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IoT Based Bus Tracking System

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Abstract: ***Tracking of public bus location requires a GPS device to be installed, and lots of bus operators in developing countries don't have such an answer in situ to supply an accurate estimation of bus time of arrival (ETA). Without ETA information, it's very difficult for the overall public to plan their journey effectively. In this paper, implementation of an innovative IOT solution to trace the real time location of buses without requiring the deployment of a GPS device is discussed. It uses Bluetooth Low Energy (BLE) proximity beacon to trace the journey of a bus by deploying an Estimate location beacon on the bus. BLE detection devices (Raspberry Pi 4) are installed at selected bus stops along the path to detect the arrival of buses. Once detected, the situation of the bus is submitted to a cloud server to compute the bus ETAs. A field trial is currently being conducted in Johor, Malaysia together with an area bus operator on one single path. Our test results showed that the detection of BLE beacons is extremely accurate and it's feasible to trace the situation of buses without employing a GPS device during a cost-effective way.***

Keywords: IOT , BLE , Raspberry Pi 4, GPS .

I. INTRODUCTION

City Bus is that the most ordinarily used mode of public transportation within the India. people believe public bus to commute between home and work place. However, public buses often suffer from over-crowding, and therefore the current transportation infrastructure isn't adequately supported by the govt to affect the overwhelming number of commuters. additionally, the general public bus network in developing cities and rural areas are mostly unreliable, and therefore the service frequency is unpredictable most of the time. Although a person's time-keeper is used at the bus depot to enforce the schedule of the bus, it falls short thanks to human errors and non-compliance by the bus drivers. With the arrival of IoT and tracking technologies like Global Positioning System (GPS) and cellular based Internet connectivity, bus fleets can now be tracked in real-time. This has provided great certainty to the commuters, allowing them to plan their journey more efficiently and hence reduce their waiting time at the stop. The concept of Smart Bus Stop1 aims to enhance commuter experience by having enhanced cooling at the stop, also as accurate time of arrival of the buses on an information panel.

An interactive chatbot is additionally deployed to permit for commuters to converse with the chatbot using various local languages and dialects, to question the bus time of arrival, weather outlook, and therefore the quickest route to their destinations. All the cool features of Smart stop require that the real-time location of the bus fleet to be available. In many City's that aren't able afford these advance solutions, bus operators aren't even thinking of putting in GPS devices and 3G connectivity on their bus fleet. Deployment of GPS devices and data connectivity on the bus fleet implies additional operating expense to the bus operators, e.g., a stage bus company between two cities may have up to twenty buses servicing the route and this suggests that the bus operator will need to bear additional cost of GPS installation and therefore the recurring data connectivity cost for every bus. On the opposite hand, bus operators that deploy GPS on their fleet are reluctant to form the buses' GPS traces available to the general public. The GPS traces are mainly used for the aim of speed monitoring, illegal route deviation, compliance to the service schedule, and generation of reports to the regulatory agency. Therefore, the crucial information, i.e., the real-time location of the bus, isn't readily available in most cases. As a result, it's impossible to supply an estimation of bus time of arrival (ETA), including the features of Smart stop in many developing countries.

In this paper, we implemented a completely unique and innovative IoT solution to trace the situation of buses without requiring the deployment of a GPS device. Our solution uses Bluetooth Low Energy (BLE) proximity beacon to trace the journey of a bus along its service route. BLE beacons (i.e., Estimate location beacon) are deployed on buses to be tracked, while BLE detection devices (Raspberry Pi 4 or esp32) are installed at selected bus stops along the route, including deployment at the bus terminals. With this, the implemented solution is in a position to first track (a) when the bus leaves the bus depot, (b) at what time the bus arrives at a specific stop , (c) estimate the time of arrival (ETA) of the bus along the route. The collected location data is then analyzed and, within the future, are often fed into a predictive analytics model to predict the bus ETA.

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II. PROBLEM STATEMENT

A. Manual bus tracking is not accurate.
B. GPS based bus tracking system is expensive for bus operators.
C. Need of accurate and low-cost solutions for bus tracking.
D. No information displays on bus stands.

Management of buses of public transportation is that the main problem now each day. Based on to the present system there is no such system which provides information about the bus, its expected time of arrival, the expected waiting time and what's the present location of the bus.

