Bus Location Tracking using Node MCU

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Abstract:
The present generation requires information from time to time. The use of technology has been increasing day by day. We are planning for the combination of present technology with the requirement of information transmission, we planned for the creative approach of "Bus location tracking using Node MCU". Missing the college bus is a major issue which most of the college students face. It is a major issue because most of the students stay far away from college which makes it difficult for the students to reach college on time. We propose to solve this issue by making an android app which provides the live location of the buses. This is done by using NodeMCU. We will set up a NodeMCU with a GPS module inside a bus which will help us fetch the location of the bus.NodeMCU is an open source IOT platform. It includes firmware which runs on ESP8266 WiFi SoC. The application is going to display a list of all the available buses, selecting which will display the location of that bus. The users will be notified if the bus enters the geofence of the user.
Keywords: **Node MCU, IOT, GPS, Geofencing, Android.**

1. Introduction

The movement of college buses is affected by different uncertain conditions, such as traffic congestion, unexpected delays, irregular start time and many more incidents. Many students and staff members are often late for college because they decide to wait for the bus instead of using an alternate transportation. This confusion and inconvenience can be reduced by tracking the location of the buses.

Bus location tracking system is the technology used to determine the location of a bus using a GPS sensor. The real time location can be tracked on an android app.Using this app students and staff can manage their time efficiently and reach the bus stop just before the bus arrives, without having to waste time in the bus stop by going early and without missing the bus. The system consists of modern hardware and software components

1.1 Problem Definition including the significance and objective

The problem definition is to design an android application for the users who want real time information about the current location of the college busses. The real time location tracking of busses is done by periodically updating the location of the college bus to the cloud, and these real time updates can be viewed on an android application.

The objective of this project is to develop an affordable and efficient IOT hardware and an android application which provides the real time tracking of college buses and also provides some other useful features such as geofence notification.

1.2 Methodologies

Blynk Server

Responsible for all the communications between the smartphone and hardware. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi. Blynk can run on over 400 hardware modules. You can also run blynk on emulators.

Google maps API

By using the Google Maps API, it is possible to embed Google Maps into an external website, onto which site-specific data can be overlaid. The Google Maps API is free for commercial use, provided that the site on which it is being used is publicly accessible and does not charge for access.

Geofence

A geofence is a virtual fence or a perimeter around a physical location. Geofencing is a tool to connect the virtual experience with the offline world's physical location. When a bus enters this area, a notification can be sent.

2. Literature Survey

2.1 Introduction to problem domain

The Internet of Things (IoT) is nothing but the devices (things) communicating with each other by using the internet. IoT is a trend-setting innovation in which all the data from sensors is stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement.

Location tracking implies technology that can locate, in real time, people or objects while electronically recording and tracking their movement. Such technology is used together with GPS navigation every day when finding locations on digital pictures and searching for premises around using normal maps.

2.2 Existing system

In our existing system, people keep missing their buses often. The reason for this is either the bus arrives early or they wake up/get ready late. What they do to not miss the bus is either call their friends to find out the bus location or go to the bus stop early and wait for a long time at the bus stop. The problem with this is calling friends to find out the location is not always an option, their friend might not answer the call for various reasons. Even waiting at the bus stop everyday for a long time is not a good option. Sometimes people might want to board a different bus, but doing so is difficult as they will have no clue about when the bus will arrive at the bus stop.

One more solution that people use is whatsapp live location, but the problem with that is there must always be a person who manually shares the live location with others and also it does not always work, that is, when the whatsapp application is in the background, the live location does not get updated.

2.3 Proposed system

The user will be provided with an android application developed using Android Studio. The primary goal is to keep track of bus locations. In addition to this we are using Geo fencing to notify the user when the bus enters the proximity. Node MCU, a low power microcontroller equipped with a GPS sensor broadcasts its location to the Blynk Server. Blynk application also contains the latitude and longitude of all the buses.

Information from the Blynk server is retrieved using REST API. The minimum amount of time taken to reach the bus stop from the user's current location is estimated. Google Directions API and Ray casting algorithms support in getting the best route to reach the destination and to stay aware of the proximity.

