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IoT Based Intelligent Real-Time System for Bus Tracking and Monitoring

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Abstract— **Smart education is the constituent of smart cities. Smart education is the use of computers in the classroom. However, there are many other factors to improve a child's quality of education. One part is the amount of time the child spends on a bus from traveling bus to home. Although, with currently available technologies as the Internet of Things (IoT) and Android, with these advanced technologies we will be able to track or visibility in a child's life. This paper presents the design and implementation of an IOT based system that permits parents, schools and regulatory bodies to track the conditions of comfort and safety inside a bus in a real-time manner. A variety of reports for various activities for bus comfort and attendance are then generated from this real-time providing complete visibility of buses.**

Keywords—B-Tracker, IoT, RFID, QR

I. INTRODUCTION

The tremendous growth of Internet of Things (IOT) has pushed us to have crash on the life of students and most significantly on their education and learning environment. Now days, the ways people travel in public transport system is the reason where the real problem arises. They face lot of difficulties due to lack of time moving from one place to another. Sometimes the mode of transport is available but it doesn't have sufficient capacity to get into it. So buses are widely used transport system for the people. Bus tracking system is a device that not only tracks the bus but also tells about the vacancy of the bus. This system can be implemented in public, private bus services and schools and colleges as well. As many students use buses for schools and colleges so it can be implemented in tracking of students for the convenience of guardians/parents and can also be used for safety of students.[2]

Our main contribution is to develop a system which shows all bus tracking modules with sensors, it shows the real time tracking of buses. The paper talks about the data of both inside and outside of bus, means the tracking and monitoring of bus. The information about each bus is analyzed and results are generated out of it which helps making our system efficient.

Rest paper organized as follows: In Section 2, a literature part is presented and getting important data about the status and environment conditions. The proposed system is the subject of Section 3. System implementation is addressed in Section 4. Conclusions and Future Work are given in Section 5.

II. MOTIVATION AND RELATED WORK

The innovation of this work is to solve the problems of public transport framework in India. India is a developing country with massive population. Here, we face many difficulties in our daily life, for example water, power, house, transport etc. In transportation, for bus every bus is controlled by a conductor. The conductor collects money from each passenger in order to issue ticket. This process is usually slow and takes more human efforts. In this way, to control this issue related to public transport as a civilian of our nation we have chosen to furnish safe and automatic Public Transport System for urban cities.[3]

As we suffer a lot with our public transportation, we limit the issues related to it. We are able to provide some changes in the previous transportation in the proposed system we would providing passengers RFID tag and the conductor used to have an RFID Reader, read the RFID tag. In this system destination should be entered manually by the passenger so that amount would be automatically debited from the tag. At the same time we are providing additional information bus arrival and leaving time and real time position of bus on Google map. [4]

The transport has special feature for handicap to make the use of the bus effortlessly. With the "B-Tracker", users can track the real time bus location which helps them in their daily life for their convenience.

Leonardo D 'Errico [9] says that a system is proposed for the safety of children. Its applicability lies in every day path from home to school and vice versa, and using buses for it. Different techniques like GPS, RFID, and GSM are used for the safety of children and clarification to their parents as well. In this paper RFID technology is tested by tracking and monitoring activities of children from home to school and vica versa. In conclusion a phase of analysis is verified.

Anwaar Al-Lawati [10] says that to observe the pick-up/drop-off of school children for the improvement of children's safety a system is being developed. The proposed system consists of two main modules, a bus module and a school module. The bus module is for identifying whenever a child enters or leaves the bus. It is a database driven application that is used for management and a children details is being provided to an authority. A prototype of the system was developed and tested for the validation of system functioning.

Juan Zambada [11] says that common school bus transportation is being used by many children all around. Any effort is being done to enhance the school transportation systems. It is an IOT based school bus monitoring system. The new telemetric technologies have come up with various intelligent transport systems. Even they are not provided as ITS services to end users. This paper uses many localization and speed sensors that permit many stakeholders such as the government, the school, the parents and other authorities' for the real time tracking of school buses which gives positive outcomes in a controlled way.

