International Journal of Engineering Research and Development
e- ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 22, Issue 5 (May 2026), PP 275-286

Application of Internet-of-Things (IOTs) In Car Tracking and Control Based on Enhanced Global Positioning System (GPS) In Baanool Cloud

*Nwonye Charles A[1]. Onyia Tochukwu. C[2] Nweezekwunife Ozioma. G[3]
Department of Electrical/Electronic Engineering, Madonna University Nigeria, Akpugo Campus.[1]
Department of Electronic and *Computer Engineering, Nnamdi Azikiwe University, Awka.[2,3]*

Abstract
This project is focused on improving the accuracy of vehicle position and control on real time and comparing these accuracies based on the GPS readings sent to the user phone to be analyzed by the Google map and the GPS reading sent to the Baanool cloud to be analyzed. The main objective of this project is to study Internet of Things (IoTs) using Baanool cloud and use the GPS reading from the GPS module of the Raspberry pi 4 used as the controller to locate on real time the location of the vehicle and equally use the phone user interface with the SIM module of the Raspberry pi 4 and python programming to exert command actions like start, stop, check, tracker and quit engine on the controlled vehicle. This project used a Raspberry pi 4 controller with SIM module that interfaces with the user mobile phone to send received GPS readings to the user phone and receive command actions : start, stop, check, quit and tracker from the user phone. The GPS reading was equally sent to the Baanool cloud for location resolution and map visualization via a web based interface over the internet. Also, the GPS reading received by the user phone was used by the Google map to analyze and visualize the location of the vehicle on real time. The software part involved the use of python programming codes to design engine commands: start, stop, check, tracker and quit for the Raspberry pi 4 controller located in the Toyota Camry car used for this project. Also, python programming was used in the sending of the received GPS coordinates by the GPS module of the controller via the SIM module to the user phone. The communication between the raspberry pi controller and the user phone was through short message services (SMS). The experiment was carried out from seven different locations in Enugu, Nigeria for the testing of the engine commands of start, stop, check, quit and tracker to determine their effectiveness and the delay time between commands and actions by the engine. The project showed system accuracy of 98% on the average for the seven selected locations with delay time of 11.71 milliseconds on the average. The location accuracies of both Baanool cloud and phone resolved tracking (using Google map) were equally compared for seven different locations and that of the cloud showed accuracy of 98% on the average for the seven selected locations while tracking resolved by the user phone using Google map showed accuracy of 78% on the average for the selected seven locations. Hence, this cloud based application showed higher accuracy in location tracking than most available tracking systems using mobile phone for tracking resolution.
Keywords: *Internet-of-Things (IoTs), Car tracking, Raspberry pi 4, Global Positioning System (GPS) and Cloud Computing.*

Date of Submission: 03-05-2026 Date of acceptance: 16-05-2026

I. Introduction

In terms of innovation, the internet of Things (IoT) is seen as the internet's successor. All items may exchange data and communicate via data-detecting devices thanks to the Internet of Things (IoT), a sophisticated system that links them all to the Internet. It makes it possible to precisely recognize, discover, follow, observe, and supervise. It is a system that enhances communication between people and things, and between things. Systems in the Internet of Things will be connected to a lot of things [1,2,3]. Everyone relies heavily on vehicles and the road transportation network to get around in this densely populated mechanical world. Since the dawn of time, transportation has been an integral part of human development. The number of vehicles on the road increases in tandem with the population[4,5].

Of recent, there has been geometrical increase in the number of vehicles owned by individuals, corporate entities and government and the need to ensure safety and proper maintenance of these vehicles has given rise to a number of research works in vehicle tracking. The generalized issue with a lot of the works done in car tracking; borders on the accuracy of the tracking to the actual position of the vehicle in real time and the delay time between issuing commands by the user and the execution of commands by the tracking system installed in the car. Also, there has been increase in the theft of vehicles in Enugu, Nigeria especially the Toyota Camry lower models and other cars without key sensors due to the fact that car thieves use master keys to open the doors and start the cars and move them away. But with the command stop and the appropriate password used in this project, nobody would be able to start the engine of the car until the owner sends the command start with the right password. Also, in case of tracking the vehicle, the cloud based tracking used in this project has been shown to provide high level accuracy of about 97%.

This project shows an application of Internet of Things (IoTs) in vehicle tracking and control based on Baanool cloud computing which monitors vehicle positions and speed and also the use of user mobile phone interface to initiate commands like start, stop, check or quit engine via a short message service (SMS).

The core concept of the "internet of things" is that every device should be connected to the internet and any other relevant gadgets. The data generated by Internet of Things devices may be readily uploaded to the cloud and subsequently delivered across the internet to end users.