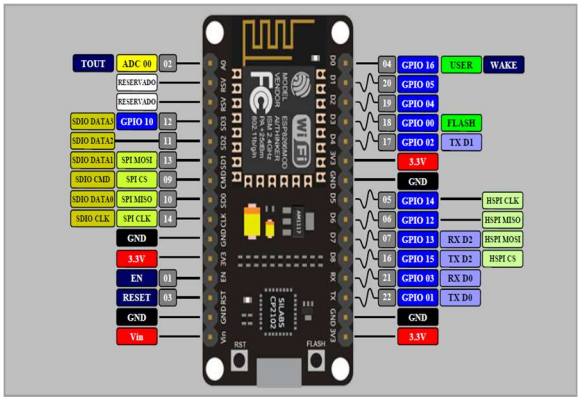

Figure 1. Node MCU

3. Design of the Proposed System

3.1 Block Diagram

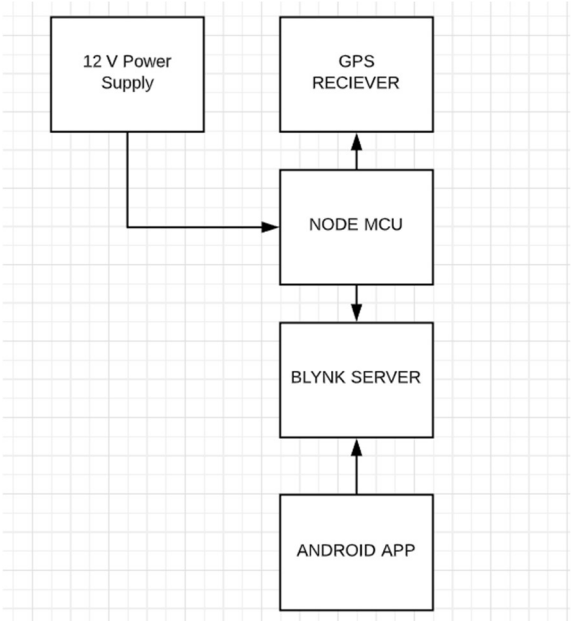

Figure 2. Block diagram

The above block diagram gives a brief description of the project. The GPS sensor is connected to the nodeMCU which will be attached to a bus. The real time location from the GPS sensor is sent to the blynk server(Cloud) which is periodically updated and can be viewed in the android app.

3.2 Module Description

3.2.1 Sending bus location to the cloud: As the bus moves the GPS sensor detects the change in latitude and longitude, this location data is captured by the GPS sensor and using the Inbuilt Wifi module and a hotspot connection, the data is sent to the Blynk server(Cloud).

3.2.2 Async API calls to the cloud: The android app periodically makes asynchronous API calls to the Blynk server(Cloud) to fetch the real time location of the bus. This location is retrieved in the form of latitude and longitude. After every asynchronous API call the location of the bus on the map view in the app is updated using Google maps API.

3.2.3 Estimating time and distance: Based on the location of the bus stops and the traffic congestion data provided by google maps API, the time of arrival of the bus to the bus stop is estimated, this time helps the user to know when to reach their bus stop.

3.2.4 Geo fencing: A geofence is a virtual fence or a perimeter around a physical location. When the bus reaches the geofence of a user, the user is notified via the app that the bus has reached the geofence.

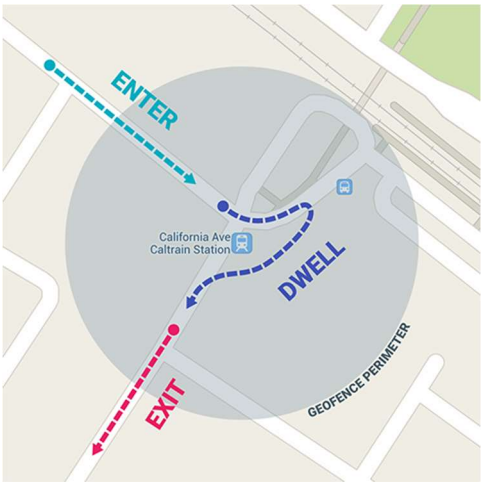

Figure 3. Geofence

3.2.5 Place Picker: The Place Picker UI is a dialog that allows a user to pick a Place using an interactive map. Users can select their current location, or a nearby place. Apps can also initialize the map to a particular viewport.

4. Results/Outputs and Discussions

Figure 4. Map widget in blynk app

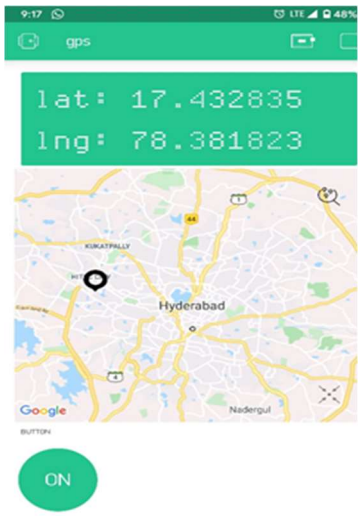

Figure 5. Location in blynk app

The location retrieved from the node mcu is displayed in the blynk application using a map widget. The map widget displays the location retrieved from the node mcu. This location is stored in the cloud and can be accessed using an API call.

Figure 6. Bus selection

Figure 7. Location in android app

The list of buses are displayed on the home screen, the user selects a bus and clicks on the button, after which the user will be able to look at the location of the bus in a map view.