III. EXISTING SYSTEM

Many researchers have contributed to the development of Intelligent transportation system (ITS) for various applications like vehicle position tracking systems, vehicle anti-theft tracking systems, Bus Tracking system and fleet management systems. These applications are intended to track the system with respect to the workstation PC and Smartphone. Authors demonstrate VERTIGUO (VEhiculaR Tracking Using Open-source approach), a GPS, GSM and GPRS technology based vehicular tracking system[1]. Authors in demonstrate an SMS based vehicle tracking system to transfer the latitude, longitude from GPS and automobile data to end systems and map their exact location in Google Earth using Keyhole Mark-up Language (KML). Researchers have also worked on SMS tracking system with theft identification and lock feature[2][3].
An intelligent vehicle tracking system (IVTS) is generally used for tracking and navigation of vehicles. These tracking as well as navigation arc possible by using GPS in vehicles. Tracking provides a continuous track of the vehicle whereas Navigation guides the user to the desired destination[4]. The Real Time Bus Monitoring and Passenger Information bus tracking device is a standalone system designed to display the real-time locations of the buses in metropolitan city. This system will enable the tracking device to obtain GPS data of the bus locations, which will then be transferred to a centralized control unit by using GSM and then transmitted to a bus stop and displayed on the GLCD as per the passenger's request. For bus positioning in real time, in-vehicle unit and a tracking server GSM is used. For this, tracking server also has GSM modem that receives vehicle location information stores this information in database[5]. Four functions have been realized in this management system, such as system personnel management, vehicles management, vehicle information management, and freights information registration and inquiry. The distribution of system personnel authority and the registration and inquiry of the in-and-out vehicles & cargo information have been achieved in this management system, thereby enhanced the efficiency of the current vehicles and security, and promoted a more effective flow of goods[6]

IV IMPLEMENTATION

The IoT Based Bus Tracking System uses the latest technology called as BLE which is the low power version of the Bluetooth. This technology contains a Bluetooth beacon which will be always transmitting data and we can configure this beacon according to bus number or bus route or according to the bus stand this Bluetooth Nikon can be used to translate the bus information. The range of Bluetooth low energy detection is hundred meters we can detect the bus. Every bus will contain unique Bluetooth low energy transmitter which will be always transmitting it is low energy it will require minimum amount of power and can be configured simply using a web application we will use ESP 32 microcontroller for that. The system on the bus stand will be IOT connected system which will contain Raspberry Pi with internet connectivity this will be always scanning for the incoming buses bus is there it will get its data and publish it to server web application from there we can calculate the extreme estimated arrival time on the next stop.

Fig. 1. Raspberry Pi 4

Also, this raspberry Pi based system will read data from the server and will display at bus stand above information about incoming buses outgoing buses so that will be useful for the user. implemented methodology is to develop an efficient bus tracking system. It involves creating a BLE beacon which will be transmitting the bus information this transmitter can be easily configured buy Wi-Fi I or USB device. This will be small battery-operated system. The bus stop device will contain a small microcomputer called raspberry Pi, display and internet connectivity also with the announcement speaker.

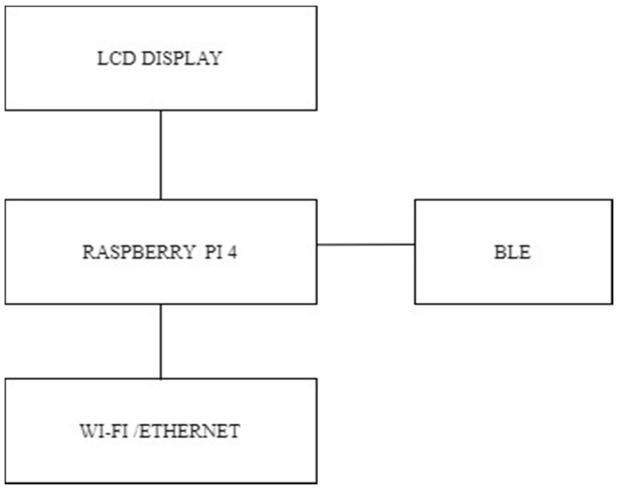


Fig. 2. Bus Stand Unit architecture (A)

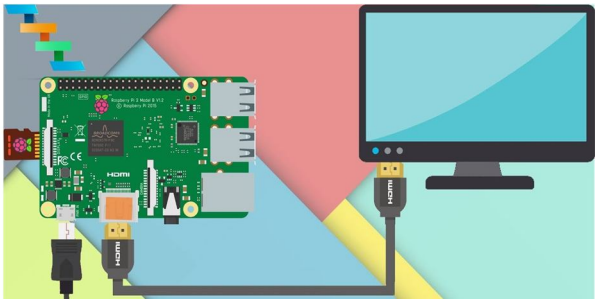


Fig. 3. Raspberry Pi with Monitor

This system will be continuously connected to the cloud web server and will be searching for or Bluetooth off incoming buses. Once the bus is detected in its range it will update that data into the cloud which will be available for the user. User can monitor the buses from the website. Also, this data from the website will be displayed on LCD panel situated at bus stand and speaker will announce the arrival of bus as well as buses at the previous station which will be arriving shortly.