II. Literature Review

Previous studies by researchers have demonstrated that various wireless technologies, including RFID, IR, GPS, Bluetooth, and Wi-Fi, manage and monitor smart public transportation systems. This is done by merging information technology, cutting-edge methodologies, and smart sensing systems. In 2023, Mohamad Abd Rahman and Muhamad developed a remote vehicle monitoring system starting and tracking Using IoT System. The developed system used microcontroller which uses codes that are not easily mutable. It did not report about the accuracy of the location resolution by the system and used only two commands of start and stop on the motorcycle engine that was used. It did not report on the delay between the issuance of the command and the response of the engine [1]. A smart bus transportation system is developed and introduced using GSM, GPS, and Arduino with accuracy of 68% in location [5,6]. Also some researchers used Wi-Fi and a Smartphone application for real-time bus tracking and had serious issue of location accuracy [8]. The programmer sends data to the cloud using the address of the bus terminal, where it is then retrieved and displayed to the user via a mobile app. The tracking system includes installing GPS, RTC, and Arduino UNO in a bus as well as an Android App that can be used to follow buses and determine the distances between stations along their routes. There was reduced accuracy on the location and speed of the bus. Also, Smart Vehicle Speed and Location Tracking System Using IoT was developed by Amarendra et al for tracking of vehicle position and speed. Though, the developed system used Internet of Things with cloud server for processing of GPS coordinates from the controller's GPS module, it did not report any information on the system's accuracy and concentrated on location identification and speed monitoring. However, it did not have any interface to control the engine of the vehicle in terms of initiating commands like start, stop, check, tracker or quit [5-7]. In 2021, Egwuonwu Adolphus C et al presented an article on Vehicle Monitoring System based on Internet of Things (IoT), using 4th generation (4G) / Long Term Evolution (LTE) to monitor the speed, location, fuel level and routes followed by vehicle but did not present any work on the percentage accuracy of the work. The work did not include commands to the engine like start, stop, quit, check and tracker which are needed in today's vehicle tracking so as to have complete control of the vehicle[8].

III. Materials and Methods

The materials used in this project are divided into two: the hardware components and the software components.

3.1 Hardware Components

These are those components of the project which we can touch and see. They are the physical components of the project as explained below:

(a) Raspberry pi 4: It is a mini computer on a very small motherboard that runs on a raspbarian operating system. It has 2 universal serial buses (USBs), 1GB RAM, 4G/LTE SIM module, two camera input ports, 2 Universal Asynchronous Receiver Transmitter (UART), microprocessor, 2 High Definition Multimedia Interface (HDMI) as shown in figure 1[9,10].

Figure 1: Raspberry pi 4

(b) GPS Module: It is the component that receives the GPS coordinates of latitude and longitude from the satellite for location resolution. It receives these coordinates and sends them to the controller. Then the raspberry controller sends these coordinates to the user mobile phone via SIM module as SMS and also to the Baanool cloud via SIM module (4G/LTE) over the internet. The GPS module is shown in figure 2.

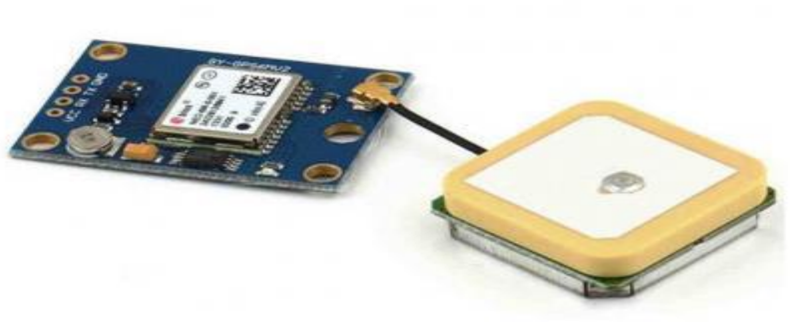


Figure 2: GPS Module

(c) Vehicle Ignition Circuitry: It is the circuitry that controls the ignition of the vehicle turning ON or OFF.
(d) Relay: It is an electromagnetic switch that is used to start or stop the vehicle ignition circuitry. It starts the engine when the raspberry pi 4 controller receives a genuine start command with the right password and triggers it on. Also, the controller deactivates the relay to stop the engine when it receives a genuine stop command with the right password.
(e) Other sensors: The system can accommodate other sensors or input devices like fuel sensors, temperature sensors, water sensors, speed sensors etc.
(f) User Mobile Phone: This is the mobile phone of the vehicle owner with a registered 4G/LTE SIM . It initiates the commands of start, stop, check, tracker or quit engine and also receives the coordinates of locations from the controller using SMS.
(g) Vehicle: The tracked vehicle used in this project is a Toyota Camry 2003 car.

