Intelligent Bus Tracking and Passenger Counting System

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Abstract : In the 21st century majority of the human race uses transportation daily to commute to various places. A significant portion of daily hours are spent commuting , hence the transportation system needs to be efficient and effective. Various problems such as an irregular bus schedule and overcrowding are faced by the public transport systems in major cities in India. To overcome these problems a GPS based tracking system and IR sensors based passenger counting system is being used.The proposed system lets the passengers track the bus on a particular route by getting the information sent on their cell phone. The real-time location of the bus is provided along with the approximate count of the number of passengers riding on the bus. This allows the passenger to know the estimated time of arrival(ETA) of the bus and gets the information about whether the bus is crowded or not. This allows the passenger to decide whether to wait or the upcoming bus or would he/she will have to ride the next bus after that. This also leaves them with an option to pursue other means of transport immediately rather than wait for a long period of time waiting for the bus and then deciding otherwise. This reduces the time and effort by a huge portion and makes the journey comfortable.

Index Terms **- IoT, Node MCU, Arduino, GPS, IR sensors.**

I. INTRODUCTION

The population of India continues to grow at a rate of 1.13%. As the nation is developing, rapid urbanization is taking place. It is predicted that by the year 2030, 40.76% of the country's population will be residing in the urban areas, according to a survey conducted by the UN State of the World Population. Many major cities are experiencing a rise in rural-urban migration. There is an influx of migrants from various parts of the country to major cities which puts a strain on its transportation systems.The middle-class working population is heavily dependent on public transport for the daily commute. Train and bus transport system comprised of a major role in public transport. Road transport incorporates bus transport systems. Busses make up to 90% of the total public transport in Indian cities. Services are mostly run by state government owned Transport Corporation Bus timings though available are not strictly followed in major cities.Bus passengers commute can be made easy if they are informed about the arrival of the bus beforehand.Most passengers aboard the first bus which arrives and it gets packed to its full capacity as the passengers are unsure about the arrival time of the next bus. This sometimes leads to over congestion in the first bus while there may be a vacancy in the following bus. Overloading of vehicles makes rides uncomfortable. This creates a dissatisfaction amongst the passengers as they have to travel in an arduous way.

This has led to a rise in privately owned vehicles which in turn causes more congestion on roads. Lack of passenger information and inadequate technical capacity adds to the problems faced by the city bus transit system. To overcome these issues, in our proposed system we provide information of the position of the bus and the vacancy level of the bus.

II. REVIEW OF LITERATURE

In most of the research papers, bus tracking is being implemented by using GPS. The advantage of using GPS is that it provides real-time tracking and instant status observation, remote-informing and updating related to the management of the status and travel of public transportation vehicles. In this system, [1] the information from the GPS module was passed on to the central server and presented to the user in the form of mini-computer based systems and digital monitors. These devices were installed at the bus stops and provide the commuter the status of the public transportation system and the arrival of the nearest vehicle to the related bus stop. Authors in [3] have also used GPS as their primary tracking technology however, they

