Smart Bus for Smart City using IOT Technology

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Abstract: Trustworthiness in public transport is of great importance today. Citizens who uses public buses waste a lot of time waiting for the bus at bus stop. In daily operation of a bus system, the movement of buses is affected by unknown conditions as the day progresses such as traffic or dispatching buses at irregular time from the depo. If people travelling by bus get exact location of bus and the approximate arrival time based on normal traffic conditions and also the count of passengers in bus it will increase the trustworthiness in the public transport. This paper proposes a system to track public bus using GPS (Global Positioning System), tell the count of number of passengers in bus and also the estimated time arrival to the user. The Location of Bus can be tracked by public using Android Application. The Android application will also contain the details of all the bus like Bus number, Bus routes, Bus Stops, Bus timings or the frequency.

Keywords: Internet of things, IR sensors, GPS, GPRS, public transport, bus tracking, Android

I. INTRODUCTION

Nowadays, due to increase of population in cities there is a need to make a smart city. The Smart City includes major changes in city life like public transportation, development of roads, electricity in houses, streets, commercial places and water supply. The current public transportation like city bus should be upgraded. The city bus at the movement is not trackable for public but only for the bus authorities. The people have to wait for bus at bus stops for long period or till the bus comes. The Timetable has the information like bus number, and where the bus is going from the specific stop and the frequency of bus. If some passenger waits for long time it must have happened that bus fails during an ongoing journey. So, at present in PMPML the conductor calls the depot and informs them about the failure of bus and in this case conductor wait for the bus which is coming towards their direction of destination and then the passengers from the failed bus are then deported in the coming bus after verification of ticket which is lengthy process. So, for this reason we are going to develop a smart bus by using embedded system. We are going to track the bus using GPS to get the exact location of bus. We have installed a microcontroller Arduino UNO in bus which is connected with GPS with wire and it is also connected with IR sensors on both IN and OUT doors with Bluetooth. The Arduino UNO is connected with the app of conductor which is android based. The whole set of bus or the embedded system is connected to the cloud server.

And there is an Android Application for public or Bus user which will help to track bus and get the exact location of bus, the vacant seats in Bus and will also contain a small database of bus' timetable. The Timetable will contain Bus Number, Names of Bus stops will also help to search source and destination and give the information about which bus to catch. The application will also tell the estimated arrival time (ETA) of bus to the user and calculating it by using Euclidean formula. ETA is calculated when user is standing on bus stop and the nearest bus coming towards the bus stops at which user is standing. Further we are going to set a frequency for buses so that some trips might be saved. It will be done by using K-means clustering Algorithm.

This paper presents a system for public transportation which is successful in producing an intended or desired solution or result.

II. EXISTING SYSTEM

The public transportation is the main source of transportation for the people. It saves the utilization of fuel and is also inexpensive. Many offices commuters' school going students, university students use public transportation as the main source for going to their specific destination.

Currently, at present the public transport buses are tracked using GPRS i.e. General packet radio service device. It is a wireless data service built on existing GSM network. GPRS device works by allowing data to be stored in Packets. This data is then transmitted in an efficient manner across the mobile networks. A GPRS device has the capability to allow users to have mobile communication and also have the internet connections. GPRS device track the location by fetching the relevant information from nearby GSM cell station. The reason public transport should use GPRS device is that it is a two-way communication between dispatcher and driver and the ability to track location information and vital vehicles statistics.

The time table declared by PMPML is on the official website or the poster which is stickled on the Bus stop. The Website contains all the information of PMPML buses which are travelling across the city. But the poster on Bus stops

contains information of buses which are going to pass by the specific bus stop. Sometimes the timetable changes according to the requirement of people without giving any prior notice to the citizens. The posters which are stickled on bus stops remain same all the time or maybe throughout the year. Only timetable which is on the website is updated. So, many times it so happens that people follow time table which is stickled on bus stops which leads in increasing waiting time.

The frequency of Bus' which are set, are based on the requirement of the people. The Survey was constructed manually by getting information about crowd or traffic from the bus conductors, drivers and the ticket checker. At present the frequency is high in morning from 7am to 11am and in evening from 5pm to 9pm and there is low frequency in early morning, afternoon and in night after 9pm.

And in case of Bus failure the conductor calls the depot manager and tells them to send an alternative bus and till the alternative bus comes the conductor helps passengers to get into the bus which is coming towards that direction.

III.   PROPOSED SYSTEM

This paper proposes a system for tracking city bus using advance techniques which are capable to deliver results and the information in a rapid and efficient way.

