ENHANCE SAFETY SECURITY AND TRACKING SYSTEM FOR SCHOOL BUS AND CHILDREN

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ABSTRACT:

A system monitors the daily transportation service for school going children to enhance the security and safety of the children. The system consists of three main units, bus unit, parent unit and school unit. The bus unit consist of hardware parts. The bus unit is used to detect when a child enters/exits from the bus using RFID Card. This information is communicated to the parent unit and school unit that identifies the children did/did not enter/exit the bus. The notification like the students whose next stop is, sent to the parent who stays on the next stop using Geofence. The system enhances the security of the children like the bus hijacked, extracting the location and instantly sending notification to the admin as well as the nearest police station using SOS and Spherical Cosine Rule. The system develops an android application for the parent for getting notifications and live tracking of the bus and web based application for the admin that facilitate the management and provides useful information about the children and some specific details like routing, allocating stops, scheduling, optimized route and reports. The system tracks the school bus by the GPS Module and also gets an alert if the bus crosses the speed limit.

INTRODUCTION:

Today time is an important factor of human's life. Millions of school students travel through school bus. The students begin and end their day with a trip in a school bus. Most of the time parents have to wait at the spot much before arrival of school bus for picking and dropping their child. School buses are the safest way to get to and from the school. Riding a bus to school is too safer than riding the family to the school and also safer than going walking to the school. An increasedconcern amongst parents today is the safety of their children on the way to school and back home.

There are many issues that might disturb the parents regarding the travel safety of the children; the paper intends to look into introducing the access safety of school buses through bus tracking system by GPS that will help the school children's transportation in a secure and safer way. There are also some issues which disturbs the parents, like forgetting the children in the bus, the children sometime late at the stop miss the bus, bus hijacked.

The school authority sometimes also faces some problems like allocating bus to the students, allocating stops to the students, notifying the bus drivers about the stop and new child details.

To overcome these all issues and problems the "ENHANCE SAFETY, SECURITY AND TRACKING SYSTEM" is developed that will help the parents to know the details of their child and the bus and also can able to keep the security safety of the children if bus hijacked and alos the school admin can keep tracks of students, buses, assign routes, assign stops, allocate bus, get live location, and keep all the records.

LITERATURE REVIEW:

A literature review has showed there are many studies introduced i.e a system[1] to monitor pick-up and drop-off service of schoolchildren to raise the value of the security of the children during the daily transportation from and to the school. A system has a developed web-based database driven application that facilities its administration and provides useful information about the children to authorization. This system major drawback is it uses web based application for admin and parents too. Parents could not able get notify easily in convenient and safer manner.

Another research [2] introduced a system that monitors children inside the bus in a safer manner. It uses the combination of RFID (Radio Frequency Identification), GPS (Global Positioning System) and GPRS (General Packet Radio Service) technologies. Each student carries a unique RFID card embedded in each of the student's school bags. When the student enters or exits from the bus the reader records and transfer data in the database.

Another research [3] introduced the system which gives the real time notifications about location of child using GPS Tracker. It also identifies the child by the Biometric Identification method. This system disadvantage is full casual and difficult for the children's to place their any body part detection correctly on the

scanner. This may also handle to an inappropriate data if the scanner did not detect the child's body part.

Another research [4] introduced a School bus tracking system is a service that gives real time notifications and updates about child location using GPS and Biometric identification from a few minutes before child enters the bus till the child reaches home safely. This system is integrated with high performance STM32 ARM Controller. This system major drawback is that it is automatic and difficult for the childrens to place their ARM detection correctly on the scanner. This may also lead to an inaccurate data if the scanner did not detect the Childs ARM by the ARM Controller. This system cost is high due to the use of STM32 ARM Controller.

Another research [5] show an efficient and systematic way of using RFID tracking applications coupled with smart phone technologies to fulfill the key security and monitoring purposes. In order to optimize the proposal, this paper investigated the effects of variable localization of RFID tags from reader and power loss, inefficiency and distance constraints caused due to equal power allocations to the tags. Reducing the number of reader by using smart antenna and increasing coverage area, several other sectors will be hopefully able to leverage the benefits of RFID technology and smart antenna using adaptive algorithm.

