International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 2, February - 2014

Vehicle Monitoring and Intelligent Data Analysis using GPS Based open Source Software

Chitravalavan
Professor
Department of ECE
AVC College of Engineering

C. Jayasri
Assistant Professor
Department of ECE
AVC College of Engineering

K. R. Vinothini
Assistant Professor
Department of ECE
AVC College of Engineering

***Abstract*- This paper proposes the recorded details of a vehicle's trip using a passive GPS tracking device. Using a GPS receiver and a logger in the vehicle can be used to show the position of the vehicle such as latitude and longitude. It also stores the values in SD card, using the stored value a report can be generated using PC and effectively viewed in a map. Open source software called openGTS is used to generate customizable report and can be viewed in Google maps, also separate database can be generated for each user to maintain their own records.**

Keywords- GPS, Vehicle tracking, PIC, Open GTS, MYSQL

1.INTRODUCTION

The Global Positioning System (GPS) is a satellite-based navigation system developed by the US Department of Defense. The first GPS system was tested in 1960's using a constellation of five satellites. This system was implemented for military purposes and provided navigational data. In 1993 the number of satellites are increased to 24. The system became fully operational and it was also made available to the civilians. Initially, the accuracy of the civilian GPS system was deliberately disturbed using a method called Selective Availability (SA). GPS has now become a widely used aid to navigation and it is commonly used in many applications such as shipping, piloting, route guidance, map making, precise time reference and hobbies and games such as geocaching. In the present fast moving urban life, transportation is among the most common and frequent needs.

With the technological advancement in the transportation sciences [1] the need of secure dynamic and highly efficient system is felt. Use of radio navigation system best fit these entire high end requirements of transportation community. With the implementation of radio navigation system in vehicles they become capable of transmitting the information about their current geodetic position. Use of this information can be done in many systems like real time intelligent dynamic vehicle tracking and navigation system, mobile asset management system, fleet management system, travel time studies, traffic control etc.The multipath effect is caused by reflection of satellite signals from objects on Earth's surface. The multipath error in GPS systems appear when there are large buildings near a GPS receiver and the signal reflects from these buildings. The reflected signal takes more time to reach the receiver than the direct signal and this result in accuracy errors. The multipath errors can be avoided by moving the receiver away from nearby large buildings or trees.

The three major parts of GPS system is shown in Figure 1. and is classified as:

- Space segment
- Control segment
- User segment

Space segment: The space segment consists of the orbiting satellites. The number of satellites is increasing all the time. As of March 2011, there were 31 actively broadcasting satellites in the GPS constellation. With the increased number of satellites, the reliability and availability of the overall system has been improved. Each satellite contains several atomic clocks. The satellites transmit low radio signals with a unique code on different frequencies, allowing the GPS receiver to identify the signals. The main purpose of these coded signals is to allow the GPS receiver to calculate travel time of the radio signal from the satellite to the receiver. The travel time multiplied by the speed of light equals the distance from the satellite to the GPS receiver.

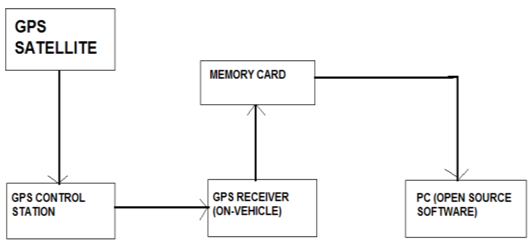


Figure 1. Block Diagram of GPS Logger

Control segment: The control segment consists of the monitoring stations located on Earth. These stations constantly monitor the operational status of all the GPS satellites and also synchronize the atomic clocks of on board satellites to within a few nanoseconds of each other and adjust the orbital model of each satellite. The unmanned stations monitor GPS satellite signals and then send that information to the Master Control Station where anomalies are corrected and sent back to the GPS satellites through ground antennas.

User segment: The user segment consists of the user GPS receivers. A GPS receiver is a small battery-operated portable device similar in size to a mobile phone. The device receives signals from the GPS satellites and then displays user's position, altitude, speed, heading and several other navigational parameters. Few sophisticated receivers also incorporate street level maps where the position of the user is shown on the map dynamically.

2. NMEA

The data output from a GPS receiver is in ASCII text format [2] and is known as the NMEA 0183, or simply the NMEA (National Marine Electronics Association) format. According to this format, navigational information are sent in the form of "sentences", where each NMEA sentence starts with a "$" sign, the navigational parameters are separated by commas and each sentence is terminated with two hexadecimal checksum characters.