We propose the bus tracking system on Android Application. It proposes the advance and latest techniques for the existing System.   The system will replace GPRS, the traditional way of tracking the bus by using GPS system. The GPS will give the exact location and co-ordinates of the Bus. The GPS will be connected to the microcontroller Arduino Uno. The Arduino Uno has web connectivity using GSM/GPRS module. The Arduino Uno is placed in a bus. The bus will have four IR sensors each pair at front and back door. The IR sensors will count the number of passengers getting into the bus and it will also decrease the count of passengers when they are going out of the bus. Both the IR sensors are connected to the Bluetooth and it sends data to Arduino Uno via Bluetooth. All the information collected by Arduino Uno like location, number of Passenger will be updated on Cloud Server. There will be an android app for public so that they can track the Bus and also see how many passengers are present in the bus it will also tell the estimated arrival time of Bus. The application will also contain information of Bus like, details of Bus, identity number on which it stops, halts, route etc. It will also help search the bus by putting required information like source and destination. We will be using Euclidean Distance formula to calculate the Estimated Arrival Time which will be shown on an Android Application. Further we are going to use k-means clustering algorithm for setting the accurate frequency of Bus so that no trip of any bus gets wasted.
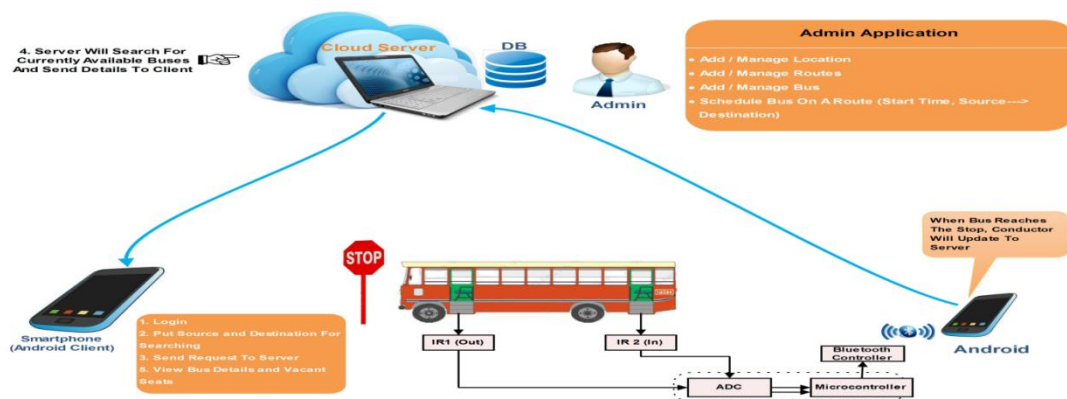
1.   K-means clustering Algorithm

K-means clustering is vector quantization method that is popular for cluster analysis in data mining. Medians are used rather than mean because this minimizes the norms.

We will be surveying around 10 routes in different timings like in Morning, Afternoon and Evening. From this survey we will come to know how many people travel in a particular route in given time and also the frequencies of bus. So, we will be applying k-means clustering algorithm to form three clusters.

The first cluster will consist of data where the crowd is maximum. This means, in this cluster we will have those entries where people travel the most in a particular route at a particular time.

The second cluster will consist of data where crowd is minimum. This means, in this cluster we will group those entries where people are less in a particular route at a particular time. At this time the bus will be partially filled of less than the half of its capacity.

The Third cluster will consist of data where the crowd is moderate. It is not over crowded neither is it empty. Here the number of people travelling in a bus at a particular time are manageable and there is no inconvenience caused to anyone.

After using the data from above clusters, we will be able to assign an appropriate set of frequency for bus in specific time. This will also help to prevent the loss of trip when demand for bus is low and also help to increase the frequency when demand is high. This will restore the faith of citizens in public transportation.

2.   Euclidean Formula

This formula will help us to calculate the estimated arrival time of bus. It will be calculated by using longitude and latitude of bus and the passenger who is standing on the bus stop.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \ .$$

We will take latitude as x-axis and longitude as y-axis. So, here x2 will be latitude of bus, x1 will be latitude of Passenger standing on bus stop. Similarly, y2 will be longitude of bus, y1 will be longitude of Passenger standing on bus stop. Applying the formula and after square rooting we will get the answer which will be estimated arrival time of bus.

Estimated Arrival time is calculated for the bus only which is coming towards the bus stop on which the passenger is standing. Considering approximate time for signals on route and moderate traffic.