PROPOSED SYSTEM AND IMPLEMENTATION:

The Proposed System consists of hardware parts and android and web based application. as shown in the Figure 1. The Proposed System is divided into 3 main units as shown in Figure 1.
1. Bus Unit
2. Parent Unit
3. School Unit

BUS UNIT:

The Bus Unit is used for detecting the child when the child enters and exits the bus and send this information to the School Unit as well as parent unit. The Bus Unit consist of:
a. RFIDTechnology: RFID Reader and RFID Tag (Radio Frequency Identification Detection) [6].
b. GPS Module : Global Positioning System [6].
c. GSM/GPRS Modem: Global System for Mobile Communication/Global Packet Radio Service Modem
d. Switch
e. Microcontroller Arduino Mega 328 [6]

The functions of RFID Reader are integrated with the RFID Tags. The RFID Reader is attached at the entrance of the bus and the RFID Reader module works as both transmitter and receiver of the radio frequency signals. The RFID Tag is enhanced in students ID card. The GSM/GPRS Modem is used for communication with the Server via GPRS and GSM SIM. The GPSModule is used for Live Tracking of the School Buses and alerting if

the bus crosses the speed limit in build in GPS Module. The switch board consists of a button where, when the bus is in major trouble can press the button as by microcontroller can communicate with the server. The Microcontroller Arduino is a very important part in the bus unit with which the all the other hardware's are connected and can communicate with server.
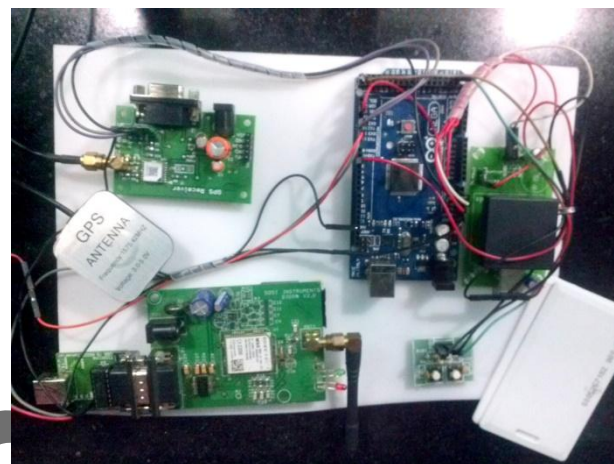

Fig.No.1. Hardware Connection

PARENT UNIT:

The Parent Unit consist of an Android Application where the Parent Sign up with the mobile number registered in the School Database Server and Login into the account to get the child's notifications automatically from the School Database Server and can also be able to track the bus in which the child is traveling.

The Parent Unit also contains the API BulkSMS for the Parents who are not able to use the Android Application; by API Bulk SMS the messages will be send in the Inbox of the Parent Phone. There is the drawback for the Parents who are not using Android Application; they could not able to view the live bus location.

SCHOOL UNIT:

The School Unit consists of a Web Based Applicationwere the Admin can be able to do all the Master Entries like Add, Delete, Update, Modify the details of the School Buses, Students, Routes, Stops and many more as required and hence it is been saved on the Server. Via GPS Module attached in the Buses; the School Unit can able to view the bus locations of the Buses on the Google Map with optimized route and schedule given to cover each stops from source to destination. The School Unit gets the alert message instantly when the Bus Crosses the Speed Limit.

The School Unit also consists of the Geo-fence. Geo-fence is the area which is designed by the admin for each stop. The adminmakes the particular area as his geo-fence and send the notification messages to the Parent Unit as soon as the bus enters into this region.

The School Unit keeps the records of thestudents, buses, routes, stops, speed of bus as well as the overall history with children in/out, time into/from the bus; assigned optimized bus route, cover all the stops, etc. These all are included in theReports on the Web Based Application which is been able to view by the Admin only.

SCHOOL DATABASE SERVER:

The School Database Server contains overall database for the child safety and is responsible for transmitting the received data from the Microcontroller Arduino into useful services. The Server filters and analyse the received data, track the real time current location of the buses, check the location against defined geo-fence areas, generate alert messages, notifications and reports and so on.

