Vehicle Tracking System by Using Cell Tower Localization

Mohammed F. Alrifaie[1,*], Norharyati Harum[1]

[1]Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia
[*]Corresponding e-mail: m_alrifaei@yahoo.com

ABSTRACT – Vehicle tracking system is a fleet management solution and a total security. It is used to determine vehicle's location by using different methods like GPS. The GPS tracking system is easy to implement and used but the use of it increases the cost of hardware and energy consumption. GPS also has a drawback if it isn't pointing then it may give inaccurate measurements. The vehicle unit will be attached to the vehicle and configured to get the required information from the cell tower to represent the location on the map in real-time. This paper presents a prototype of a vehicle tracking system using cell tower localization based on IoT.

1. INTRODUCTION

Vehicle Security is a main anxiety for all vehicle owners. For the upgrading of technology it is now possible to closely monitor and track vehicle in real time as well as to check the movements' history of a vehicle. One should be thankful to Vehicle Tracking System VTS that has helped extremely to keep the security of the vehicle by tracking its activities in the normal interval[1]. VTSs are also popular among people as retrieval device and theft prevention. When the vehicle is stolen the location information sent by tracking unit can be used to find the location and coordinates, so it can be sent to police for further action. Police can simply follow the signal given by the tracking system and locates the stolen vehicle[2]. Actually, there are a lot of object detection techniques that are available to classify and detect them. Object Detection is a method that looks for and finds examples of world objects like pedestrians, faces, vehicles, and buildings in videos or pictures. It uses the features that are extracted and thus the learning algorithms for recognizing the examples of the object class[3]. Global Positioning System (GPS) can be used for this purpose. This system consists of three parts: the control segment, the space segment, and the user segment. GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of a vehicle or other asset to which it is attached. A GPS receiver is operated by a user on earth, it measures the time taken by radio signals to travel from four or more satellites to its location, it then calculates its distance from each satellite, and from this calculation it determines the longitude, latitude, and altitude of that position. By following triangulation or trilateration methods the tracking system determines the location of the vehicle easily and accurately[4]. Actually, there are many applications have been conducted for tracking and monitoring vehicles and objects by using GPS[5][6][7]. However, the use of GPS increases energy consumption and requires an expensive hardware. Furthermore, the GPS system may give inaccurate measurements when the vehicle located in area that has no GPS coverage. The internet of things (IoT) can be very helpful in several and different categories including tracking of asset and location, shipping control of inventory and individual tracking. Since IoT permits for the communication between devices, commonly referred to as Machine-to-Machine (M2M) communication. So, physical devices are able to communicate with people letting them know where it is located and their conditions. Therefore, cell tower based localization can be proposed by this paper in order to locate vehicles. The proposed system has ability to help the personal user to track his vehicle. This tracking technique can improve the problems that mentioned above. For this, we are going to develop a smart solution to track the vehicles by using embedded system.

2. METHODOLOGY

We are going to implement a VTS for all kinds of transportation like buses, private vehicles, and motor also. To do that we use the Raspberry Pi3 and 3G/4G USB modem supporting plug and play on Ubuntu operating system/Raspberry Pi, as it is shown in figure1.

Figure 1 Vehicle unit is embedded inside the vehicle

Today mobile broadband gives both fast speed access and mobility at any place. Technically mobile broadband have easy way to use the internet access so invent as your device transceiver can achieve your

cellular network operator's network. However, The Raspberry pi is a Linux board which is programmable and on which we can insert different modules like sensors and GSM/GPRS to increase its functionality. The VTS is technology that is used by many companies and individuals to track a vehicle using some methods. The vehicle unit, which is the hardware component that is fixed to the vehicle, is configured to receive signals from the mobile cell tower. By identifying the sector of a tower that sends this signal we can accurate calculation of the location of the vehicle and send it by using internet of LTE USB dongle to the web server to represent the location on the map by using Google maps in real time as it is shown in figure 2.
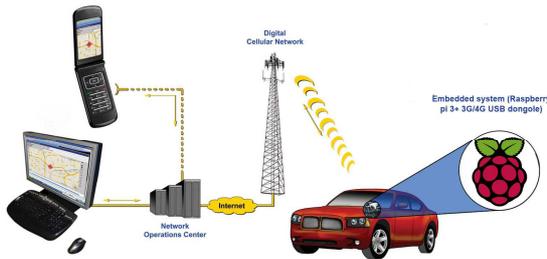

Figure 2 Cell tower localization process

Common Raspberry Pi and many other devices do not have modules to connect to cellular networks; therefore many users utilize a USB modem for wide area mobile broadband connectivity. The information that is brought from the cell tower will be converted in the format of Latitude/Longitude to be represented on a map by using Google Maps in real time.