Fig. 4. ESP32 BLE BEACON

The implemented system contains the two parts one is Bus part and second is bus stand part in bus path we will be using esp32 microcontroller. ESP32 is really a powerful IoT device having inbuilt support for Bluetooth and Wi-Fi.

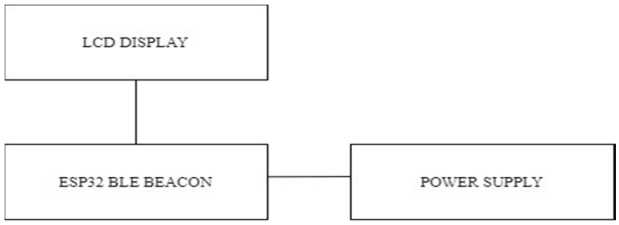


Fig. 5. Bus Device architecture (B)

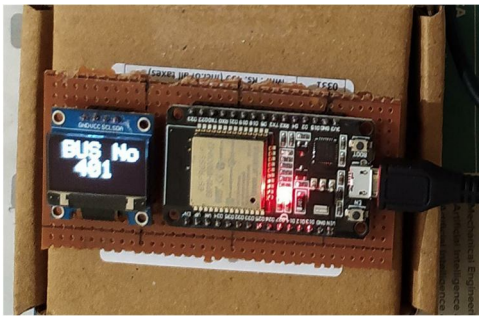
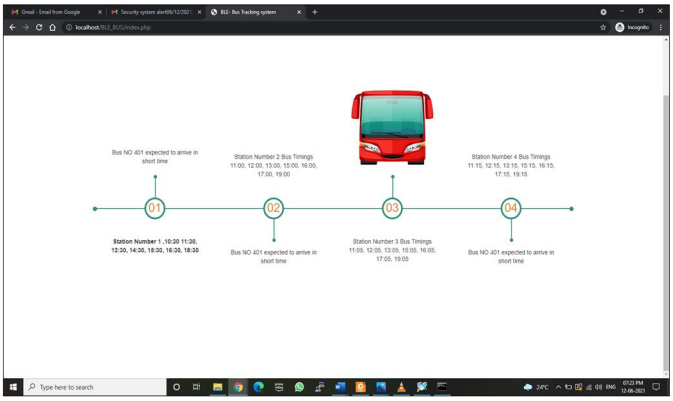


Fig. 6. Bus Device Actual Unit

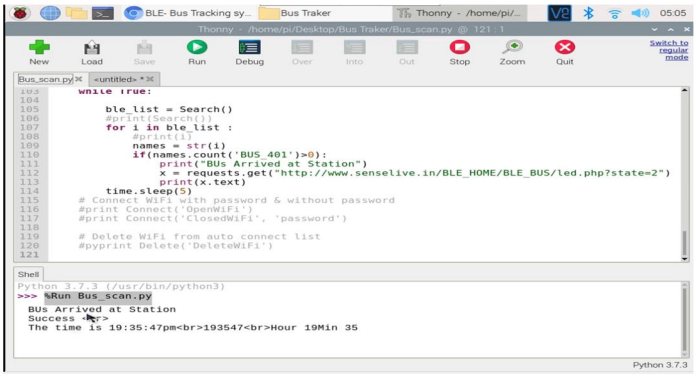
The ESP32 is advanced version of its predecessor ESP8266 with extra features like RAM, ROM, GPIO Pins etc. The ESP32 module supports both classic Bluetooth and Bluetooth Low Energy (BLE), the classic Bluetooth can be used to transfer songs or files and the BLE option can be used for battery optimized applications like Bluetooth beacons, fitness bands, proximity advertisements etc. We will use ESP32 as a server means it will be always transmitting the data. This can be configured using a webpage as it supports the Wi-Fi the driver can directly connected to the web page and field the bus route in this model. The second part of the system architecture is bus stand part which is most important part this part contains a raspberry Pi 4 microcomputer one small LCD display and internet connectivity which can be given by using 3G or 4G dongle or internet on Wi-Fi. This device will receive data from the bus using BLE AND SEND TO THE CLOUD USING INTERNET Also, this device will actively monitor the cloud and receive data from cloud and will display on the screen what are the upcoming buses in next 10 minutes and where they are going from this bus stop.

V RESULTS

The IoT Based Bus Tracking System is more user friendly than existing system. And it also gives greater performance. IoT Based Bus Tracking System also more reliable and cost effective.