School Database Server consist databases like students information, their parents details, school buses details and need some of the algorithms to complete the task like sending notification of specified parents in the database of each and every activity of the student and the bus details.

School Database Server also includes data of the police stations for getting the alert message to the Police as well as School Unit with the location of the Bus with showing optimized route to reach the bus location on the Google map.
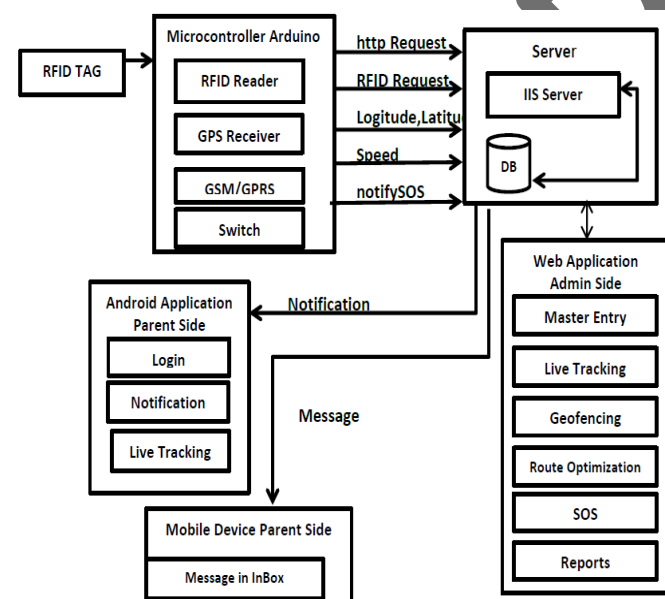

Fig. No.2. Architecture of the System

ROUTING AND SCHEDULING ALGORITHM:

Routing and Scheduling Algorithm is used to select the route covering each student and specifying nearby stop to each student from source to destination with the schedule set at each stop.
1. Data Preparation: Preparing necessary data for routing such as location and destination.

2. Bus Stop Selection: Allocating each and every student distributed in different areas to nearby bus stops in order to determine the bus stops.
3. Bus Route Generation: Generating the route to cover all the bus stops.
4. Time Adjustment: Deciding the time for each stop, that student should arrive and deciding the time for school, that bus should reach the school till decided time.
5. Route Scheduling: Assigning routes for the individual buses.

GEOFENCE ALGORITHM:

A continuous range of latitude and longitude are fixed by admin. When the bus enter in the geofence area than the message is send to the parent. Similarly the HTTP Server is updated, appended in the same row. Geo-fence Algorithm is used to calculate the distance with the geofence radius set.
1. If distance >geofence radius Bus is not near the stop.
2. If distance <geofence radius.
3. Bus entered in geofence area of the stop.
4. Send notifications to parents on the stop of that geofence.

HARVERSINE FORMULA:

The Haversine formula is an equation important in navigation, giving great-circle distances between two points on a sphere from their longitudes and latitudes [7].These names follow from the fact that they are customarily written in terms of the haversine function, given by

$$harversine(\theta) = sin^2\left(\frac{\theta}{2}\right)$$

The haversineformula is used to calculate the distance between two points on the Earth'ssurface specified in longitude and latitude.

$$\Delta Lat = Lat_2 + Lat_1$$
$$\Delta Long = Long_2 + Long_1$$
$$\alpha = sin^2\left(\frac{\Delta Lat}{2}\right) + cos(Lat_1)cos(Lat_2)sin^2\left(\frac{\Delta Long}{2}\right)$$
$$c = 2\,arctan2[\sqrt{a}, \sqrt{a(1-a)}]$$
$$d = Rc$$

Where,
Lat=Latitude
Long=Longitude
R=Earth Radius i.e Radius 6,371km

THE ALGORITHM WORKS AS FOLLOWS:
1. Start
2. Get the current location coordinates of the bus from the GPS.
3. Get the coordinates of the prominent locations and bus stop from the area set to which the current location coordinates of the bus correspond.

