

Implementation of Smart Bus Tracking System Using Wi-Fi

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ABSTRACT: Now-a-days about 60% of the people are making their transit as a Bus. The services of real-time tracking and arrival time prediction of buses is a very useful for bus riders, especially in cities. On the other side, the traditional GPS-GSM based solution does not work in rural areas due to poor signal strength and network connectivity issues. RFID based tracking system are costly and hard to implement this type of system. In this paper, we present the solution for Smart tracking system for buses using Wi-Fi and the real time tracking Mobile Application. The system consists of Wi-Fi routers at some Access Points say at Bus terminals and the Wi-Fi module in the buses. When the bus come to the bus terminal, the Wi-Fi module gets connected to the router and sends the address i.e. latitude and longitude of the bus terminals to the cloud then the data is retrieved from the cloud and displayed to the user in the mobile application, also gets notified when the bus is nearer to the bus terminal.

KEYWORDS: Smart Bus Tracking System, Internet of Things, Wi-Fi module, Router, ThingSpeak, Android App Development.

I. INTRODUCTION

In the way people move to commutes in public transportation systems is the main problem which play an increasingly important role. It is a very cheaper way of transport. Due to heavy traffic and roadwork etc., most of the buses are not in time. At the bus terminus people have to wait for long time without having knowledge of when the bus will arrive. Anybody who wants to use the public transportation system, they can't find the time of arrival of particular bus at the particular destination even plan their departure from home accordingly. Due to unexpected delays in traffic jams the bus arrival time cannot be predicted. Our main aim is to develop a system to which the user's waiting time reduced for bus and will provide him/her with all necessary details regarding the arrival/departure time of the bus, its exact location and when the bus is nearer to the bus terminal. So to find out the current location of a bus and the dynamic arrival time a systematic tracking system is required. For best tracking result, GPS and GSM technology can be used. For tracking a vehicle the GPS and GSM based system can provide all specifications that are necessary. Our proposed system can find the location of the bus and inform the central controller at the bus terminal. Once this information is uploaded in the cloud and then the commuter can access the information via the mobile application using internet even at their homes or any work place. Additionally, our system also provides a mobile application which is interfaced with Google Maps which displays all transmitted information to the end user along with location of the bus on the map. A mobile application has an internal global timer which refreshes the tracking application after every twenty seconds and collects the latest location and other customized vehicle parameters and updates the end user with the latest information of the bus. By helping commuters move from single occupancy vehicles to public transportation systems, it can reduce traffic congestion as well as environmental impact. Our goal is to increase the public transportation and satisfaction of current public transportation users and help to motivate more people to ride. If remote users who wish to use public transportation had an easy way to see which bus is near

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to their location and approximate time it will take to reach the particular stop, in real time, then they can make a more accurate decision of whether or not to wait at a stop. Our proposed system will provide pedestrians with this convenience. The location of bus is determined by using Wi-Fi module and then the information is transmitted. The transmission can be through the router. Once the location data along with other custom data is collected a wireless communication system (router) is used for transmission purpose.

II. RELATED WORK

A. INTELLIGENT BUS MONITORING IN MALAYSIA

A box called black box contains RFID reader, GPRS transmitter and GPS is installed in the bus. As the bus approaches the bus terminal with an 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, 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 data from GPS and RFID are sent to database through GPRS. But the RFID is not cost effective and also the poor connectivity to the network through GPRS in the remote locations [1, 7].

B. UNIVERSITY BUSES ROUTING & TRACKING SYSTEM IN SAUDI ARABIA

Taibah University developed an android app to improve the transportation services for bus for its University 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 i.e. smart phones. It would give the students about the exact time of arrival and departure of buses on route. This app would only be used by students and drivers of Taibah University. Any change in the time table of the buses would be updated in the app. Regular alerts would be sent in case of delays or cancelation of buses. Bus locations and routes are shown on maps using Google maps. The application is designed and tested where the users assured that the application gives the real time service and it is very helpful for them. The major usage is GPS and GIS 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 [2].

C. GPS AND GSM BASED PASSENGER TRACKING SYSTEM IN INDIA

A Global Positioning System (GPS) and Global System for Mobile communication (GSM) based tracking system consists of GPS and GSM which are installed inside buses. It tracks by using ticket number of passenger and show the location in Google map. The GPS gets the satellite lock and starts locating the coordinates i.e. it gets the latitude and longitude of the location and the retrieved data is sent through a SMS or it is sent through GPRS to the cloud and also can get the location in the Google map. This is very common system which we use for the tracking the buses. But the limitation of this system is in the remote locations we do not have the signal connectivity to send the data to the cloud [3, 4, 5, 6, 8, 9, and 10].

III. SMART BUS TRACKING SYSTEM USING WI-FI

Management of buses of public transportation system is the main problem now a day. Based on to the current system there is no such system which provides information about the bus, its expected arrival time, the expected waiting time for bus and what is the current location of the bus. Our system provides the relevant information regarding all the bus numbers going from user's source & destination along with the route details, real time location. We also surveyed many commuters and the bus terminal officer to understand the problems in implementing smart bus tracking system using Wi-Fi and given in the Table 1.

