International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072

INTEGRATION OF IOT IN PUBLIC TRANSPORT

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Abstract*-As population is burgeoning, a risen the* number of vehicles on the road and hence an upswing in the problems associated with traffic management, especially the Public Transport. There is also an increase in the number of accidents and different traffic related issues. Intelligent Transportation System (ITS) provides the solution to most of these problems by integrating existing technologies with the underlying infrastructure. With the arrival of mobile technology and the omnipresent cellular network, real time vehicle tracking for efficient transport management has become feasible. The trivial long wait for a bus to arrive can be averted by Intelligent Public Transportation System. The pervading of Smart Phones and their ever increasing power at a very economical price makes them one of the most stunning options for developing IOT applications. Here, an approach based on the combination of technologies like GPS and Android is discussed which can assuage passengers who commute by the means of about the current location of nearest buses approaching the bus-stop on a mobile application. Using readily available Android API's ,technologies like 3G network and SMS based services in the existing mobile phones can abate the cost and size of hardware required, as well as direction to a better output. Public transport. The user is furnished with explicit information.

Keywords— GPS, Android, Web Server, ITS, ICT, RFID

1. INTRODUCTION

Public transport is a service used by passengers to commute daily. Passengers share the system here. This system has many advantages like reduction of private cars driving on road and fuel consumption. It reduces pollution, hence it is environment friendly. Mainly, it is economical. In big cities, it is easily accessible as well as indispensable mode of transport.

On the other hand, there are some drawbacks of this system. Time is one of the biggest demerits, to mention here. People have to wait for so long at the bus stops, without prior knowledge of the time of arrival of their buses**.** Hence they end up turning late at work. Due to this, people cannot rely on public buses and they have to switch to other modes of transport, which may cost them high. Although bus operating companies provide updated time tables and bus running schedules on their websites, but this information is not timely updated. Moreover, due to traffic congestion, road works, buses get delayed. Passengers should be provided with accurate bus arrival times, so that they can schedule their travel accordingly.

Each technology has its own merits and shortcomings. Methodologies based on GPS-GSM and mobile phone based participatory sensing are reviewed here [1], [2]. These systems have not been fully implemented in India. Mobile phone based participatory sensing is the technology which solves many shortcomings of the previous systems [3]. This is the latest technology which has been implemented in Singapore campus shuttle buses. Public transport is a service available on sharing basis forth benefit of the general public. It includes city buses, trolleybuses, trams, passenger trains, ferries and rapid transit like metro and subways. Unlike transportation modes like carpooling, rickshaws and taxis, this system encompasses an entirety of strangers. The main reasons as to why people choose public transportation over other modes of transport are its subsidized rates, environment-friendly attributes and easy accessibility. Firstly, public transport is very economical allowing a large population to have access to it. Using a bus or train to commute is comparatively cheaper than using private car [4].

If people have their own car, they have to spend lot of money on car servicing, repairs, and insurance. There are many discounts available for some individuals, like students and senior citizens who choose public transport as their transportation option to get to work or go to school. Secondly, public transport can preserve the environment by reducing the amount of pollution. With an increase in the use of public transportation, there will be a reasonable dip in the number of private vehicles on the road, therefore, improving the environment and in addition, solving the traffic congestion issue [4]. Furthermore, public transportation has good accessibility in big cities, making it easier to travel to any part of the city, making buses a favourable option to opt for. It provides personal mobility and freedom for people from every walk of life [4]. Taking into consideration the other aspects of public transportation, there are some downsides to this service as well. Public transportation, by its very nature, is far more time-consuming than any other mode of transportation. Most trainband buses run in accordance with a scheduled timetable. However, these time schedules are seldom followed. There is always an uncertainty regarding the arrival of a bus. Often, buses break down causing further problem to commuters.

Another pitfall we see is that public transportation often lacks organization. Commuters are often confused with regards to bus routes and bus stops. Even if the buses are running on time, they are usually crowded, the reason being, less frequency of the buses. Since the ratio of the buses to the population availing
Public transportation is disproportionate, overcrowded buses are not a rare sight.

