Public Bus Tracking System

Sushmita Manikandan[1], Sharath N[2], Sheela D[3]

[1]Computer Science and Engineering, PESIT Bangalore South Campus, Bangalore

[2]Information Science and Engineering, PESIT Bangalore South Campus, Bangalore

Abstract: ***The paper is concerned with the prototype implementation of a smart bus tracking system which overcomes the shortcomings and disadvantages in other such systems. The product helps a passenger to estimate the lead time for the bus to arrive using smart phone, on a real time basis. The discerning features of this product include Internet of Things to connect all the buses via Internet, a novel approach to ticketing system in an attempt to reduce paper, use of Mobile GPS as against the conventional Global Positioning System module installed inside the bus, for sending bus coordinates and the use of Mobile Identification Number, instead of RFID tags for bus identification. The ticketing system is enhanced from the conventional paper based to electronic notification or SMS based service. The crowd of the bus is calculated based on the number of tickets sold and the scanning system which is used for authentication of the passenger which is absolutely accurate.***

1. Introduction

With an exponential rise in population and an increase in environmental concern and education, the proclivity towards energy efficient practices among people is escalating. Mass transit, especially the public bus system, is a prevalent energy conserving mechanism that is popular among common commuters of the city. However, many cities of India follow a very inefficient approach for public bus transportation. This paper considers challenges faced by users of Bangalore Metropolitan Transport Corporation, regulated by the Karnataka Government of India for its case study and the product aims at providing solutions for the same.

Consider an application "mybmtc" which was developed for the commuters in the city. It has been observed to have the following shortcomings:

- Runs on data that has not been updated.
- Shows fixed routes.
- Web based application and is, therefore, not potable.
- Poor user interface.

An analysis of the above existing apps shows that these applications had a myopic view of requirements and do not provide a holistic bus tracking system. This project aims at overcoming these drawbacks and provides a novel approach towards real time bus tracking.

2. Literature Survey

The first attempt at bus tracking was done by [Roboticwares Pvt Ltd, 2011], with the product called Far Eye which is a centralized monitoring system to manage vehicles and keep track of their activities. It was aimed at filtering out potentially rash drivers and it also provided a live video of the vehicle which helped in providing exact count of people traveling and provide data to estimate which routes should be provided with more buses. This would also help in stopping pick-pocketing and other unwanted activities in buses. This would make public feel safe to travel in public transport. People traveling inter-city could set option for SMS alert so that they don't have to wait at bus stop. Alert is generated on fuel pilferage and also shows the details of fuel in the vehicle. It also tells how much fuel gets filled and at which petrol pumps.

Yasha Sardey et al, 2014 [2] developed a mobile application for bus system tracking using client server technology. The system is divided into two modules: Module 1 gives information about all the routes from the source to the destination and give maps for the same. Module 2 give information about all the buses along with the bus numbers that go through the selected stops, track the location of the selected bus and send this information to the passenger giving him/her the estimate time required for the bus to reach.

Mrs. Swati Chandurkar et al, 2013 [1] proposed another real time bus monitoring and passenger information system. Algorithm was incorporated for route creation and expected time of arrival calculation. The paper effectively explains algorithms for route calculation and eta prediction. ETA is based on present and past observations of conditions.

Ganesh K et al, 2012 [3] came up with a bus track system using GPS to send the bus coordinates to a central server. The disadvantage of this system is that it necessitates a GPS module to be installed inside the bus which results in cost overheads. An increase in the hardware results in a rise in installation and maintenance costs.

Aravind. P et al, 2015 [4] made use of similar aforementioned technologies and used Google Cloud Server messaging in order to intimate the user regarding the whereabouts of the bus. Arrival time prediction forms the core of any RTPIS system. The algorithm can be very simple, involving only a bus schedule table, zone based or could be very complicated, involving Artificial Neural Networks, space-time correlation and time series modeling. Bus schedule table and past location data can be used to predict arrival time.

3. Proposed System: Architecture and Development Environment

Figure 1 shows an overview of working of the application. The system consists of server, a user handset, a handset for the conductor/bus and a finally a handset for the passenger.