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Table 1 – Survey Results

Name	Profession	Question Imposed	Problem found in existing solutions.
Mr. Vijay	Govt employee	How convenient is bus to travel?	I tried to get information and bus timings but nowhere information is available.
Mr. Rajesh Kannan	Technology expert	A smart, public bus information system Using GPS module, Arduino board and a GSM modem. GPS module, Arduino board and a GSM modem	Arrival time predicted is not reliable and not implemented.
Mr. Suresh Kumar	M.Tech Student	Box system tracks the bus location using GPS technology and transmits the data to the connected server. GPS and SMS infrastructure	Varying traffic condition and this system is not tested in real time.
Mrs. Nagamani	Home Maker	How can I know the timings of School bus/College bus coming to the bus stop?	Can it be known by using the Android application which is to be installed in the mobile?

From the above survey we have understood that the devices should be user friendly and should have low maintenance. It should be affordable. The major challenge is to convince the commuters about the importance and advantages of the device.

IV. ARCHITECTURE OF SMART BUS TRACKING SYSTEM USING Wi-Fi

Generally our system is operated by Wi-Fi module which is installed in the bus. Firstly when the bus arrives to the bus terminal the Wi-Fi module gets connected to the router which is installed in the bus terminal. The location is determined with the help of latitude and longitude of the bus terminal and transmits that data to the cloud through the Router. Generally remote user can access this information of a bus based on user's source and destination. This work gives the real time location of bus. Bus tracking technology is advantageous for tracking and monitoring a bus in Figure 1.

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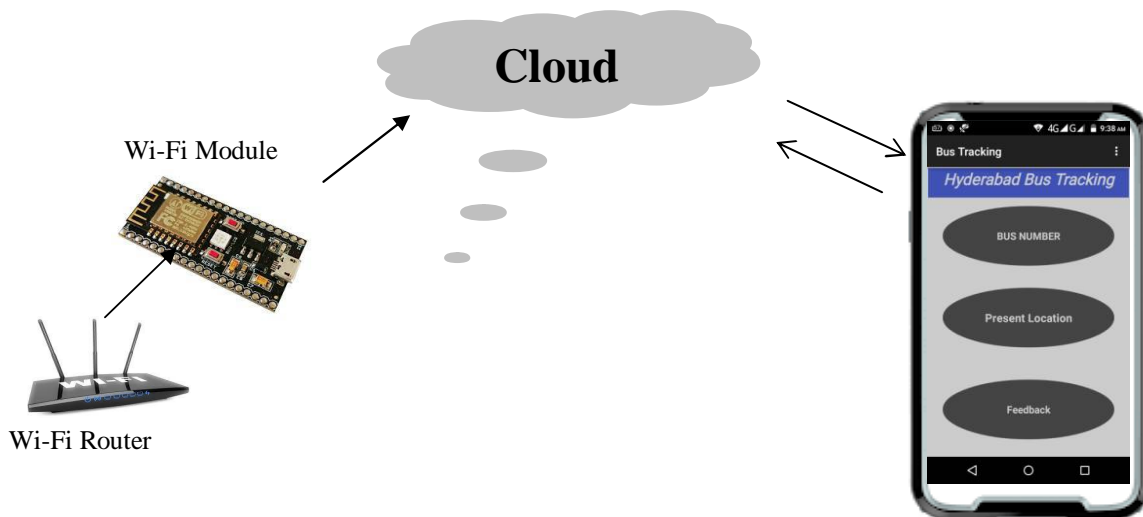


Figure 1: ARCHITECTURE OF SMART BUS TRACKING SYSTEM

A. Wi-Fi Module

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 & 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 timestamp which is then compared with the previous coordinates and if there is any difference then the coordinates are updated and sent to cloud (ThingSpeak). The location details are stored in cloud in the format such as ID (Bus number), longitude, latitude, timestamp etc. To identify each bus uniquely among the various buses here list picker in mobile application is used for identification. 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.

B. ThingSpeak

Cloud whose task is to upload all static information about bus i.e. to collect the data of the latitude and longitude from the Wi-Fi module and analyse the data which in turn send it to the mobile application of the user. The cloud we used is ThingSpeak. ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyse live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.

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- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software.
- Automatically act on your data and communicate using third-party services like Twilio® or Twitter®[11].

C. Thunkable App Inventor

The user side module is nothing but an interactive mobile application which services the various function of system to remote users. The user side module takes two inputs i.e. one is source which indicates where the remote user is now and second is destination which indicate where he/she wish to go . When user send a request the application fires a query to the cloud for accessing the information stored in cloud and gives the list of available buses according to remote users source and destination. Now it's user's task to select or choose particular bus number to know the real time location of bus or other information. After selecting a particular bus number the application shows the real time location of that bus on Google map. This application gives support and interacts with various clients to provide service to user's requests. The system facilitates the real time tracking of bus. This application is designed and developed so as to provide the remote user with all the necessary information as to which buses from the source will go to his destination along with their routes and exact location. The user side module and admin module is implemented using Thunkable App Inventor and ThingSpeak cloud for storing and retrieving the necessary details respectively[12].