A.   System design

The figure 1 shows the block diagram of the system. The system shows three levels: -
Hardware Level:-
It contains the technologies which we are going to use in bus like Arduino Uno, GPS, IR Sensors and Bluetooth.
Admin Level:-
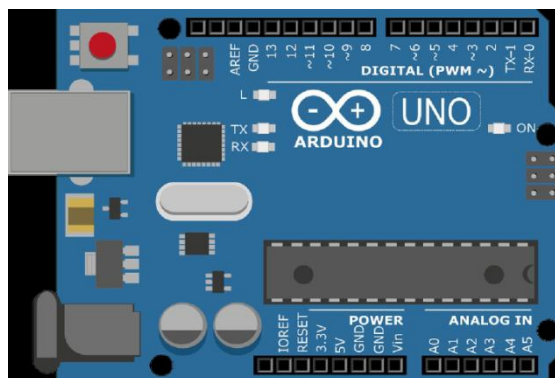It contains thee cloud server which helps Hardware level to communicate between user level.
User Level:-
It a android application which helps user to get all the information related to Bus
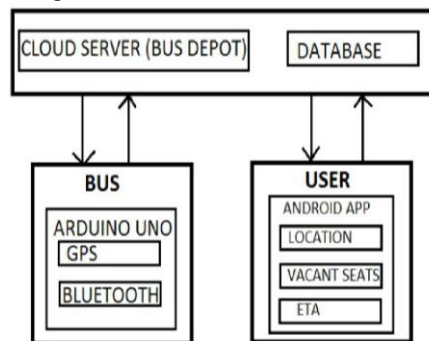
b. The technics and technologies used are briefly
Explained below

1) ARDUINO UNO

The Arduino Uno Board which we are going to install in Bus near the driver.

The Arduino Uno comes with the following features:

● Microcontroller: ATmega328
● Operating Voltage: 5V
● Input Voltage (recommended): 7-12V
● Input Voltage (limits): 6-20V
● Digital I/O Pins: 14 (of which 6 provide PWM output)
● Analog Input Pins: 6
● DC Current per I/O Pin: 40 mA
● DC Current for 3.3V Pin: 50 mA
● Flash Memory: 32 KB of which 0.5 KB used by bootloader
● SRAM: 2 KB (ATmega328)
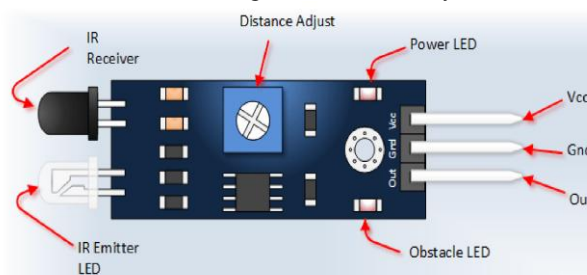● EEPROM: 1 KB (ATmega328)
● Clock Speed: 16 MHz
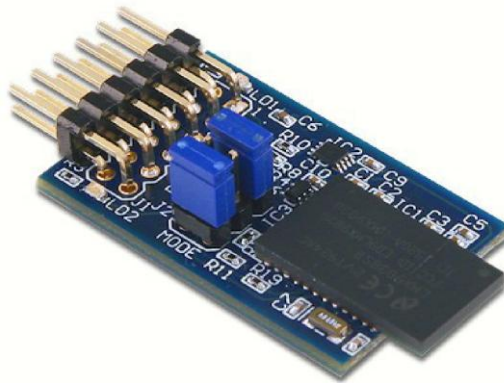
2) GSM/GPRS Module

A GSM module or a GPRS module is a chip or circuit that is used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. These modules consists of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. GSM/GPRS modem is a class of wireless modem, designed for communication over the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network.

3)IR Obstacle Detection Module

● Vcc - 3.3 to 5 Vdc Supply Input
● Gnd - Ground Input
● Out - Output that goes low when obstacle is in range
● Power LED - Illuminates when power is applied
● Obstacle LED - Illuminates when obstacle is detected
● Distance Adjust - Adjust distance. CCW decreases distance. CW increases distances
● IR Emitter - Infrared emitter LED
● IR Receiver - Infrared receiver that receives signal transmitted by Infrared emitter

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4) Bluetooth

Bluetooth is a standard wire-replacement communications protocol primarily designed for low-power consumption, with a short range based on low-cost transceiver microchips in each device. Because the devices use a radio (broadcast) communications system, they do not have to be in visual line of sight of each other.

IV. CONCLUSION

The conclusion of this study suggest that knowledge of specific domain improves the results. This Project has been implemented on Android platform. Also, different attributes have been added to the project which will prove to be advantageous to the system. The requirements and specifications have been listed above. This project is implemented using Android and the data mining domain. Using the GPS system, the application will automatically display the maps and routes to the different locations and also track the bus location using client-server technology and forward it to the client device. It uses basic measurements of distance between two locations and provides necessary details of each and every route for people to easily pick up buses or any other conveyance possible on the specified route. Specific location details are provided to the user along with bus no. so that the person can identify the bus correctly. It uses remote server as its database. Due to this the records can be easily manipulated on the device itself and the server burden gets reduced.

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