The user handset is a mobile or a tablet which is present with the user of the application. The conductor handset is a mobile or a handset which is present with the conductor of the bus.

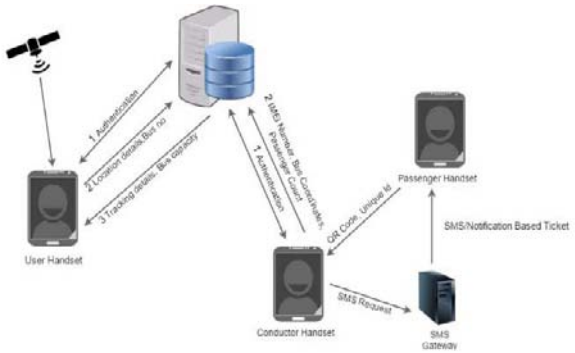

Figure 1: An overview of working of the application

The passenger handset is a mobile or a handset which is present with the passenger of the bus. The server consists of the database and the logic for the tracking of the bus. The user, conductor and the passenger logins into the system whose validation and authenticity is checked in the server. The user sends in the location and the bus number which he is expected to board. The server takes the user's coordinates and checks for the nearest bus from the user's location and starts to track the bus providing additional details such as the crowd associated with the bus. The conductor updates the IMEI number and enables the GPS to get the coordinates of the bus which the conductor is associated. The conductor then continually sends the coordinate data to the server. The passenger gets the ticket either by a notification or by a SMS. The passenger is classified into three categories and based on the category the passenger belongs the ticket is generated accordingly. The conductor scans the QR code from the passenger or uses the unique identification code from the passenger and uses that to generate and give tickets to the passenger. The conductor regularly updates he passenger count based on the number of tickets sold and the codes which were scanned from his mobile.

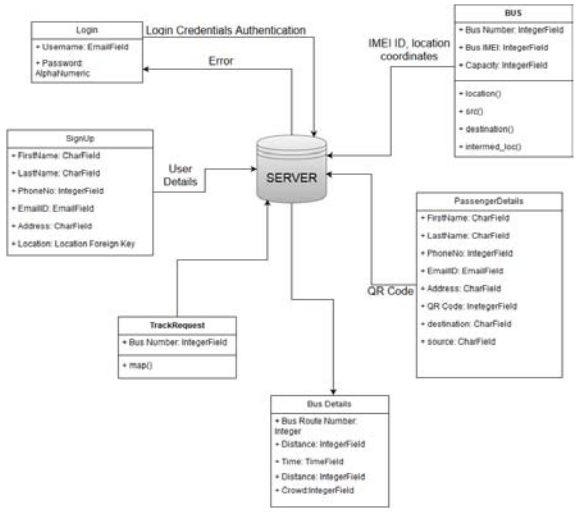

Figure 2: High level architecture

Figure 2 shows the High level architecture of the system. The login is based on the username and the password provided by the user. The Signup details are added in a pre-login session with the server. The user sends the user location and the bus number in which the user intends to travel. This is one side request to the server whose acknowledgement would be a response from the server giving the details of the nearest bus to the user or acknowledging the user that no such bus exists in the vicinity or during that period of time. The response would contain the bus location details that is the whereabouts of the bus with this an additional information of the crowd of the bus which is calculated based on the number of tickets sold by the conductor in the bus. The bus sends in the IMEI number to the server which is used to uniquely identify the bus from the common lot. The capacity of the bus and the bus number are the additional information which is provided by the bus to the server. The capacity is used to calculate the crowd present in each bus individually as the number of seats vary across buses. The bus IMEI is associated with the physical device that is the phone updating it only once would do the job. But the location coordinates should be updated at equal interval of time. The passenger only gives the QR code to the conductor which is sent to the server where it is checked for validation. The conductor then generates the ticket to the associated mobile number and sends him a notification through a SMS/notification gateway. If the QR code is not present, the passenger requests for a unique code which is valid only for a small period of time. Based on the mobile number which requested the code the e-ticket is sent to the that person. The ticket would contain details such the ticket number, source, destination and the timestamp during which the ticket was generated.