With regard to all problems mentioned above, the simple knowledge of bus related information can solve a number of discrepancies related to public transportation. For instance, the time of arrival and departure of each bus, a comprehensive list of bus-stops, etc. can prove to be very beneficial. Hence, an Intelligent Public Transport Management system is necessary to solve these issues. In order to provide necessary bus data tall passengers, this paper proposes a Smart Public Transport System where all relevant information of the bus will be gathered, processed, and presented to the user. This system includes introducing an instalment inside the bus for indicating the approaching bus terminus and the remaining bus route Moreover, the system helps in nullifying the long waiting hours at bus stops. Along with the uncertainty in time, there is also inapprehension regarding the capacity of a bus [5]. Even if the passenger is aware about the arrival time of the bus, they do not know how many additional people can be accommodated inside the bus. The information will be half-baked and hence of no use. Thus, determining capacity of any given bus is equally important to the arrival time estimation. Therefore, by using high-end technologies, like Android and QR code facility, and integrating them with the existing system, we can provide good solution to the issues discussed [6]. To summarize, the system will eradicate the uncertainty in arrival time that commuters face every day and prove to be of great assistance in planning their journeys well in advance.

2. LITERATURE SURVEY

With the advent of advanced technologies a lot of countries have started investing in their transportation sector. As a result, extensive research has been carried out in the past few years. The state-of-the-art advancements in wireless communication and ubiquitous Internet capabilities have encouraged the development of Intelligent Public Transportation Management System. In this section we will survey in brief about the work being done in Information and Communication Technologies (ICT) usage in public transport towards tracking and scheduling.

2.1GPS Tracking in Public Transportation

Automated Fare Collection (AFC) System also known as the Transit Smart Card System provides us an edge over the manual fare collection system by lowering labour costs an also increasing the efficiency of manual fare collection process. The desire to extract more information than just a simple deduction of fare from transit smart cards has led to the research efforts in extracting other relevant information such as points of origin where a passenger would board a bus and have the data recorded as the passenger's smart card is scanned. To accomplish this, a Markov chain based Bayesian decision tree algorithm has been developed in this study, wherein the algorithm is verified with the use of public transportation vehicles that are equipped with GPS tracking and data loggers. Convincingly, it's stated that data collected to represent points of origin when passenger's transit smart card is scanned, is crucial to the process of transit system planning [7].

2.2 RFID in Public transportation for Scheduling

RFID technology mainly includes three components: Freytag, RFID Reader and Middleware logic for interaction with the back-end database continuously. Many applications forbid technology have been suggested over the past few years. However, these efforts have been challenged with regard toothier feasibility, deployment, privacy, security and such other aspects. One such research is focused on applying RFID towards potential passengers passing through a simulated bus door equipped with commercial off-the-shelf RFID readers and antennas, passengers as they board and exit the bus. The research concluded that RFID technology can be effectively used for this type of application; however, there was an issue which hampered the concept. It was found that in case of online of sight between smart cards and reader in accordance with the radiation pattern and positioning of antenna, there might become performance glitches as these factors are very crucial and critical to the whole process of recognition [8].

Research was also focused on how RFID Technology can be used to solve trouble faced by Public Transport authorities especially in metropolitan cities by doing research for enhancement of automated tracking of buses that can be very useful in providing useful estimates regarding bus arrival times and intern provide improved passenger convenience. A real time tracking and monitoring system is employed which utilizes framework of Event, Condition and Action (ECA). This proves to be helpful in filtering data effective to remove all the unwanted or inaccurate details and then categorize useful data by clustering. Utilization of collected data for prediction of bus
Movement is also discussed in an effort to improve the tracking system and in turn enhance travelling experience by Public Transport [9].

2.3. Hardware Based Approaches

Many hardware based approaches have been proposed to solve the problem of bus tracking and

scheduling. Most of the approaches use the same basic architecture: Micro controller, GPS module, GPRS/GSM Modem. All these are bundled together to form an On-Board Unit (OBU) which is fitted onto the bus. The GPS collects location data which is sent to the micro controller which in turn sends it to the GPRS/GSM Modem, transmitting data through wireless cellular network tithe back-end server. The back-end server is responsible for processing all the incoming data and extracting meaningful information from it like dynamic route tracking. Pham, Micheal, Chi [8] suggest a novel vehicle tracking system consisting of the GPS module, which is used to obtain the vehicle's coordinate and the GSM modem, which is used to transmit the location to the user's phone through the mobile network. The Global System for Mobile Communications (GSM) is the second-generation digital cellular mobile network [9].