have used Android devices and Google API's to relay the information regarding the public transportation system to the user. They have used two applications, one for the client and the other for the server. In this design [4] with the help of GSM Module, GPS Module, and microcontroller the user can gain the data about the location of the bus by calling the number of SIM which is present in the tracking system. The call will be disconnected after two rings and the user will receive an SMS, it will provide the longitude and the latitude of the exact location of the bus and the user can find the location of the bus by using google maps. An entire smart bus system conceptual module is also prepared in [7]. It will consist of four basic components namely Smart Bus Depots, Smart Bus Stops, Smart Buses and Interactive Citizen Interface (Web portal based and smartphone App based). It will consider city bus service to model and upgrade at per with the smart city theme of India using Aadhar Card by using GPS, IOT. The sensor networks will be connected to city internet backbone through wi-fi hotspots in the bus stops, depots and inside buses.[11] has proposed a system containing application simulators, which contains the bus stop billboard display, the mobile application, and the control room application. It also contains bus simulator and a server. The bus simulator is useful in computing the current location and to send this information to the GPRS server. The server in this system plays a very important role and carries out functions such as to maintain the entire database of bus routes, calculate the ETA(Estimated Time of Arrival) based on the location data received by it. The advantage is that GPS works in all weather conditions so there is no need to worry of the climate as in other navigating devices.GPS receivers have become much more accurate over the last couple of years. GPS costs you very low in comparison other navigation systems.The most attractive feature of this system is its 100% coverage on the planet.GPS-GSM based solution does not work in rural areas due to poor signal strength and network connectivity problems. Taking these issues into consideration [9] has used WiFi technology to provide bus tracking. WiFi Routers are placed at bus terminals and WiFi modules are placed inside the busses. When the bus arrives at a certain bus stop, the WiFi module gets connected to the router and this information in the form of latitudes and longitudes is sent to the cloud which is then received by the user on an Android device.[2] Artificial Neural Networks (ANN), MQTT (Message Queuing Telemetry Transport) protocol is used to give an accurate estimate of the arrival time (ETA) to the commuter by means of an application. In [5] algorithms such as C4.5 (a statistical classifier) algorithm for the estimation of bus arrival times along with GPS and Google Maps are used for navigation for real-time tracking, bus route stops and other information available to the user after scanning the QR codes available at bus stops. For counting the number of people [6] have made the use of Arduino Uno, Bluetooth HC-05 module, pressure pad, potentiometer, data collection software module (Arduino IDE, Bluetooth terminal HC-05). The pressure sensors on the bus seats detect any weight above 20 kg and count it as a person occupying a seat.The authors of [10] have used Passive Infrared- PIR as the motion sensor and OMRON D6T as the thermal sensor. The sensors start detecting the people when the bus starts moving. All the sensors and GPS are interfaced externally with a gateway. The project[8] will make access to public transportation stops like bus stops much easier for differently abled people. This project employs a blind card equipped with intelligent technology. The system uses sound by using Apr9600 IC to convey information and large LCD displays for the visually impaired.

III. PROPOSED METHODOLOGY

For implementing this improved bus system the project is divided into two modules - Bus tracking module and Passenger counting module.

3.1 Bus tracking module

This is the module which would enable us to track buses and display their location .There are multiple components used in this module such as U-blox NEO-6M GPS module and NodeMCU ESP8266.

3.1.1 U-blox Neo-6M GPS Module

Ublox NEO-6M GPS Module comes with an active antenna and is cost-effective. High-performance U-blox 6 based NEO-6 series of GPS modules, that brings the high performance of the U-blox 6 positioning engine to the miniature NEO form factor. These receivers combine a high level of integration capability with flexible connectivity options in a small package. This makes them perfectly suited for mass-market end products with strict size and cost requirements..

Fig. 3.1.1 GPS Module

3.1.2 NodeMCU ESP8266

NodeMCU is a wifi SOC (system on a chip) produced by Espressif Systems. It is based on the ESP8266 -12E WiFi module. It is a highly integrated chip designed to provide full internet connectivity in a small package. It can be programmed directly through the USB port using the Arduino IDE. By simple programming we can establish a WiFi connection and define input/output pins according to your needs exactly like Arduino, turning into a web server. It can be used as an access point and/or station, host a web server or connect to the internet to fetch or upload data.

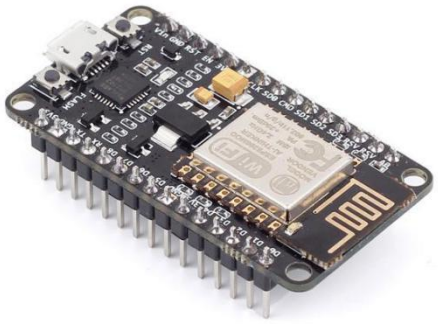

Fig. 3.1.2 NodeMCU ESP8266

3.1.3 Working

A user gives input in the form of source and destination stops on a particular route. The route will consist of multiple stops.GPS modules are installed on the bus. The GPS module tracks the location of the bus in real time and sends the data to the server through which it is displayed on the Google Map interface to the user. To send data to the server NodeMCU esp8266 module is used as it has built-in support for wifi connectivity. This data is constantly updated to the server and real-time data is continuously provided to the user on the client device. The estimated time of arrival (ETA) taking into consideration the traffic conditions is displayed to the user.

3.2 Passenger Counting Module

This would enable us to count the number of passengers in the bus currently and the passenger can see that in the app.The components used in this module are IR sensors and Arduino Uno.