3.2 Software Components
This involves the software and control programs used in the development of the tracking system as discussed below:
(a) Python programming language: The commands issued from the user mobile phone to start, stop, check, track or quit the vehicle's engine are writing in python language. We used python here because it uses English language with very dense syntax and rich library [11, 12, 13].
(b) Baannool Cloud Software: It was downloaded from Google play store into the user mobile phone. The user registers the 4G SIM number, particulars of the vehicle, user name and password. Then, with the user name and password, the vehicle owner can always visit Baanool cloud to access the location of his registered vehicle in the cloud.
(c) Control progam: It is the sequence of steps followed to achieve the project implementation. It will be discussed under the method sub-section.

3.3 Methods
It involves all the methods employed in other to achieve this project as discussed below:
(a) Hardware connections and troubleshooting: Here, the different hardware in section 3.1 are connected to the Raspberry pi 4 controller as shown in figure 3. The Raspberry pi is started by inserting an SD card with Raspbarian Operating system and powered using either Universal Serial Bus (USB) or Universal Asynchronous Receiver Transmitter (UART) port of 5V and 2.5A. You will need to enable Hardware Serial. Type **sudo raspi-config**, go to Interface Options, then select **Serial** and choose **yes**. After that, reboot the Raspberry. Before starting typing the Python script, you can try the commands that we will send to the HAT by installing minicom as stated below: Then open minicom and select the port you will use. We used UART interface - /dev/ttyS0 as the serial port of Raspberry 4B that was used in this project. To exit from minicom; press Ctrl + A, after that Q, select Yes. Type "AT" and press Enter, to get the status of the SIM module. You should receive OK as an answer. If you receive an Error, quit from minicom and enter again. Another command that we will use in our Python script is "AT+CREG**?**". When you type it in minicom you should receive +CREG: 0, 1 and if the second parameter (after the comma) is 1 (or 5), the network is registered successfully. **"**AT+CMGF=1**"** will be used just to set the SMS to Text mode. We don't need to get in deep with this command. Send a SMS to the SIM card's number while you are inside minicom. You will see notification like +CMTI: "SM",17, where the last

number indicates the index of the received message. In this scenario the index of the message is 17, and we can read it by typing "AT+CMGR=17" You will get something like CMGR: "REC UNREAD"', '"Your phone number"', '""', '"22/02/24', '17:13:13+08"\r\nHello World\r\n\r\nOK\r\n' .Please keep in mind that all phone numbers should be starting with + country_code. Last command that we used was to send SMS from Raspberry to our phone number. Type AT+CMGS="Your phone number" and click Enter. After that, type the message you want to send. When you are done, press Ctrl + Z. After few seconds you should receive the message on your phone. After this configuration of the Raspberry pi, the GPS Module was connected to it using the UART port. Also, the vehicle ignition circuitry is connected to the Raspberry pi controller using a relay that connects to one of the serial ports of the Raspberry pi 4B as shown in figure 3[14, 15].