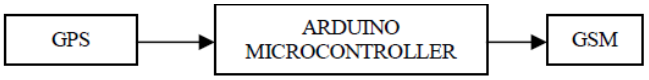

Fig1.Inside Bus Module

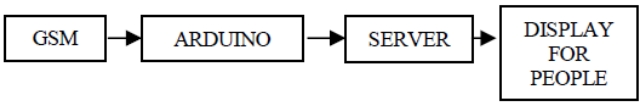

Fig2.Bus Stop Module

It is widely expanded around the world. Although improvements to GSM such as the next generation systems have been rolled out to cater for faster data centric traffic, backward compatibility to GSM is still maintained. Due to its broad possibility, it is chosen as the medium for transfer of location information. The simple and inexpensive Short Message Service (SMS) allows users to send up to 160characters. For the purpose of this project, the SMS is more than sufficient for sending the location information. The hardware components used by Pham, Michael, Chi [8] in their implementation include the state-of-the-art u-box NEO-6QGPS receiver module and u-box LEON-G 100 GSM module. A micro controller, the Adriano Uno [10] is also employed to control both modules and to provide an easily customizable platform for any required application. Other micro controllers like Adriano Mega [10] and Raspberry Pi are also being used for the development of vehicle tracking applications on a large-scale .These boards provide an easy user-friendly development environment to create effective applications in a simple manner.

3. SYSTEM MODEL

Hardware approaches to ITS are too dependent on the quality of the sensors and the micro controllers used. Moreover flexibility of such approaches is also less along with the complexity involved in the bundling together of the various components into a single hardware framework. The hardware based methods also suffer from problems due to electrical noise, maintenance, wear and tear etc.

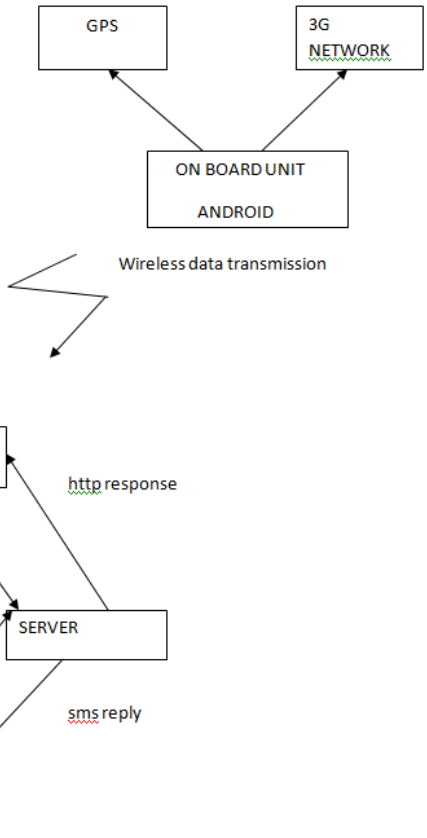

Fig3.Block Diagram of the System Model

We propose a simple Android and IOT based approach which can provide dynamic bus tracking information to the bus-stops as well as into the commuters in an efficient manner. We propose an architecture which is basically divided into three parts. The On Board module which consists of an Android Smart phone equipped on the bus, basically used to track the position of the bus using the inbuilt GPS of the phone. The collected location information is then sent to a server using 3G network of the phone. The backend consists of a server module which receives continuous data from the On Board Unit. The received data is used to extract meaningful information which is then used to service various queries. The client module consists of an Android applications well as a SMS based system which can be used by commuters to track the location of the bus in real-time as wells plan their journeys in advance. Apart from this we also propose installation of static QR codes on each bus-stop. Arcades prove to be an effective measure to provide information to passengers regarding the buses going through that bus-stop.Fig.1 shows the complete block diagram of the

proposed architecture in an abstract manner. It provides further insight into the working of the complete system as a whole.