3. RESULTS AND DISCUSSION

3G/4G USB modem gets the required information form the cell tower to be converted in form of pairs (latitude/ longitude) and send it directly to represent the location on Google Maps. As it is shown in Table 1, the recorded information is stored on a flash memory at the same time of representation as a location on Google maps.

Table 1 recorded data on the flash memory

No.	Lat.	Long.	Date/Time
1	2.251961	102.270741	10/02/2018 08:40
2	2.237563	102.286953	10/02/2018 21:06
3	2.2515444	102.2452784	11/02/2018 04:30
4	2.2324183	102.281143	11/02/2018 20:53
5	2.251961	102.270741	12/02/2018 12:10
6	2.2524283	102.2749291	12/02/2018 01:17
7	2.1901261	102.2531906	12/02/2018 19:10
8	2.2711554	102.2901603	12/02/2018 17:15
9	2.3106947	102.3200757	13/02/2018 10:40

The locations in Table 1 have been visited at different intervals to check the proposed system at different times of day. According to the information in table 1, the accuracy of this approach is about 67% better than GPS based localization in a cloudlessness day. That is due to the number of locations that were located in more accurate possession. In fact, the results were very good and accurate and based on several factors that positively or negatively affect the accuracy for that location. These factors are the weather conditions and the nature of the place in terms of the momentum of things and objects around the specific location.

4. CONCLUSIONS

The proposed system plays an important role in VTSs real-time-based. The results indicate a significant success in term of accuracy depending on the elicited data from the system which gathered during the testing stages. Information such as the traveled distance and current location details are viewed on a digital map by using Google maps. This system allows the company owners, managers, or private individuals to keep track of their vehicles in real-time. In future, a hybrid system can be implemented by using both techniques (cell tower and GPS) based localization. At one time two signals can be brought and compared with each other to get more accurate location.

REFERENCES

[1] S. R. Nalawade and S. Devrukhkar, "Bus Tracking by Computing Cell Tower Information on Raspberry Pi," in *2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication (ICGTSPICC)*, 2016, pp. 87–90.

[2] M. Abinaya and R. Uthira Devi, "Intelligent Vehicle Control Using Wireless Embedded System in Transportation System Based On GSM and GPS Technology," *Int. J. Comput. Sci. Mob. Comput.*, vol. 3, no. 9, pp. 244–258, 2014.

[3] G. Garg and A. Kaur, "Study of Various Vehicle Detection Techniques – A Review," *Int. J. Adv. Res. , Ideas Innov. Technol.*, vol. 2, no. 3, pp. 1–5, 2016.

[4] H. Jian-ming, L. Jie, and L. Guang-Hui, "Automobile Anti-theft System Based on GSM and GPS Module," in *Intelligent Networks and Intelligent Systems (ICINIS) 2012 Fifth International Conference*, 2012, vol. 1, no. 3, pp. 199–201.

[5] P. Zhou, Y. Zheng, and M. Li, "How Long to Wait? Predicting Bus Arrival Time with Mobile Phone Based Participatory Sensing," *IEEE Trans. Mob. Comput.*, vol. 13, no. 6, pp. 1228–1241, 2014.

[6] P. A. Shinde and Y. B. Mane, "Advanced vehicle monitoring and tracking system based on Raspberry Pi," in *Proceedings of 2015 IEEE 9th International Conference on Intelligent Systems and Control, ISCO 2015*, 2015.

[7] S. Almishari, N. Ababtein, P. Dash, and K. Naik, "An Energy Efficient Real-time Vehicle Tracking System," in *2017 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PACRIM)*, 2017.