An Example of NMEA sentence,
$GPRMC, 220704, A, 5127.3506, N, 00003.2307, E, 0.0, 74.7, 051108, 2.5, W, A*30

Here:

220704	Fix taken at 22:07:04
A	Navigational data is correct
5127.3506, N	Latitude 51 deg. 27.3506 min. North
00003.2307, E	Longitude 0 deg. 3.2307 min. East
0.0	Speed over ground (Knots)
74.7	Course made good
051108	Fix taken on 5 November, 2008
2.5	Magnetic variation 2.deg West
30	Checksum

3. HARDWARE SPECIFICATION

A Parallax GPS module is used in the design. This is a small, low-cost GPS with the following features:

- On-board passive patch antenna;
- Single wire, 4800 baud serial TTL interface;
- Provides either raw NMEA output, or specific data can be requested via a command interface;
- Operates with single +5V supply.
- The GPS module has four pins:
- Pins 1 and 2 are the ground and the supply voltage respectively;
- Pin 3 is the TTL compatible, non-inverted serial input-output pin. The data format is 4800 baud, 8 data bits, no parity.

From Figure 2. Pin four is the output format selection bit, called the RAW pin. When RAW is low, the GPS module sends out NMEA sentences automatically every second. When RAW is high (or unconnected), specific GPS data (e.g. the latitude) can be requested from the device by sending commands. In this project the GPS module is operated in the automatic mode.

The SD card is connected to port pins RC2 to RC5 of the microcontroller and is operated in SPI mode. A card holder is used to physically make connections to the card pins. The voltage at output pins of the micro-controller is too high and can damage the input circuitry of the SD card.

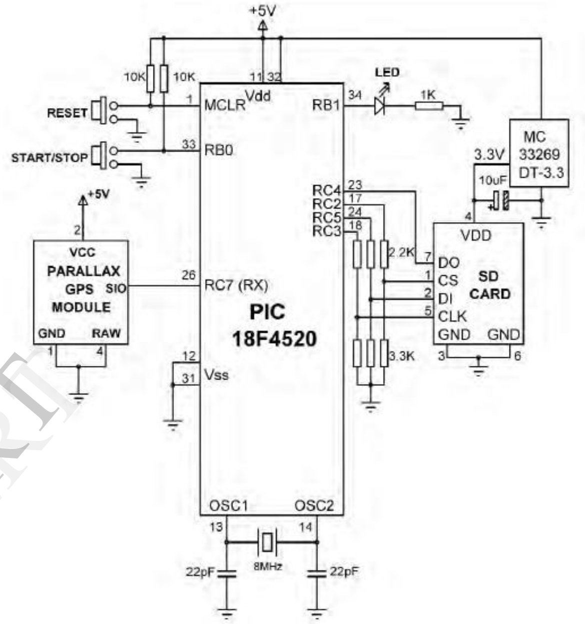


Figure 2. Circuit Diagram

A pair of potential divider resistors (using 2.2K and 3.3K resistors) is used to lower the microcontroller output voltages to a level acceptable by the SD card inputs. The SDcard is powered using a 3.3V regulated supply, obtained using a MC33269DT-3.3 type regulator. A PIC18F4520 type microcontroller (MCU) is used in the design [3].The PCB model is shown in Figure 3.

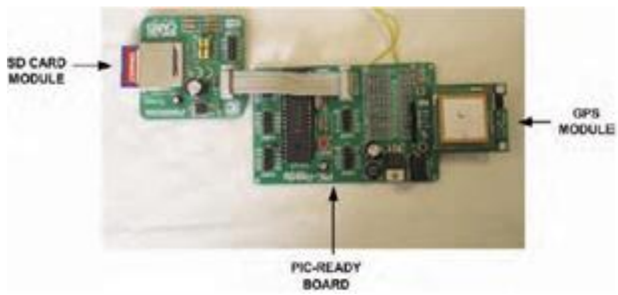


Figure 3. PCB Model

The microcontroller is operated with an 8MHz crystal. Pressing the switch starts and stops the data collection. During the data collection the LED flashes at a rate of about once a second. If the SD card is not inserted into its holder, the LED will flash quickly to show an error condition. The switch should be kept pressed for about five seconds to terminate the data logging and wait until the LED turns OFF before removing the SD card from its holder.