Figure 8. Add bus stop

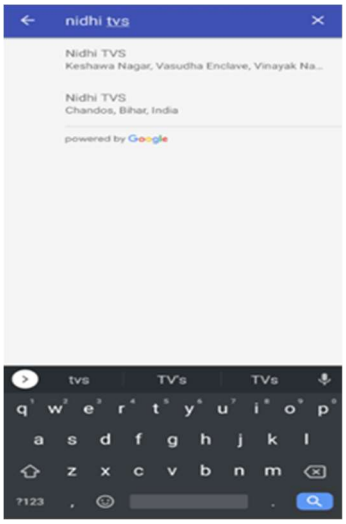

Figure 9. Autocomplete form for location

Autocomplete search is available to select the bus stop location and it can be invoked using the add bus stop button in the home screen.

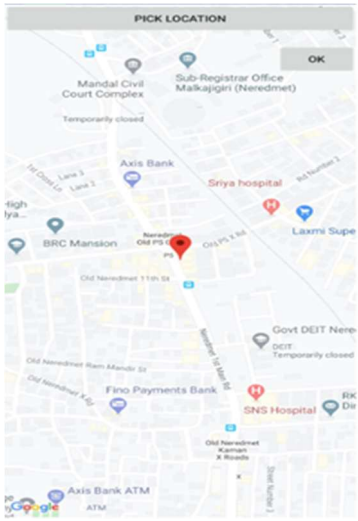

Figure 10. Bus stop location

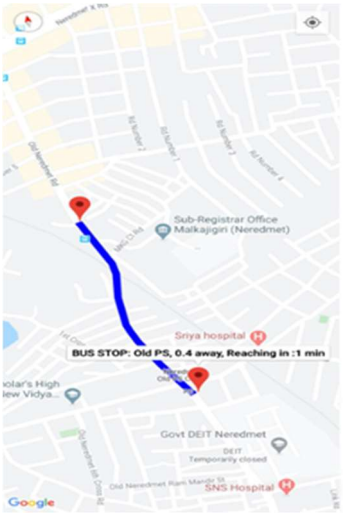

Figure 11. Estimated arrival time and distance

The blue line that connects the bus location and the location of the bus stop, is the shortest route between the locations, and the text above the bus stop location tells the users in how much time the bus will reach the bus stop and how far it is from the bus stop.

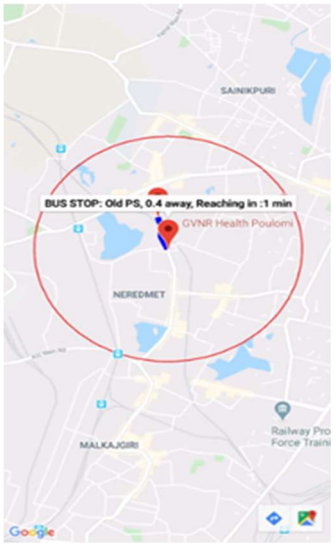

Figure 12. Geofence of bus stop

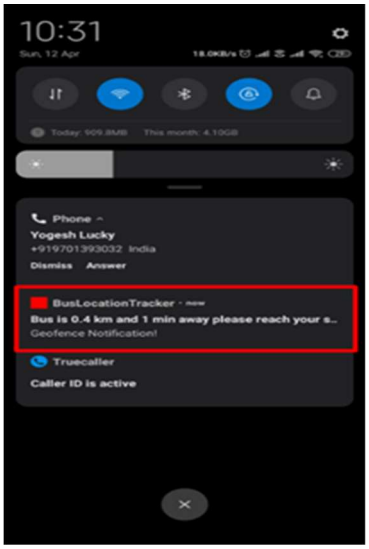

Figure 13. Notification when bus the enters the geofence

The circle depicts the geofence of the bus stop, when the bus enters the geofence a notification is sent to the user which tells the user where the bus is and also when the bus will reach the bus stop.

5. Conclusions and Recommendations

This project helps us keep a track on all the buses of the institute. This is an ideal system of bus transport established by us for college purposes. By implementing the proposed system, a passenger can plan their journey more efficiently before time, and the waiting time at the bus stop can be reduced. The main features of this system are the efficient usage of time, real-time information of the buses, estimation of arrival of buses, notifying the students when to go to their bus stop. Our system also takes into consideration the traffic, if the location of the bus does not change with time it means that either the bus is stuck in traffic or it broke down, and the student can arrange for a different means of transport or board another college bus instead of wasting time by waiting for the bus.

5.1 Future Work

5.1.1 Making the UI more immersive: Making the UI more immersive means making the user interface of the application more attractive, this can be acheived by using design frameworks such as flutter, bootstrap.

5.1.2 Extend the scope of application to more college buses: Our application is made for the buses of cbit only, but this can be extended to all the colleges which have the college bus facility.

5.1.3 Implementing E-bus pass, bus fee payment, real time seat availability: As of now students use a hard copy for bus pass, but there are many problems related to this such as losing the bus pass or forgetting to carry it everyday to college. Implementing an E-bus pass would be very helpful as it would solve the problems mentioned above. Bus fee payment could also be added as a feature which would make students' lives easier. Real time seat availability is a feature which would help students to know if the bus is full before boarding the bus, which will prevent them from entering a full bus and standing for the entire journey.

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