e-ISSN: 2455-5703

A Node MCU and NEO 7M GPS Module based Bus Tracking System for College Buses

[1]Asst. Prof Vivek M R [2]Maria Antony [3]Maria Sumi K S [4]P Anderson Britto [5]Rahul Jacob
[1,2,3,4,5]Department of Computer Science and Engineering
[1,2,3,4]Albertian Institute of Science & Technology, Kalamassery, Kochi

Abstract

The proposed system is aimed at managing all the buses of a college through an Android Application. The Application will allow all the faculty and students of a college to monitor where exactly each college bus is at any point of time. It makes use of a GPS module that must be placed inside each bus which will help us find the location of each bus and the data is retrieved in an Android App which will make use of Google Maps to track the movement of each bus. This app will help students and teachers to reach the bus stop at the right time or look for another alternative if the bus has already left or even check if there is any other bus going through the same route. This application will prove to be a great help for college students. Every Student shall login to the application by using the college Registration number. After logging in we can easily identify where exactly each bus of the college is travelling at that point of time.
Keyword- GPS, Tracking, Node MCU, Neo7m

I. Introduction

SEURANTA is a real time bus tracking system. Mainly used to track college buses. This helps the students to exactly know the bus position so that they could reach the bus stop on time and the movement of the buses are affected due to lots of factors like traffic and unexpected delays. Many students wait at the bus stop without knowing that the bus has left. For this reason, many of them are often late to the college. Different types of vehicle tracking devices exist. Mainly they are classified as "passive" and "active". The GPS location, speed, heading and sometimes a trigger event such as key on/off, door open/closed are stored by "passive" devices. When the bus reaches a place where the data is collected from the bus unit and it is processed in the system. Passive systems contain auto download type that transfer data via wireless download. Devices which collect the information usually transmit the data in real-time via cellular or satellite network to a computer or data centre for evaluation are "Active" devices.

Both active and passive tracking abilities are used in modern vehicle tracking devices. The Tracking device sends the coordinates to the server when the device is connected to a network. In remote locations where there is no network coverage the tracking unit stores the coordinates value in the memory and when the network becomes available it is stored in the database.
Tracking vehicles has been accomplished by installing a unit in the vehicle, either powering with a battery or wired into the vehicle's battery. However, many companies are interested in the emerging cell phone technologies that provide tracking of multiple units, such as both a worker and their vehicle. These systems also offer tracking of texts, calls, web use and generally provide a wider range of options.

In this system we have a tracking unit fixed in each bus. The unit consist of a GPS tracker and Arduino unit. The GPS tracker provides the Latitude and Longitude points these points are directly stored into the database. Every 5 second the location points are updated so that we would get the exact position. The location point is made use at the user side to plot the location in the map.

II. Literature Survey

A. Design and Development of Android based Bus Tracking System

Tracking of organization buses while moving on highway is a crucial task. A person patiently waiting for the bus may want to enquire about the position of current location of the bus. Phone discussion is not always possible due to traffic disturbances. Further it involves variant costs due to the calls and message service over phone and the person in the bus may get annoyed if he gets multiple calls from people boarding that bus. Mobile based Bus Tracking System provides a solution to this problem which helps anyone to retrieve the location of the bus without calling or disturbing the person travelling in the bus. The people boarding the bus and the coordinators of the bus should own an android driven mobile phone with internet connectivity. The Global Positioning System (GPS) supports in area following with backing of Global Standard for Mobile (GSM) in cellular telephone to report transport area information again to the servers. Continuously, this shows where transports are on a guide and evaluation the entry time and separation with reference to holding up stop by utilizing propelled gimmicks of Internet. The function of proposed system is to provide an economical, flexible and reliable system for bus tracking.

B. Location Tracking in GPS using Kalman Filter

We present a novel technique to send GPS coordinates to other mobiles through short message service (SMS) based on Global Positioning System (GPS) technology. Two algorithms, Kalman filter and velocity renovation, which can be used in conjunction with GPS are used as a basis for location tracking. This technique can be used to help people, using their mobile with or without GPS, to find the location of a friend using Google maps. The first coordinates are generated from a GPS assisted mobile on Google map, this location is then sent through SMS to another person. The latter can then see the exact location of the sender on his map with an accuracy of 0.57 m. The advantages of this technology is by using existing equipment and free services like Google maps and GPS, we can construct a very reliable location tracking system. The basis of this program is GPS. GPS is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the United States (US) Department of Defence (DoD). GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS can show you your exact position on the Earth in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS. The improved location tracking algorithm which uses the Kalman filter with the velocity renovation process is implemented. The velocity renovation process consists of a velocity estimator and direction finder. By this process, the proposed algorithm can use accurately estimated velocity in the location estimation.