4. Calculate the Haversian distance between the coordinates obtained from step 1 to each of the coordinates obtained in step 2.
5. Calculate the minimum Haversian distance from the results of step 4.
6. Return the minimum obtained distance from step 5 to the server.

SPHERICAL LAW OF COSINE:

In spherical trigonometry, the law of cosinesis a theorem relating the sides and angles of spherical triangles, analogous to the ordinary law of cosines from plane trigonometry.

$$\cos a = \cos b \cos c + \sin b \sin c \cos A$$
$$\cos b = \cos c \cos a + \sin c \sin a \cos B$$
$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

When first arrived at this formula, it did not realize that this is actually the spherical cosine law, which is closely related to the Euclidean cosine law for triangle:

$$c^2 = a^2 + b^2 - 2ab \cos C$$

BUS HIJACKED SOS:

1. ROUTE: Identify the route of the bus. The next police station will depend on its direction. The database has the table for the route where it checks before identifying the nearest police station.
2. SHORTEST DISTANCE: GPS system can be used to get location which includes details like latitude, longitude and altitude values along with the timestamp details etc. The location which will have the shortest distance is one closest to the bus. Therefore the report will be sent to the next station the bus will encounter to take action. The shortest distance is calculated by the spherical cosine rule. A spherical polygon on the surface of the sphere is defined by a number of great circle arcs which are the intersection of the surface with planes through the center of the sphere.
3. Nearest PoliceStation: calculate the nearest police station as per bus location with latitudes and longitudes and report the incident to Police station and the school unit with location of the bus.

RESULT:

1. Web Application GUI login and includes students, routes, stops, reports where the students details are added and stops are selected and saved in the database server, clicking on route the route as we required is been created and then by optimization algorithm the optimized route is generated by Harversine Formula, Reports keeps the records of the students in/out data with time and date and also includes the over speeding bus details.
2. The Android Application at Parents side gets instant and automatic notification/SMS saved in the server for eachactivity performed like next stop is yours using Geofence, child entered/exited the bus by RFID Scanned to the RFID Reader and Parents are able to see the live location of the Bus by GPS Receiver Module.
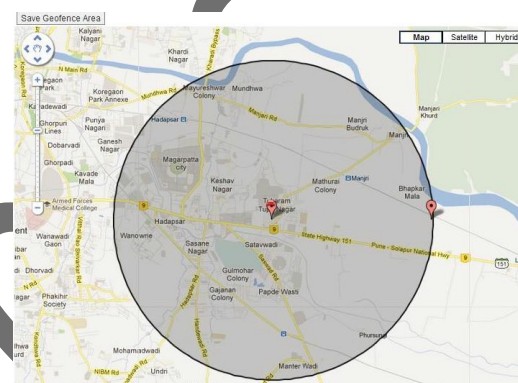

Fig.No.3. Circular Geofence Area

3. The switch enhanced in the bus and if pressed, the system uses the Spherical Cosine Rule and the Bus Hijacking SOS Algorithm is applied where the shortest distance is found and by the GPS location latitude and longitude the route is generated and the nearest police station is found where the nearest police station gets the instant and automatic SMS about bus in trouble with the Location of the bus. This message is also send to the school unit.
4. By using GPS Receiver the speed of the bus is also been calculated and if the limit of speed is crossed, the alert message is sent to the school unit.

CONLUSION AND FUTURE SCOPE OF WORK:

Problems occurred now days for child's safety have become a major concerning issue for the parents and school too. This proposed system aims at enhancing the safety of children during the daily transportation to the school and from the school. RFID Reader located inside the bus detects the RFID tags of the child. It sends instant notification with the relevant data from the school database server via internet. The system checks and detects each and every activity, problems and notifies to the Parents, Admin and Police station about the specified activity. The parents can log into the Application and monitor the details of their children and track the location of the bus. The admin can add stops, allocate stops and optimized route is generated. The system deals with live tracking of the bus.

Future Scope includes Parking Management System of the School Parking, can also include the concept of VANET for bus to bus communication. This system can be extended for full-time monitoring of children that will be of interest to concerned parents and guardians.

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