Shah Shraddha [12] suggests a real time tracking of children which benefits their parents for the safety. GPS module is used for tracking the location and a RFID card is used for identification of children. When a student enters into a bus, the RFID tag is detected by the reader in the bus and by authenticating the student details; it will send the message of real coordinates of location to the parent's mobile phones. In this manner ,parents knows their child's whereabouts .The paper also presents a security system like drive and drunk prevention system and also the speed control mechanism.

Sanual Haque [13] says that now days Education Institutions are expanding vastly at a greater pace. But with fast technological growth, educational institutes are still lagging behind. They still depends manual handwritten Id cards and files. If an efficient ID card system is used, it is easier for identification of a student and his/her location. So, we use advanced techniques like QR code generation and student ID generation. QR code is scanned and the student's personal details can be generated and using QR code with ID card came up with positive outcomes. With the help of software tools, identity card is useful for educational institution as it is free of cost.

Saranya [14] says that a system provides information about each group of children and not about each individual child which results in less assured for the safety of the child. The system consists of a child unit and a two receiver unit for the missing child information on a regular basis. The child unit consists of GPS, GSM, Voice playback circuit, microcontroller etc.. The second unit consists of Android mobile device and other as for monitoring the database in control room of the school. Therefore, the final outcomes are produced in the end.

SuleymanEken [5] says that time and patience is of much importance for public transportation. It has been experienced by the people that public buses results in time loss because of waiting of bus at their stops. In this system, people can scan the QR code at the bus stand to identify the current bus location and the arrival time of the bus. Any individual can use these maps and can sign up to get free alert messages of bus arrival time and location. They used C4.5 (a statistical classifier) algorithm for getting the bus arrival time to reduce the passengers waiting time.GPS and Google Maps is for navigation and displaying of services.

The Sneha [8] says that the departure information of the bus from the starting point and the passenger can get the total number of stops at which the bus stops. This is implemented using VMD (Variable Message Display) which identifies the bus coordinates and gives this information to the server.GSM module is for sending the notification about the coordinates of the bus who have subscribed for same type of service. An Android device is used for getting the notification and subscribing for a bus. The system is implemented on few vehicles first and later it will be tested on large transportation vehicles.

The bus monitoring device will work as a notification system and will tell the pedestrians that, they should wait for the bus or they should walk to reach to their destination. It tells the Mumbai citizens the real time location of buses. [3, 4] It has the passenger information system that tells proper information about the passengers also, these systems are installed at bus stops; it also tells the relevant users about the routes and cost of each route. As soon as bus comes to its stop it tells its number and routes travelled to receiver at bus stop. The device needs an external power supply and is portable and sustainable.

This paper [15] talks about the transport convenient for people who travel daily using public transport of the city,it also helps Transport Department to create an efficient public transport. It says that there are many applications in market that gives important information about buses and tells routes but this survey gives an aim that why one should build these applications. This helps increasing and improving bus monitoring systems. Aim of this paper was to build comfortable, flexible and easily available bus service so that people can feel public transport much convenient and can shift from private transport to public transport.

III. PROPOSED SYSTEM ARCHITECTURE

Now days, buses are the most conveniently used mode of transportation in our country. It is an android based IOT application which facilitates people to track real time location of bus using raspberry pi controller. The people are provided with an Android app where they can register their details like username, email-id, password and mobile number. After the process of registration, users can login into their profile. After login, it will notify the number of buses on that particular route along with number of vacant seats available. A RFID system is connected with the raspberry pi, GSM and GPS module to notify the location and updated count of passengers in the bus. An updated count of passengers refers to the traffic in that area that facilitates the administrator to increase or decrease the bus services in that area. The proposed system can also be implemented in school buses which helps the parents to check the real time location of their child in the bus. The parents will also be notified using a message that the bus will be arriving in 5 minutes at the bus stop .RFID along with GPS and GSM module helps in sending the message that when their child enters a bus and whenever he/she gets out of it.