4. SOFTWARE SPECIFICATION

Mainly GPS based open source software is used, which is called openGTS (GPS Tracking System). It is intended to provide a generic back-end web-based service [4] for querying and viewing GPS related data. It is designed to operate independently of any specific GPS tracking device or protocol, but comes with support for several device protocol formats (such as OpenDMTP- Open Source Device Monitoring and Tracking Protocol)

Figure 4. OpenGTS Login Page

It is specifically designed for use in small to medium sized commercial enterprises wishing to take advantage of GPS tracking for "fleets" of vehicles. However, OpenGTS is highly configurable and scalable to larger enterprises as well.

On the server side, OpenGTS (Figure 4.) is designed to be device and protocol independent. In order to use the features of Open GTS, a specific device/protocol communication server will need to be implemented to communicate with the remote device and place the data in the SQL database. Open GTS is completely implemented in Java and should run fine on any system that fully supports the Java Runtime Environment.

GPS receiver [5] stores the data in GPX format which is an XML schema. OpenGTS software can read these xml file format from the memory card where the files are stored. OpenGTS can be easily integrated with Google Maps, or any other mapping software.

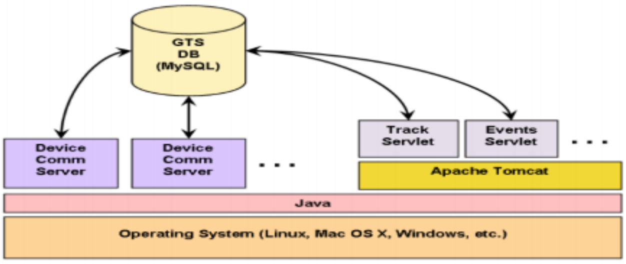


Figure 5. Architecture

With the help of co-ordinates, the position can be represented in map form so that it will be easy to identify the vehicle's trip. This will be helpful for call taxi offices who has to manage many number of vehicles. So a database can be created for each user and maintain their own records seperately.

As shown in Figure 5. **MySQL** is the world's most used open source relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. When Mysql [6],[7] and Apache tomcat server are integrated a separate username and password can be generated for each user and act as a server or administrator.

Apache Tomcat (or simply **Tomcat** is an open source web server and servlet container. Apache Tomcat includes tools for configuration and management, but can also be configured by editing XML configuration files.
With custom coding, other devices can also be integrated as well using the included example "template" device communication server.

- **Customizable web-page decorations**: The look and feel of the tracking web site can easily be customized to fit the motif of the specific company.
- *Customizable mapping service:*

OpenGTS comes with support for Open Layers/OpenStreetMap in addition to support for Google Maps, Microsoft Virtual Earth, and Maps traction (which provides mapping support for MultiMap, Map24, MapQuest, and more). Within the ***OpenGTS*** framework, other mapping service providers can also easily be integrated.

- *Customizable reports:* Using an internal XML-based reporting engine, detail and summary reports can be customized to show historical data for a specific vehicle, or for the fleet.
- *Customizable geofenced areas:* Custom geofenced areas (geozones) can be set up to provide arrival/departure events on reports. Each geozone can also be named to provide a custom 'address' which is displayed on reports when inside the geozone (for instance "Main Office").
- *Operating system independent:*

OpenGTS itself is written entirely in Java, using technologies such as Apache Tomcat for web service deployment, and MySQL for the datastore. As such, ***OpenGTS*** will run on any system which supports these technologies (including Linux, Mac OS X, FreeBSD, OpenBSD, Solaris, Windows XP, Windows Vista, Windows 20*XX*, and more).
So as per the requirement of the user the software can be re-designed. Also cost of software is none as it is an open source and also independent of platforms, so it is flexible for all type of customers.

4.1 NMEA Conversion

The NMEA protocol shown in Figure 6. is received using GPS device.

After accepting the IMEI (International Mobile Station Equipment Identity) and NMEA data from the device by the web server, a method is used for tokenizing all the particular data. This is done after verifying the IMEI number of the device that the NMEA formatted data converted to the decimal format. After converting NMEA formatted data to decimal Latitude and longitude, it changes as following: 2345.3522N = 23.755895 09022.0288E = 90.367205

With the help of co-ordinates a report can be generated as shown in the Figure 7. From that we can convert the report to any format like html, doc, and text. So that it will be portable and can be used anywhere.