C. Design and Implementation of an Accurate Real Time GPS Tracking System

GPS tracking has many uses in today's world; the system can be used for children tracking, asset, car or any equipment tracking and as spy equipment. This paper presents an accurate and reliable real time tracking system using GPS (global positioning system) and GSM (global system for mobile communication) services, which was designed and implemented successfully in university of Khartoum labs. The system permits localization of a portable tracked unit and transmitting the position to the tracking centre. The GPS tracking system consists of portable tracked device attached to a person, vehicle or any asset, and the tracking centre where the portable device's location should be monitored. The mobile tracked device receives its coordinates from the GPS and sends these coordinates as SMS via GSM modem to the tracking centre, which is simply a personal computer with many interface programs to display the location on Google maps using free version of Google Maps APIs (application programming interfaces). The testing shows that the system meets its objective of being low-cost, accurate, real time and adaptive for various applications.

D. An RFID Based System for Bus Location Tracking and Display

An RFID is a technology similar to that of barcode scanning. An RFID system consists of tags, which use radio frequency signals to transmit its location information to a reader, which usually sends this information to a server that processes it according to the needs of the application. This paper presents a system that can track buses across a city by placing RFID tags in the buses and the readers in every alternative bus stop. RFID works as a combination of a reader, which can read information from tags. Readers can be passive RFID systems, where the reader and reader antenna send a radio signal to the tag, and tag then uses the transmitted signal to power on, and reflects energy back to the reader. These can operate either in low, high or ultrahigh frequencies, with low covering frequency covering 30 KHz to 300 KHz, high frequency covering 3 to 30 MHz and the ultra-high frequency covering 30 MHz to 3 GHz respectively. For this system, the ultra-high frequency readers will be efficient, since they work anywhere in the 5 to 12m range. RFID tags can either be transponders or beacons, where a transponder replies with the stored message only when the reader sends a signal, and a beacon keeps relaying the message it has stored constantly and is equipped with its own power source. The RFID based bus tracking will reduce operation cost for long run also the reader can communicate with the tag via radio waves. But for short run cost will be high and poor read rate can occur if the reader and receiver is not properly aligned. Tracking with GPS technology become much more prevalent. GPS can be used for large tracking by using satellite but an active RFID cannot provide extreme read range that GPS can provide it involve tracking item in fixed area.

III. OVERVIEW OF PROPOSED SYSTEM

A. Problem Statement

To design an android application for the users who want real time information about the estimated time of arrival (ETA) buses, current position of the buses in the college. Use of centralized server to share the calculated ETA to bus passenger through any convenient way.

B. Architecture of Proposed System

Fig. 1: System Architecture

C. Tracking Unit

A GPS unit essentially contains a GPS module that receives the GPS signal and calculates the coordinates. In the case of data loggers, there is a large memory for storing the coordinates. Data pushers additionally have a GSM/GPRS/CDMA/LTE modem to transmit the information to a central computer by either SMS or GPRS in the form of IP packets. Satellite-based GPS tracking units will operate anywhere on the globe using satellite technology such as Global Star or Iridium. They do not require a cellular connection. Three types of GPS trackers are available, although most GPS equipped phones can easily work in any of these modes if they have the required mobile applications installed.

D. Data logger

GPS logger log the position of the device at regular intervals in its internal memory. Sometimes GPS loggers may have either a memory card slot, or internal flash memory card and also a USB port. Some of them act as a USB Flash Drive, which allows the track log data to be downloaded for further computer analysis.

E. Data Pusher

The data pusher is the most common type of GPS tracking unit and it is used for asset Tracking, personal tracking and vehicle Tracking systems. Also known as a "GPS beacon", this kind of device pushes, at regular intervals, the position of the device as well as other information like speed or altitude to a determined server, that can store and analyse the data instantly. A GPS navigation system and a mobile phone sit side-by-side in the same box, powered by the same battery. At regular intervals, the phone keeps sending text messages via SMS or GPRS, holding the data from the GPS receiver. Newer GPS-integrated smartphone running GPS tracking software can turn the phone into a data pusher device. When a regular GPS receiver is turned on, the following sequence of operations must take place before the receiver can access the information in a GPS signal and use it to provide a navigation solution:

Step 1. Determine which satellites are visible to the antenna. Step 2. Determine the approximate Doppler of each visible satellite.
Step 3. Then Search for the signal in both C/A-code delay and frequency (i.e., Doppler shift).
Step 4. Detect the signal and determine its code delay and carrier frequency.
Step 5. Track the C/A-code delay and carrier frequency as they change.