A. Android Application used:

For the convenience of people an android application is being developed named 'B-Tracker' that is easily available at no cost. This application is developed in java that requires very less memory in the mobile phones. Android Studio is the software for developing android applications and java code run on this software and is stored in .apk format.

B. Hardware:

Various hardware devices are being used and they are connected using wires for developing the proposed system and data flows to the database. Following hardware devices are used in this system.

a) Raspberry Pi -: Its cost is low and it is debit-card sized computer that inserts into computer monitor and uses standard mouse and keyboard. Raspbian is the official operating system for all models of raspberry pi , but Noobs operating system is used for beginner level users.

b) GSM Module -: It stands for Global Systems for Mobile Communication .GSM SIM900A is built on two frequencies 900hz and 1800hz.The modem comes with RS232 interface which assists you to connect PC and microcontroller with RS232 chip.It is useful for voice ,SMS and data transfer in M2M application. You can also make audio calls, take up the incoming calls and internet through simple AT commands.

c) GPS Module -: It stands for global positioning system. We use Neo-6m GPS module in this system. It is very cost effective, high performance with a ceramic antenna , an onboard memory chip and a backup battery that can be easily integerated with broad range of controllers.It works well with DC input in the range 3.3V-5V. It is used for getting the real time location coordinates of the bus.

d) RFID Module -: It stands for radio frequency identification system. It consists of two main components tag attached to an object for identification and a trans-receiver also known as reader. A reader comprises of a radio frequency module and an antenna which generates high frequency electromagnetic field. Tag does not contain a battery, it comprises of a microchip that stores and processes information and an antenna to receive and transfer a signal.

C. *Database:*

As bus is widely used mode of transport, so that large number of people travels through it. Because of this a huge data is being generated that is stored is database. This can be seen and analyzed by authorities for making the transport system more efficient. The authorized and authenticated persons can only view this data.

D. *System Architecture*

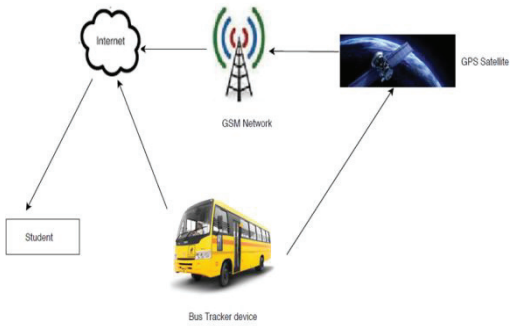

Fig. 1. System Architecture

Figure 1 shows the architecture of proposed system that shows how the system should work.

E. *Algorithm for Proposed System:*

Step 1: Initialize the hardware devices.

Step2. Initialize LCD display unit and sensors.

Step3. If connection is setup properly then:

- If LCD displays the message “Network Found”, it will send the message to the people and they can get the real-time coordinates of the bus.
- Else it will display the message “No Network Found” and will have to wait for the network to come.

Step 4. If a RFID system is working properly then:

- If a passenger goes inside a bus RFID card is scanned with the help of RFID reader and passenger count is increased in the database.
- Else passenger count is decreased in the database.

Step5. Repeat the process if the system doesn’t work properly.

IV. Experimental Results and Working Model

The product B-Tracker has implemented the main goal to track the location of a bus and also add the necessary features into application like accurate bus timings, student arrived date and time, and more on forming a device having GPS and GSM both in it. In this we are implementing functionality of IOT by using raspberry pie and android to formulate the app on mobile phone. We are also adding RFID that could scan the student detail using barcode to detect whether he belong to this bus or not.

The proposed system has two function modules and three user modules:

A. *Function Module:*

- Location Tracker: It gives the real time location of the bus.
- Passenger Identification: It keeps record of the passenger’s details like email-id, password and phone number etc.