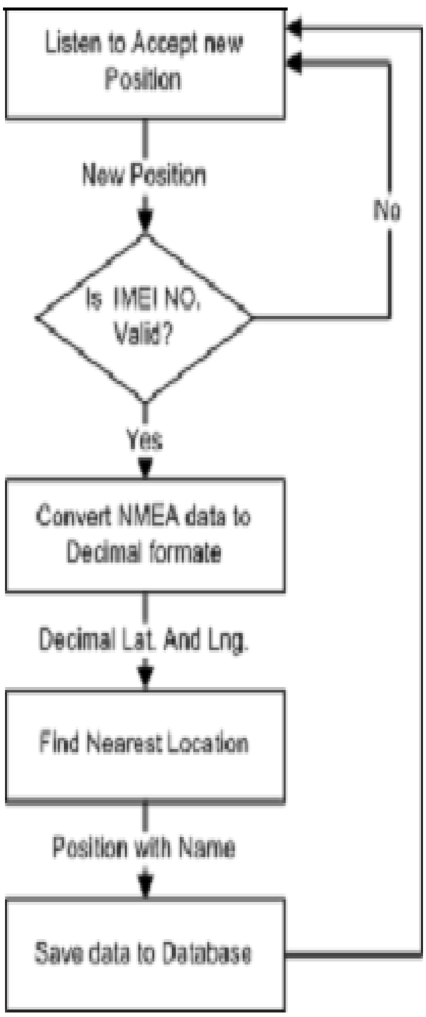
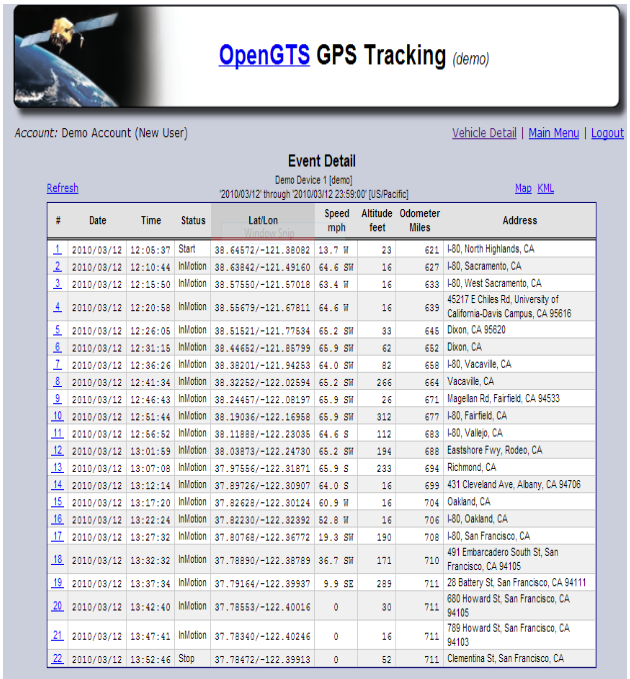


Figure 6. NMEA Flow Diagram



#	Date	Time	Status	Lat/Lon	Speed mph	Altitude feet	Odometer Miles	Address
1	2010/03/12	12:05:37	Start	38.64572/-121.38082	13.7 W	23	621	I-80, North Highlands, CA
2	2010/03/12	12:10:44	InMotion	38.63842/-121.49160	64.6 SW	16	627	I-80, Sacramento, CA
3	2010/03/12	12:15:50	InMotion	38.57550/-121.57018	63.4 W	16	633	I-80, West Sacramento, CA
4	2010/03/12	12:20:58	InMotion	38.55679/-121.67811	64.6 W	16	639	45217 E Chiles Rd, University of California-Davis Campus, CA 95616
5	2010/03/12	12:26:05	InMotion	38.51521/-121.77534	65.2 SW	33	645	Dixon, CA 95620
6	2010/03/12	12:31:15	InMotion	38.44652/-121.85799	65.9 SW	62	652	Dixon, CA
7	2010/03/12	12:36:26	InMotion	38.38201/-121.94253	64.0 SW	82	658	I-80, Vacaville, CA
8	2010/03/12	12:41:34	InMotion	38.32252/-122.02594	65.2 SW	266	664	Vacaville, CA
9	2010/03/12	12:46:43	InMotion	38.24457/-122.08197	65.9 SW	26	671	Magellan Rd, Fairfield, CA 94533
10	2010/03/12	12:51:44	InMotion	38.19036/-122.16958	65.9 SW	312	677	I-80, Fairfield, CA
11	2010/03/12	12:56:52	InMotion	38.11888/-122.23035	64.6 S	112	683	I-80, Vallejo, CA
12	2010/03/12	13:01:59	InMotion	38.03873/-122.24730	65.2 SW	194	688	Eastshore Fwy, Rodeo, CA
13	2010/03/12	13:07:08	InMotion	37.97556/-122.31871	65.9 S	233	694	Richmond, CA
14	2010/03/12	13:12:14	InMotion	37.89726/-122.30907	64.0 S	16	699	431 Cleveland Ave, Albany, CA 94706
15	2010/03/12	13:17:20	InMotion	37.82628/-122.30124	60.9 W	16	704	Oakland, CA
16	2010/03/12	13:22:24	InMotion	37.82230/-122.32392	52.8 W	16	706	I-80, Oakland, CA
17	2010/03/12	13:27:32	InMotion	37.80768/-122.36772	19.3 SW	190	708	I-80, San Francisco, CA
18	2010/03/12	13:32:32	InMotion	37.78890/-122.38789	36.7 SW	171	710	491 Embarcadero South St, San Francisco, CA 94105
19	2010/03/12	13:37:34	InMotion	37.79164/-122.39937	9.9 SE	289	711	28 Battery St, San Francisco, CA 94111
20	2010/03/12	13:42:40	InMotion	37.78553/-122.40016	0	30	711	680 Howard St, San Francisco, CA 94105
21	2010/03/12	13:47:41	InMotion	37.78340/-122.40246	0	16	711	789 Howard St, San Francisco, CA 94103
22	2010/03/12	13:52:46	Stop	37.78472/-122.39913	0	52	711	Clementina St, San Francisco, CA