F. Signal Acquisition

The acquisition process consists of Steps 1–4 in the foregoing list. In the first two Steps the visible satellites and approximate Doppler shifts are usually found using approximate time, approximate receiver position, and almanac data (for satellite position and velocity) — all of which have been previously stored in the receiver. This allows the receiver to establish a frequency search region for each visible satellite, and is similar to establishing the region of ocean to search in the above analogy.

Step 3 requires by far the most computation. The C/A-code search includes correlation with a replica code in the receiver which is precisely time-aligned with the received code.

Alignment of the code is achieved when averaging over a sufficient time period allows the signal-to-noise ratio (SNR) to be built up to a usable level. Thus, in addition to the code search, a receiver will also need to search in frequency.

G. Signal Tracking

Once the cell containing the signal is detected in Step 4, typical receivers use code and carrier tracking loops in Step 5 to generate error signals that keep the replica and received codes aligned and also keep the receiver tuned to the correct frequency as changes in Doppler occur. However, a discrete approximation to these methods of tracking is to repeatedly compare the values of S in the current signal cell with the values in the eight cells surrounding it.

Even though the approximation is somewhat crude, it makes analysis of tracking sensitivity much easier and does not really falsify our understanding. If the maximum value of S in the surrounding cells exceeds that of the central cell, the cell with that maximum value is declared as the new signal cell. In this way, the code delay and carrier frequency of the received signal can be tracked by repeatedly performing a local search over only $N = 9$ cells, each local search resulting in a tracking update.

Therefore, to summarize, with enough processing, no theoretical limit exists for either acquisition or tracking sensitivity. However, as tracking requires examination of only a local code delay and carrier frequency region (and coherent averaging can be used as well over the full length of data bits in legacy L1 GPS signals), tracking can be made more sensitive than acquisition before cost limits are reached.

H. Correction Techniques for Greater Accuracy (DGPS)

- How accurate is GPS, really? A normal civilian GPS receiver provides 10-15 metre accuracy, depending on number of satellites available, and the geometry of those satellites. More sophisticated GPS receivers, costing $5,000 or more, cannot by themselves, provide any better accuracies. To get within a centimeter or two, they must use correctional information and computing, as well as using more sophisticated radio reception techniques.
- Similar correctional information is also available for a normal civilian GPS receiver. Then it's accuracy can be improved to one or two metres (in some cases under a metre!) through a process known as Differential GPS (DGPS). DGPS employs another receiver at a fixed location to compute corrections to the GPS satellite measurements. How are these corrections provided to your GPS receiver? There are a number of free and subscription services available to provide DGPS corrections.
- WAAS provides the GPS receiver along with additional satellite ranging to achieve better accuracy and reliability.

I. Elevation Readings and GPS

GPS primarily indicates a surface (horizontal) position based on a mathematical model representing the earth's near-spherical surface. Height or elevation is different. GPS can give a distance from the centre of the earth, and then by using the radius of the surface model, give you an elevation from the surface model. Let's call this the mathematical elevation. Then we check if it represents a height above sea level. The result is no. It may do so in places, but only by accident.

There are lots of differences around the world, between the mathematical elevation and sea level elevation. The spherical (ellipsoidal to be accurate) models for GPS and sea level, are called the spheroid, and the geoid, respectively. These differences are the result of observations taken over the last few centuries, by surveyors, space scientists and geologists.

Geologists get involved in such observations, because anomalies in gravity strengths often indicate mineralogy. And gravity strengths relate to the behaviour of level determination on the earth's surface.

Because the position solution found by GPS is a mathematical one, and the ranging from the satellites is in the order of 20,000 kms, there is an error bias in the direction of the earth's centre. (Because of intersecting lines that may not meet.) This of course is the elevation solution.

If we have an error of 10 metres in the horizontal position, then error in the elevation will be more like 20-30 metres. The small standard GPS unit usually displays elevation, but you must accept it with the above limitations. We can say that it is reasonably sensible. Near the coast of Australia, it will be somewhere around zero, give or take 50 metres. In Toowoomba, it will be about 600 metres. Other places in the world, it may show greater, or lesser discrepancy.

