumit S.  Dukare ;Dattatray A.  Patil ;Kantilal P.  Rane (2015). Vehicle Tracking, Monitoring and Alerting System: A Review. *International Journal of Computer Applications*, [online] 119(10), pp.39–44. Available at: https://www.ijcaonline.org/archives/volume119/number10/21107-3835 [Accessed 27 Dec. 2019].

[10] Ahmed, A., Nada, E. and Al-Mutiri, W. (2017). University Buses Routing and Tracking System. *International Journal of Computer Science and Information Technology*, [online] 9(1), pp.95–104. Available at: http://aircconline.com/ijcsit/V9N1/9117ijcsit08.pdf [Accessed 26 Dec. 2019].

[11] Banu, A., Khatoon, F., Khan, Z., Elahi, M. and Students, &amp;4 (2019). School Van Tracking Using SMS\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*-\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*. *International Journal of Scientific Research and Engineering Development*, [online] 2(1). Available at: http://ijsred.com/volume2/issue1/IJSRED-V2I1P37.pdf [Accessed 26 Dec. 2019].

‌[12] Shaaban, K., Bekkali, A., Hamida, E.B. and Kadri, A. (2013). Smart Tracking System for School Buses Using Passive RFID Technology to Enhance Child Safety. *Journal of Traffic and Logistics Engineering*, 1(2), pp.191–196.

[13] Dhoke, M. and Ghutke, P. (2007). Certified Organization) Website: www. *International Journal of Innovative Research in Science, Engineering and Technology (An ISO*, [online] 3297. Available at: http://www.ijirset.com/upload/2017/july/306\_Innovative.pdf [Accessed 27 Dec. 2019].

‌[14] Computer, in (2019). *Bus Tracking System*. [online] Academia.edu. Available at: https://www.academia.edu/33112860/Bus\_Tracking\_System [Accessed 27 Dec. 2019].

[15] Scribd. (2017). *Intelligent Bus Tracking System Using Android*. [online] Available at: https://www.scribd.com/document/335482335/Intelligent-Bus-Tracking-System-Using-Android [Accessed 5 Jan. 2020].

‌[16] Mishra, M., Panchal, S., Kharat, M., Walve, P. and Kadge, S. (n.d.). *Bus Tracking System Using Android & Web application*. [online] Available at: http://iosrjen.org/Papers/Conf.19018-2019/EXTC/Volume-10/19.%2086-89.pdf [Accessed 5 Jan. 2020].

‌[17] Humphries, M., Radev, P. and Shirvaikar, M. (2020). *A realtime vehicle tracking system*. [online] Proceedings of the Thirty-Seventh Southeastern Symposium on System Theory, 2005. SSST ’05. Available at: https://www.academia.edu/34671178/Real-Time\_Vehicle\_Tracking\_System [Accessed 5 Jan. 2020].

[18] Patel, D., Seth, R. and Mishra, V. (n.d.). *Real-Time Bus Tracking System Professor. Rucha Pathari 4*. [online] *International Research Journal of Engineering and Technology (IRJET) e-ISSN*, pp.2395–0056. Available at: https://www.irjet.net/archives/V4/i3/IRJET-V4I3195.pdf [Accessed 5 Jan. 2020].

‌[19] Instructables (2016). *Vehicle Tracking System Using  WIFI*. [online] Instructables. Available at: https://www.instructables.com/id/Vehicle-Tracking-System-Over-Internet-Using-Arduin/ [Accessed 5 Jan. 2020].

‌[20] Durga Bhavani and Ravi Kiran S C V S L S (2017). *Implementation of Smart Bus Tracking System Using Wi-Fi*. [online] ResearchGate. Available at: https://www.researchgate.net/publication/328433555\_Implementation\_of\_Smart\_Bus\_Tracking\_System\_Using\_Wi-Fi [Accessed 6 Jan. 2020].

‌