Figure 7. Generated Report

5. RESULTS

The result shows the vehicle's trip from one place to another place is shown in Figure. 8 and the green marker represents the waypoints which are the recorded at particular interval of time. The yellow marker shows the origin and the red marker shows the destination of the vehicle.

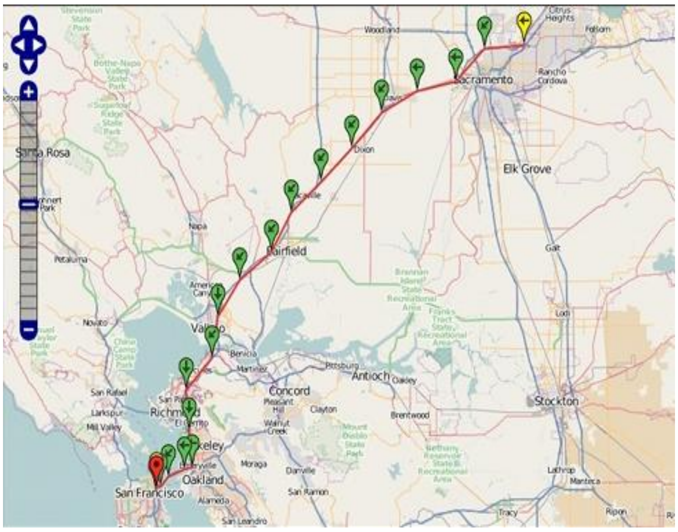


Figure 8. Google Maps showing Vehicle Path

6. CONCLUSION

This paper proposes passive tracking of a vehicle and analysis of recorded details using open source software. This will be essential in future for any organisation running with much number of vehicles in a city. In future active tracking can be done with the help of GSM module attached to it. By using active tracking this method will be more efficient and will be successful in automobile industries. With the help of GPS, It may avoid trespassing restricted areas and critical borders. This system used to find the shortest path to reach the destination. Travelers will not lose their path, if they have GPS system installed. Software cost is not necessary as it is open source software. This kind of approach avoids the usage of company vehicles for personal works.

Implementation of GPS in vehicles can certainly bring a revolutionary impact in transportation science in a developing country like

India where there is an extremely high urban as well as rural vehicular transition every day.

A rial ion wide integrated business plan for including automobile companies and GPS system providers is desired to bring this revolution.

REFERENCES

1. Al-Bayari, O., B. Sadoun, "New centralized automatic vehicle location communications software system under GIS environment", *International Journal of Communication Systems*, Vol 18, Issue 9,April 2005, pp. 833–846.
2. Hap sari, A.T., E.Y. Syamsudin, and I. Pramana, "Design of Vehicle Position Tracking System Using Short Message Services And Its Implementation on FPGA", *Proceedings of the Conference on Asia South Pacific Design Automation*, Shanghai, China, 2005.
3. Brown, A. "A low cost vehicle location and tracking system "August 2002.
4. Iqbal, M.U. "Privacy Implications of Automated GPS Tracking and Profiling" IEEE Society on Social Implications of Technology June 2010.
5. [5] Wang Bo "The System of GPS Navigation Based on ARM Processor" November 2010.
6. [6] MySQL AB. MySQL Documentation, Available: http://dev.mysql.com/doc.
7. [7] MySql AB *Casestudies.* Available: http://www.mysql.com/whymysql/casestudies/ mysql_cs_utel_en.pdf.