IV. CLIENT INTERFACE

Client interface is an android application which make use of the google map to plot the position. The tracking unit in the bus regularly updates the Latitude and Longitude value using those value the current location is mapped in the map.

There is a dedicated server used to store the location values as well as the user details like username password and also to store the bus details.

V. WORKFLOW OF THE SYSTEM

The tracking unit in each bus calculate the location coordinates and sent it to the server. The coordinates are recalculated at regular intervals and the database is updated with the new value each time.

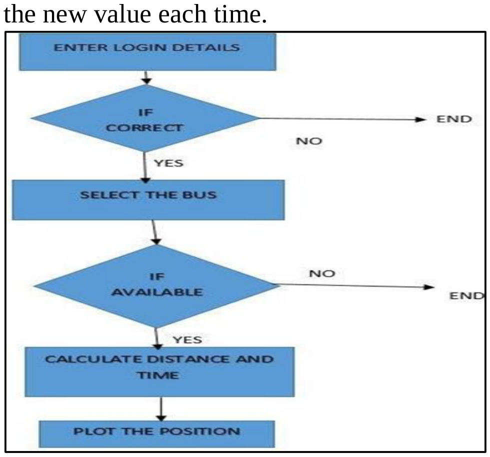

Fig. 2: Workflow diagram of application

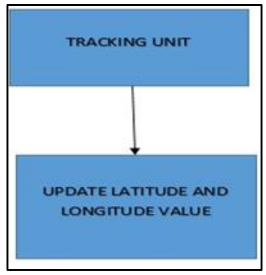

Fig. 3: Workflow diagram of GPS

In order to use the application, the user needs to login first. Only certain users will have the right to use the application because only students or employees belonging to those institutions only need to know about the bus location. After login the users need to select the bus which they have to track and it would be showing the location and the arrival time.

VI. NODE MCU

Node MCU is an IOT platform which is based on the ESP-12 module. It is an open source. It's basically an SoC (System on Chip) which is an integrated circuit that integrates all components of a computer or other electronic systems in a single chip. It is programmed using Arduino IDE.

VII. NEO 7M

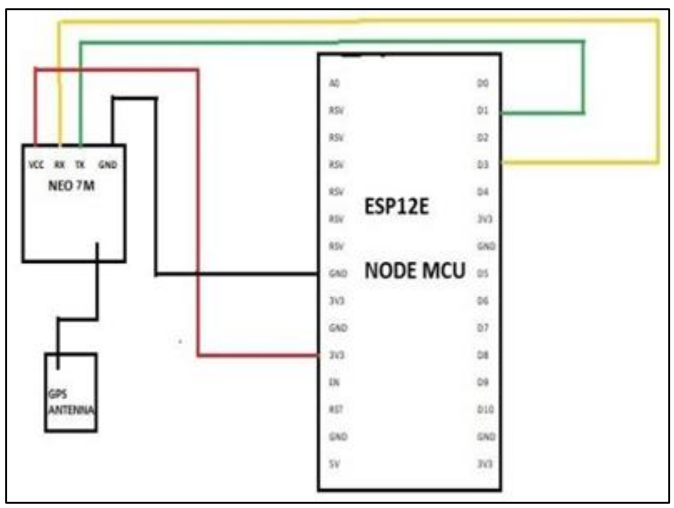

Fig. 4: Architecture diagram of Hardware

The NEO-7 series of standalone GNSS modules is built on the exceptional performance of the u-blox 7 GNSS (GPS, GLONASS, QZSS and SBAS) engine. The NEO-7 series delivers high sensitivity and minimal acquisition times in the industry proven NEO form factor. The NEO-7 series provides maximum sensitivity while maintaining low system power. The NEO-7M is optimized for cost sensitive applications, while NEO-7N provides best performance and easier RF integration. The industry proven NEO form factor allows easy migration from previous NEO generations. Sophisticated RF-architecture and interference suppression ensure maximum performance even in GPS-hostile environments.

REFERENCES

[1] Design and Development of Android Mobile based Bus Tracking System. Authors: K Sujatha, KJ Sruthi, IEEE 2014
[2] Location tracking in GPS using Kalman filter through SMS. Authors: Mania Anu V
[3] Design and implementation of an accurate real time GPS tracking system. Authors: Hind Abdalsalam Dafallah, IEEE 2014
[4] An RFID Based System for Bus Location Tracking and Display. Authors: Mohammad Zababy, Prawesh Gaonjur