B. *User Module:*

- Admin: It manages and coordinates all the activities of the bus.
- Driver: It gives the information to the bus administrator regarding any accident or incident occurring inside the bus.
- Passenger: The number of passengers going inside and outside the bus.

The B-Tracker will send the detail to the bus administrator and mobile devices of the people. People can open the Google map to track the real time location of the bus or can get the SMS notification of the real time coordinates of the bus .RFID system is useful for the identification of passengers. Sensors are fixed on both the doors. Front door is for the entry and back door for the exit. The entry door increases the count of passengers and exit door decreases the count of passengers.

The functionality for different modules is listed below:

- Identification of the people is done by the RFID. Each has their own RFID tag. With the help of this basically students can be monitored by their parents and also by the bus administrator.
- When passengers enters or exits from the bus, the data is updated in the database of the bus.
- With the help of RFID tag, the count of passengers can be viewed.
- Front door is for entry and back door for the exit of the passengers.
- The RFID reader senses the RFID tag and sends and alert message to parents through GSM and GPs module.
- The tracking system details will be sent to the people and to the people as well.
- The GSM and GPS module is used to send the alert SMS notification to people and bus administrator.
- The LCD display is displaying messages of events of the proposed system

Working Model:

Fig. 2. Working Model

Figure 2 shows the working model of proposed system where the raspberry pi plays a role of central unit of processing.

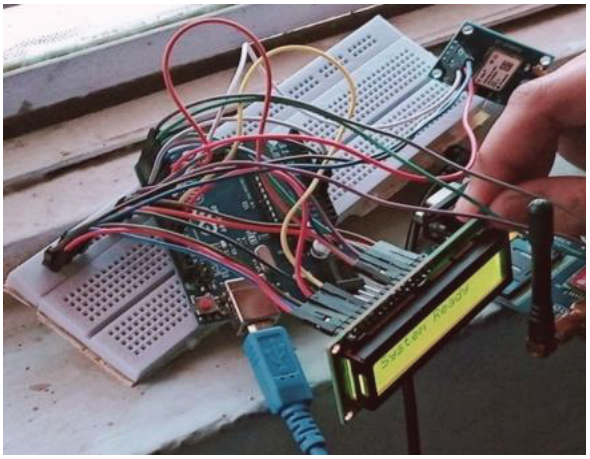

Fig. 3. Circuit Diagram of Proposed System

Figure 3 shows the circuit of proposed system that has the display unit, shows real time data of the processing of the system.

V. Prototype Results

The locations of buses are tested on different applications. They are tested on their reliability to perform in real time and provide the live results to the users. The accuracy of the hardware is also tested with the software. Hardware and the software has been tested together for their stability on communication with one another. The features are also tested on the face book and YouTube live with the features of live comments or complaints.

In figure 4 the route is visible in Google Earth from University to UTHM main campus. GPS device gives out signals in 'GPGGA', 'GPRMC' and GPGSV format. Positions on a map are then displayed when the received signals from the GPS device is translated. Gps Gate provides the option of using Google Earth. Google Earth could be used as a platform to display the latitudes and longitudes. Signals from the Gps Gate are translated and an icon named "Bus UTHM" is displayed for real-time navigation on Google Earth.