V. PROPOSED ALGORITHM

Initialise the Wi-Fi Router and the Wi-Fi module in the bus terminal and the bus respectively. When the bus comes to the bus terminal the Wi-Fi module get connected to the Router and data is sent to cloud through Wi-Fi module and retrieved in the mobile application.

1. START
2. Installing ESP modules in each bus.
3. Installing Wi-Fi routers at different nodes which serve as Access points (say at bus terminals) for ESP module.
4. The module when comes in range of Wi-Fi router sends the MAC address and SSID of router to the cloud.
5. The SSID of the router is compared with the stored SSID of all the routers in the system and the physical location of the bus stop is found.
6. This physical location is then shown in mobile application in a map.
7. STOP.

VI. RESULTS AND DISCUSSION

The proposed system is more user friendly than existing systems. And it also gives greater performance than RFID, GPS-GSM systems. In the proposed system the signal connectivity and also the cost are achieved.

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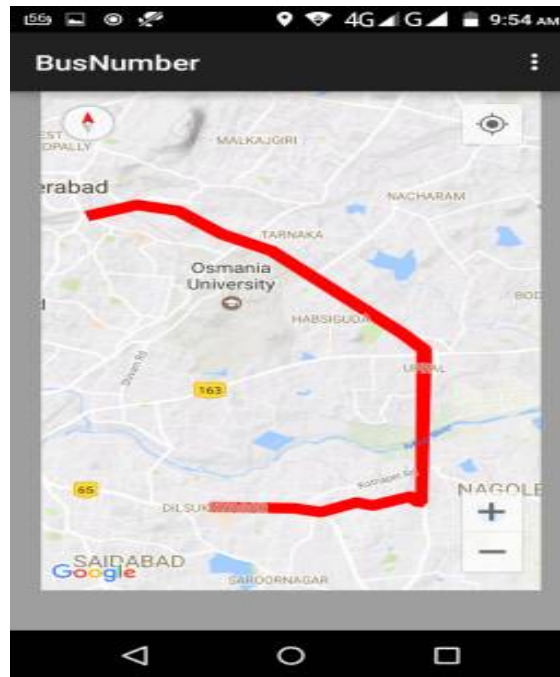


Figure 2: – Bus Route map

The Bus route of the specific bus can be known by the simple mobile application developed, we need to select the bus number by Bus Number button and then the bus number list picker will appear and in that list picker select the bus number which we want to see the Route or Route map of a particular bus. The Route map of a bus is shown in Figure 2.

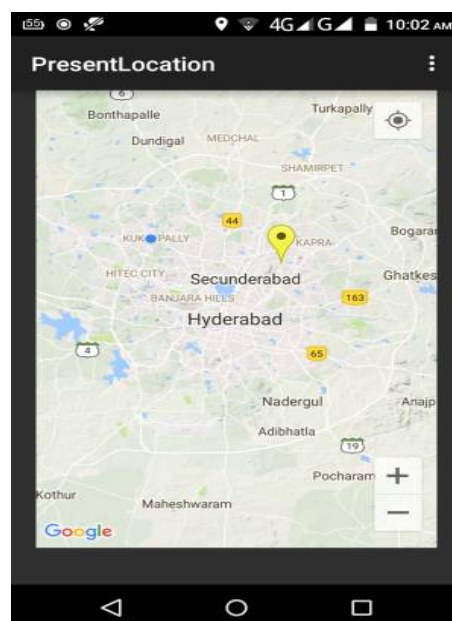


Figure 3: – Tracked location shown in Map

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The present location of the bus can be known by selecting the Present Location in the mobile application and then select the bus number from the list picker and then click on Map which gives the exact location of the bus in the map and also we have integrated the Google maps so that we can connect to the Google map by clicking the Google map icon at bottom right. The present location of the bus which is already located in the map is shown in the Figure 3.

VII. CONCLUSION AND FUTURE WORK

This proposed work is successfully designed, implemented and tested. Our system reduces the waiting time of remote users for bus. With the mobile application we can track the location of bus at any point of time. All the current information is stored to the cloud and it is retrieved to remote users via mobile application. This system is more user friendly for users to get information visually shown on Google Map. User can freely get this mobile application for real time tracking of bus which provide interactive interface environment. So by using this application remote user can just wait or they may reschedule their journey according to the availability of bus. So this paper presents a system which provides high practical value in the modern fast era. The system has high practical value and cost efficient. This work is having a wide scope. A mobile application which can be further modified using cloud with GPS module. Use of video camera to this system would take this system to the next level in the field of security. It will help to monitor the crimes that happen now days which is witnessed by common people every day. This would prove a major breakthrough in reducing the crime rates; with use of motion sensors the speed of the bus can be calculated. Also, with the use of RFID tags we can implement E-ticketing system in the buses.

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