We present a very basic implementation of the proposed concept using Android OS. We have used Android Studio version 1.0 [11] tested on a Android Phone supporting minimum API 15 (Ice-cream Sandwich).By targeting API 15and above ensures that the application will run on approximately 90.45% of the devices that are active on the Google Play Store. We have also used php My Admin version4.0.10 as the Web Server.

3.1 On Board Module

Combining separate GSM/GPRS modules together to Forman integrated unit is a tedious task. We can take advantage of the fact that these components are already inbuilt in our Smartphone's. Given the fact that most people nowadays use Smartphone's and that they are available at a reasonable price makes this approach viable. We propose an application based on Android OS utilizing the inbuilt GPS to track the location of the bus continuously and push it to a server on a frequent basis. Once the application is started for the first time, an interactive Activity [12] pops up asking for the detailed description of the particular bus route.

Once the bus reaches the destination the application can be reset by clicking on a button by the driver. After this the application begins tracking the route of the bus again in similar manner as described above. The Smart Phone can be powered by using the 12 V battery of the bus. Since there are issues regarding usage of GPS due to high battery usage and inability to use indoors, we propose to use a combination of NETWORK PROVIDER and GPS PROVIDER service of Android OS. Our algorithm will dynamically switch between both providers according to need. Along with this we can also take advantage of recently launched off line mode of

Maps.
The provider switching algorithm works as follows:
 if gaps enabled
o Get location using GPS PROVIDER.
 if network enabled
o Get location using NETWORK PROVIDER.
 if both gps enabled and network enabled
o if accuracy(gps) > accuracy(network) then
 Get location using GPS
PROVIDER
o else
 Get location using NETWORK

PROVIDER

The calculation of distance as the bus is moving is done byusing a simple algorithm which we call as ArrivalTimeAlgorithm.

3.2 Server Module

The Web Server module forms the core of this proposed system. It serves as the back-end tool. The server contains all the information about the routes of all the buses as well as the intermediate bus stops on the route. The server also processes request from a client regarding the estimated arrival time of a bus at a particular bus stop. The server maintains a database of information pertaining to the buses, routes and stops in the form of tables. The server database can be organized in many ways, to reduce memory requirement, improve access speed, or reduce the number of queries. We have used LAMP [13] server in our implementation. The Android application installed on the bus sends in formation to the server in JSON [14] encoded format which is stored in the tables created on the server using MYSQL [15].As soon as the information reaches the server a PHP script is invoked which is responsible for updating this information.

As the bus is travelling on its desired route the server constantly updates the Left From Station and Next Station columns in the tables so that if a user queries about the availability of a bus at a required bus stop , using the data in the tables appropriate response can be generated and provided tithe inquiring user.

The server is multi-threaded in nature and hence can process multiple simultaneous client requests at a time. As soon as a client request comes in, the server creates a thread to serve that client. The thread is then responsible for handling all communication with that particular client. After the communication is over the thread goes back to the pool.

3.3 Client Module

Despite a lot of development in IT'S in the Public Transport sector, the communication gap between a regular user and the information generated from the system remains abridged. Our implementation is aimed towards bridging this gap. We propose to develop an application on the client side which cane used to dynamically track the location of the bus and availability at a particular bus stop along with the ETA. As result commuters can plan their journey in advance. Also the uncertainty and long waiting hours at the bus stop incompletely avoided by this approach.

4. CONCLUSION

This paper presented an efficient framework of Intelligent Public Transport Management System that dynamically tracks the location of all the buses and estimates the arrival time of the next bus on the bus terminus. The estimates are updated at regular intervals,

every time the bus sends an update to the server. It distributes this information, on demand, to passengers who send request using a smart phone application or through SMS. The issues with traffic can be curbed as more and more people will opt for the efficient and economical public transportation as a medium of travel on a frequent and regular basis. With the information on demand service, the commuters can plan their journey well in advance, hence saving a lot of time and making the individual more productive. The commotion of the next arriving bus terminal is also solved by the in bus display module which will give details of the route at regular intervals. To conclude, this system assists commuters, drivers and also the administrators of the transport system in a very convenient manner.

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