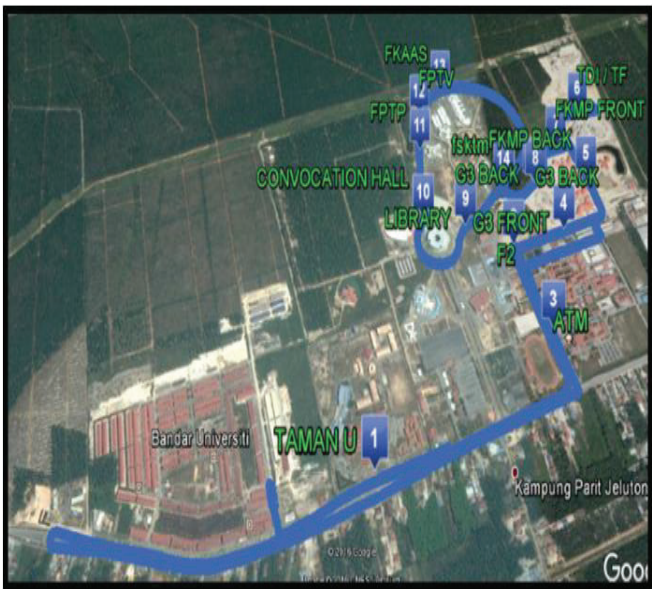

Fig. 4. Bus route in Google Earth

In figure 5 the snapshot of the YouTube stream is visible on the Many Cam software. The software is used to record computer screens, which are broadcast to users. The software has the feature to resize the resolution of screen from 144p to 720p. It could record live screens or footage and customize the screen with effects. At the bottom of the screen the title bar is visible that says "KATSINI UTHM" which could be customized. For the bus route a blue color line is displayed. Many other buses could also be fixed with names 'uthm1', 'uthm2', 'uthm3'.

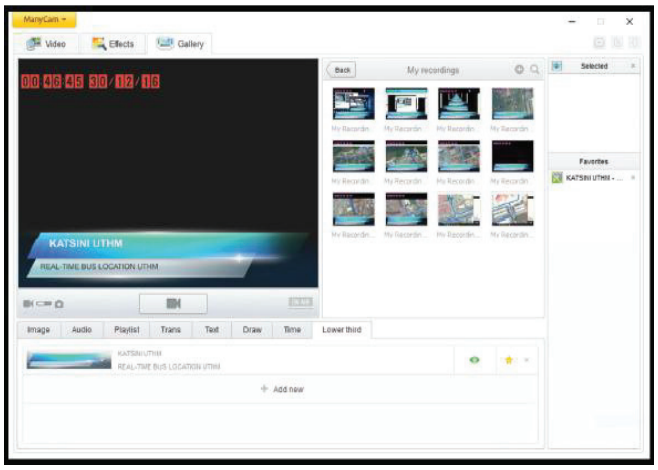

Fig. 5. Many Cam software for YouTube live

Figure 5 shows the you tube live where user get the real time live information of the vehicle.

VI. Conclusion and Future Scope

A. *Conclusion:*

This technology is an example of interaction between machines and humans. It helps in minimizing the gap between human and machine capabilities. This technology uses application, protocols and IOT.

There are many issues faced by the bus due to which its movement gets affected such as road or traffic blocks, delays that are unpredictable and due to irregularities in vehicle dispatching time. This technology uses Real Time Bus Tracking to track the bus location constantly in real time. GPS device is installed on the bus which reads the location of buses in small time interval. This data is passed to a microprocessor which analyses and stores the data on web servers. Real time data can be now displayed to the user through web servers. An RFID technology are also added for providing information on the number of passengers in a bus at any time and provides information on the number of vacant seats.

This technology provides real time information on bus location and passenger which helps the travelers to decide if they need to wait for the bus or not. Hence it reduces the waiting time of passengers by the help of Global Positioning System (GPS).

Estimated time of arrival is also provided to the users along with the current location. The estimated time of arrival is calculated and is provided to the user through mobile application.

B. *Future Scope:*

GPS devices are affordable nowadays and are not limited to big enterprises or government agencies. Demand for such trackers is high and as a result the prices are low. These devices could be produced for small companies and even individuals.

Businesses could use vehicle tracking for assessment of driver's performance and give the travelers best experience. In the near future vehicles could use tracking devices which would prove efficient in saving time as it reduces the waiting time for the travelers.

Tracking systems could be used by individuals. Family members could monitor the teen drivers in the family. Trackers could also be helpful for ensuring the safety of elderly and could be monitored anytime they are away on road.

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