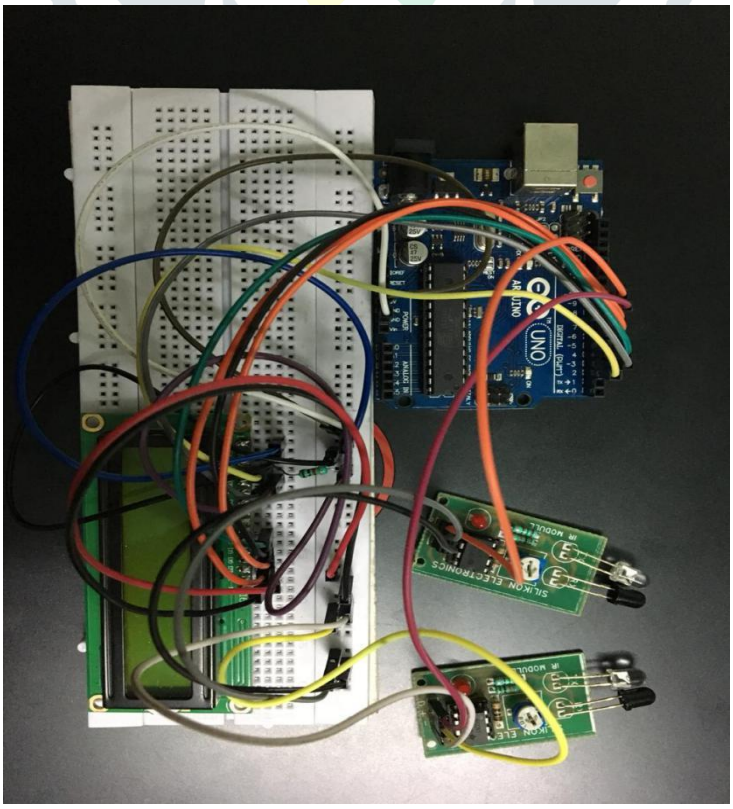

Fig.3.2 Passenger counting module

3.2.1 IR sensors

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared Obstacle Sensor Module has built in IR transmitter and IR receiver that sends out IR energy and looks for reflected IR energy to detect the presence of any obstacle in front of the sensor module. The module has an onboard potentiometer that lets the user adjust the detection range. The sensor has a very good and stable response even in ambient light or in complete darkness.

3.2.2 Arduino Uno

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

3.2.3 Working

Passenger counting module is implemented using IR sensors. The module consists of two IR sensors, one for the front door and the other for the back door of the bus. These sensors are connected to the Arduino. The sensors recognize when a person passes through its vicinity as the input to the sensor is low. A count variable is used in coding to keep track of the number of passengers. Passengers will board the bus from the back door, the count will increment. Passengers will alight from the front door of the bus and the count will decrement. A call is directed to the Google API and database to store the count as well as display the information on the user's cell phone. The purpose of recording the number of passengers is to let the user know whether there is any vacancy on the bus beforehand depending on the bus size as each bus has a different capacity. Depending on the bus size the information is provided in the form of categories like vacant, crowded, overcrowded.

IV. CONCLUSION

IoT technology is used to track the location of vehicles in real time through the use of GPS devices namely Neo 6M. Provision of information about the bus schedule, next bus information or delays within the system cell phone, or similar device used by the traveler. Provision of accessing information through the internet or mobile applications, either directly or through a service is made available. Option for a traveler to request trip information by specifying a trip origin and destination.Time-saving is a huge benefit to transit users.Amenity benefits to passengers: comfort, prestige.Ease in accessing public transport leads to an encouragement to use public transport and attracts a maximum number of passengers.Passenger Information technology helps to reduce the waiting time and increases ridership. A long term positive effect is reduction in air pollution as more public vehicles will be in use instead of privately owned vehicles on the road. A good public transport system creates an impact on the form and development of cities.For further analysis the bus administration can use the data gathered by the passenger counting module. This data can be useful in determining the number of buses required on a particular route at a particular time as it shows the number of passengers accessing the bus service at a specific time. This helps the administration to decide the time during which more buses will be required to operate on the route. For example, morning working hours will require more buses active than in the afternoon hours.

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IV. ACKNOWLEDGMENT

We extend our sincere thanks to Prof. Mrs. Asmita Deshmukh and Prof. Mrs. Dhanashri Kanade.

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