When Bus is detected, the python shows the following output



VI CONCLUSION

This paper mainly studied the overall design of bus management system based on multi-node RFID cards and GPS. There is lot of work done for the bus tracking system in the public transportation but many of these uses similar approach like GPS and GPRS based system although this is GPS is accurate but it requires a recurring cost of monthly internet recharges to send the data to cloud using the GPRS also for the city buses running inside the city this cost can be unnecessary as we know the Bus stands are usually situated near to each other and buses run on the limited root Also some system suggest RFID based approach but that is also not visible as the RFID is prone to external noise and radio interference One of the paper suggest Android application based approach but this approach is again based on the user Android phone required to send data from his phone to the bus server bus operator server. Arduino many public bus operators how cost constraints that's why they are not able to install the GPS based systems in their buses.

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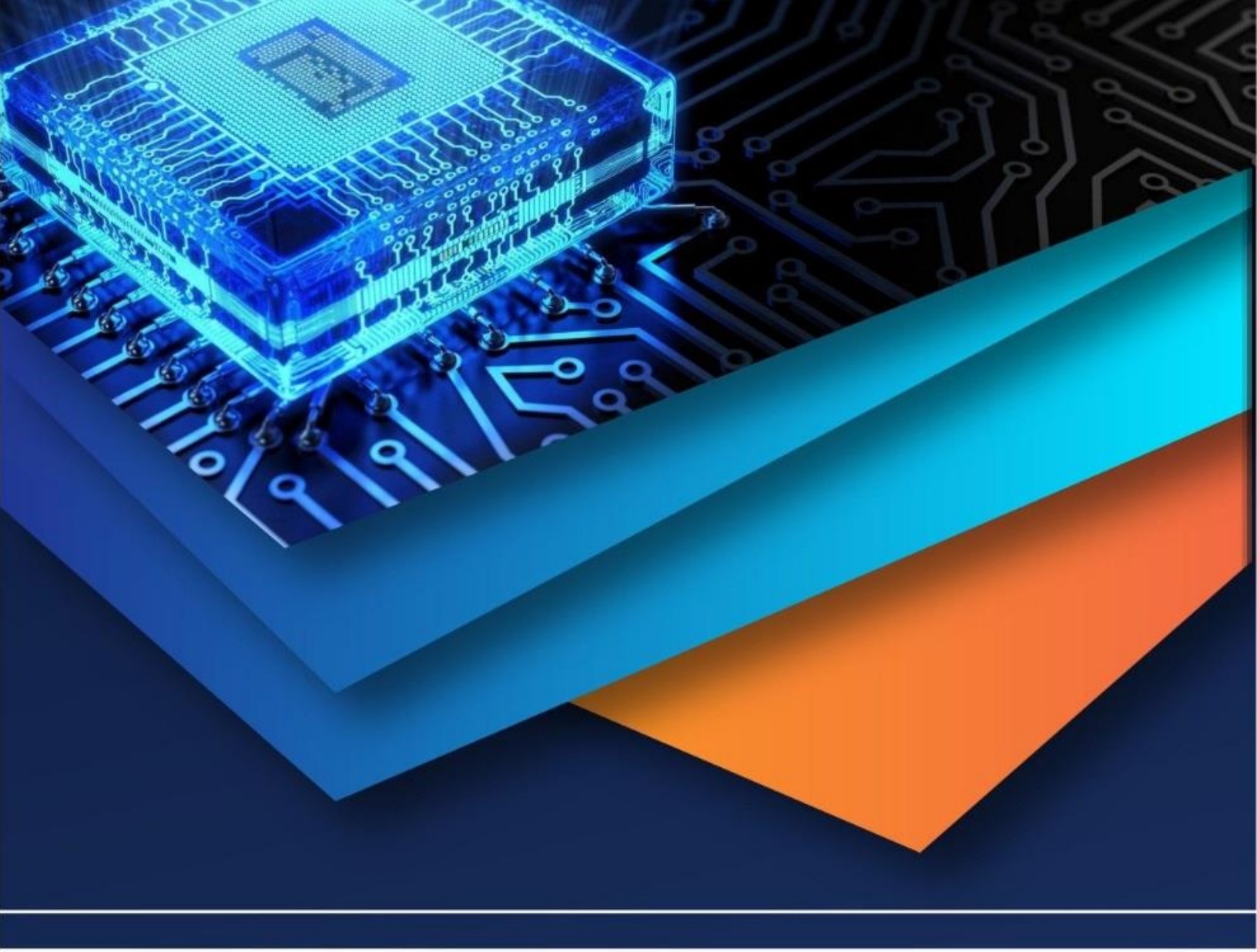

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