The system requires a cross platform mobile development tool. NativeScript is one such platform which can be used. Django will be used for the server sided scripting. MySQL for the Database Management system in the application.

1) NativeScript

NativeScript is used in this application because it is cross platform tool and covers android and IOS platform which is almost 90% of the mobile market in the world. NativeScript uses web based technologies such as HTML, CSS and JavaScript for development. We obtain a performance which is almost equal to the native environment. All the native components can be accessed through NativeScript with no mediator required. We can access the native UI components through NativeScript. There is no need for a web view which would be needed in other web based mobile technologies.

2) Django

Django is used in this application for server sided scripting. Django uses. MVT model which abbreviates as Model, Views and Templates. Models represent the database tables, Views are the functions which performs a specific task on a request and Templates are the front end viewing part. Django encourages rapid development without any hassles of reinventing the wheel of web development. Django is free and open source which is an added advantage.

3) MySQL

MySQL is used in this application for database management systems. MySQL is an open source relational database management system. It uses client Server based model. The ease of use makes MySQL stand out. MySQL is very secure with authentication, solid security layers that protect

sensitive data from intruders. It is very fast and scalable. It is available on multiple platforms such a Linux and Windows.

4. Functionalities Provided by the System

- Tracking public bus
- The crowd of the bus
- Ticketing system
- Notification on the arrival of the bus

1) Design

The product is essentially split into three different modules as shown below.

a) USER MODULE
b) BUS LOCATION MODULE
c) TICKETING MODULE

Each of these is described in detail as shown below.

a) USER MODULE

Figure 3a shows the flowchart of how the user module works. The user logins or signs up, as the case may be. The details are sent in to the server where the user's login credentials are validated. User location and required bus number is sent to the server, the data about the location collected from the GPS system in the mobile phone, from the USER DETAILS page and the bus number is entered as per the user's intention of travelling in that particular bus. The user is then redirected to the BUS DETAILS page wherein information regarding the tracked details are provided with the crowd of the bus. This details also include the ETA of the bus. The user application terminates upon receiving user feedback which is stored as a knowledge base which could be used for further optimization.

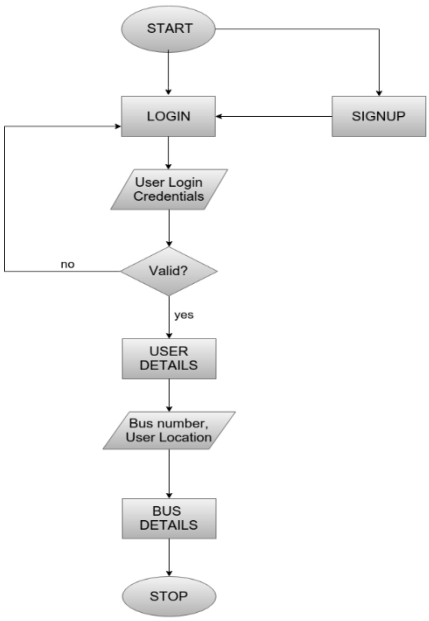

Figure 3a

b) Bus Location Module

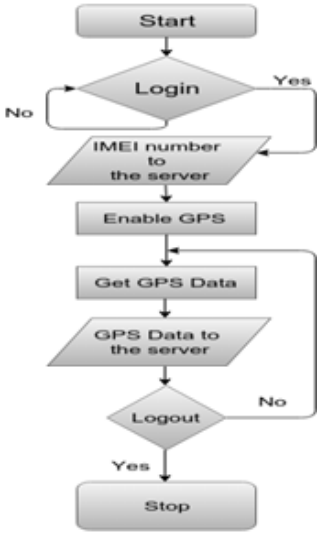

Figure 3b shows the working of bus location module. The conductor of the bus is provided with a mobile phone which is uniquely identified by the IMEI number which is associated with every mobile phone. The conductor logs in to the system and is authenticated for validity. The conductor connects to the server and sends the unique identification number to be separately identified from the common lot. The conductor then enables the GPS service in mobile phone and starts sending his location coordinates to the server. The server keeps track of this coordinates and when request is received from a user it gets the location of the bus from this coordinates and calculates the ETA for the user.

c) Ticket Module

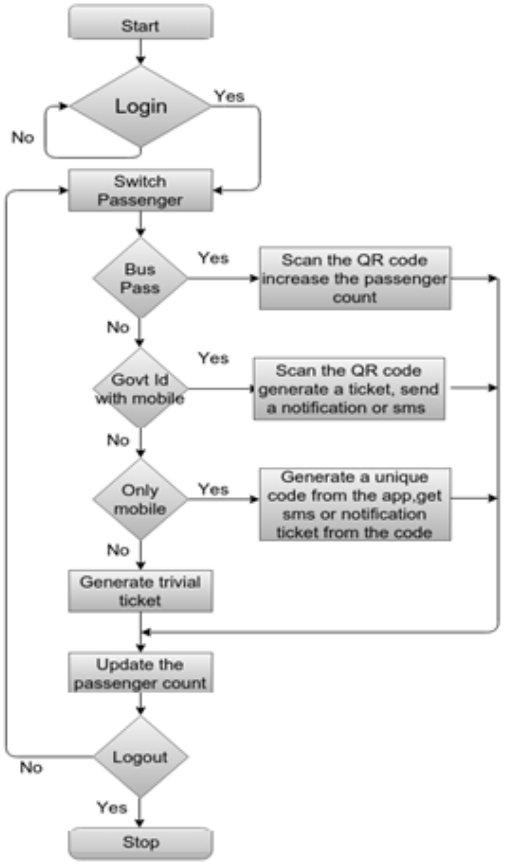

Figure 3c

Figure 3c shows the flowchart of the novel approach for ticketing. The ticket can be further subdivided into categories of passengers. Passengers may be of one of the following three categories:

1) Passengers with a bus pass – Daily or Monthly
2) Passengers with a Govt ID and a mobile
3) Passengers with a mobile phone.

Passengers belonging to category 1 will have a Bus pass which will contain a QR code. The QR code will be scanned by the conductor using the handset for validation of the bus pass. The conductor then increments the passenger count which is used for crowd suggestion. The passengers belonging to the category 2 will have a government issued id card which will have a QR code for the validation of the passenger. The conductor scans the QR code which is validated in the server and a ticket is generated to the associated mobile number. A notification/SMS based ticket is sent with details such as the ticket number, source, destination, timestamp to avoid duplicity of the tickets with bus identification number from where the ticket was generated. Identification happens using QR code present on their respective IDs. The conductor increments the passenger count based on the number of tickets which was sold to the passenger. Passengers belonging to category 3 will only have a mobile phone without any identification document from the government or the bus pass. So these passengers have to login into the system, when they want a ticket they can generate a unique identification code from the application which ensures validity of the passenger, when the unique identification code is given to the conductor, the conductor generates a ticket to the mobile number through which the passenger logged into the system. The conductor then increments the passenger count and updates to the server after each check point. With every ticket generated the counter will be incremented and decremented when the bus stop arrives, thereby predicting how crowded the bus is. If a passenger doesn't fall into any of these categories, then a normal ticket is generated.

5. Results

The application solves problems such as waiting for a bus. It provides an optimized ticketing solution, indicates the crowd in the bus on a real time basis with an accuracy of 100% because there are no passengers in the bus whose presence has not been recorded. The ticketing system which uses SMS/Notification is hassle free unlike the conventional paper based tickets. The authentication and validation of the passengers are scrupulous, which will definitely stop impersonation, fraudulent activities and hitchhiking. The conventional use of the GPS and RFID tags are replaced by the usage of a mobile or tablet which increases accuracy and reduces the overhead cost of installing and maintaining complex hardware components.

6. Conclusion

The conclusion of this study shows that by including a mobile based GPS tracking system and IMEI, the shortcomings of the traditional hardware GPS based system and RFID tagging system are overcome. The product reduces cost of installation and maintenance of hardware. A novel ticketing system included with the mobile based tracking system overcomes the hassles of the paper based ticketing system. The crowd estimation is 100 % accurate which is difficult to achieve. A constraint of this system is that each bus should be associated with a cellular phone, which in itself is not a disadvantage since mobile phones are ubiquitous and economically feasible.

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