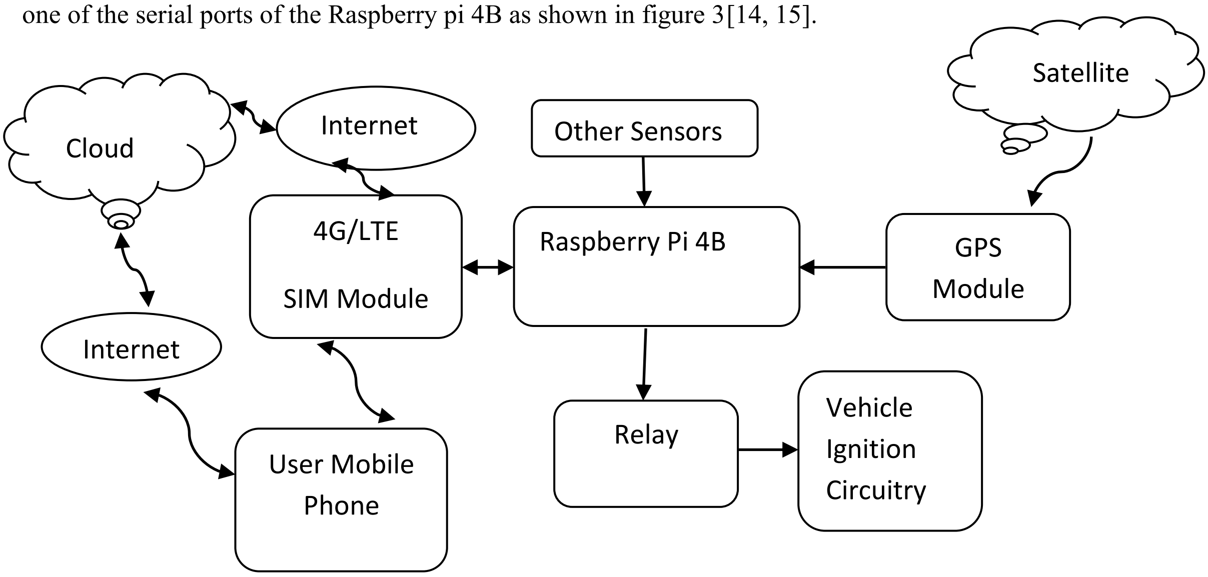


Figure 3: The block diagram of the developed Internet of Things tracking system based on Baanool cloud

(b) Development of the control programs: The control programs for this project were developed from the control flow chart of figures 4 and 5. Figure 4 represents the control flow chart for the issued command to the vehicle engine from the user mobile phone while Figure 5 represents the control flow chart for the tracking of the vehicle by both Baanool cloud and the Google map in the user mobile phone.

(c) Python Programming Language for the Vehicle engine commands issued from the user mobile phone: In the course of this project, a python function named car_engine_control was developed to execute the commands of ‘start’, ‘stop’, ‘check’, ‘tracker’, ‘quit’ on the vehicle engine when issued from the user mobile phone with the correct password. The developed function is as shown below:

```
Import getpass
def car_engine_control( ):
    ”””Vehicle control with password”””
     Password=correct_password
     engine_on= False
     while True:
          command=input(“Enter ‘start’, ‘stop’, ‘check’, ‘tracker’, ‘quit’:”).lower( )
          if command= = ‘start’:
             password=getpass.getpass(“Enter password:”)
             if password= = correct_password:
                if engine_on:
                  print(‘engine already started’)
                elif engine_on= = True:
                    print(‘engine started’)
             else:
                  print(‘wrong password’)
            elif command = = ‘stop’:
                 password=getpass.getpass(“Enter password:”)
                 if password= = correct_password:
                    if engine_on= =False
                       print(‘engine already stopped’)
                    else:
                         print(‘engine stopped’)
```

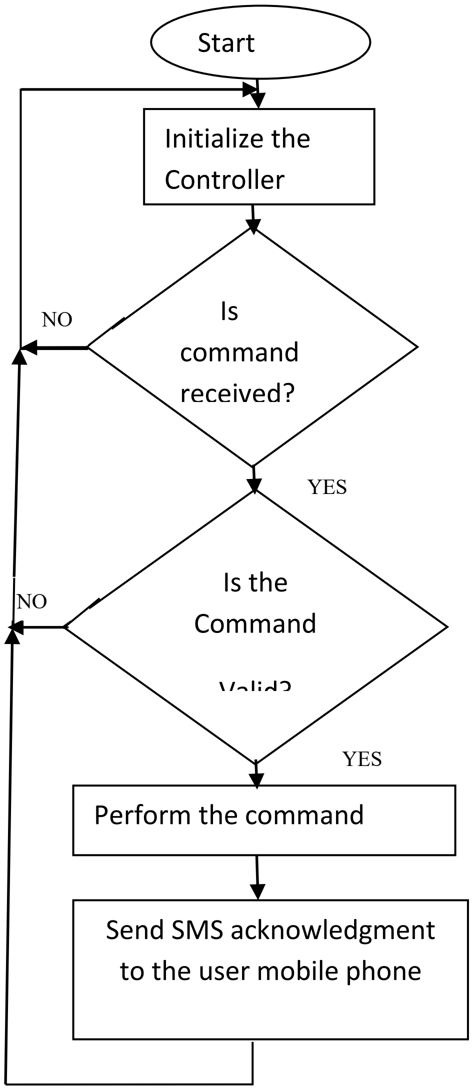
```
         else:
              print('wrong password')
    elif command = = 'check':
        password=getpass.getpass("Enter password:")
        if password= = correct_password:
           if engine_on:
              print('engine is running')
           else:
                print('engine is not running')
      elif command = = 'quit':
           password=getpass.getpass("Enter password:")
           if password= = correct_password:
              print('exit program')
              break
            else:
                 print('wrong password')
```

3.4 Testing of the developed vehicle IoT tracking system based on Baanool cloud

After the development of the tracking system, it was tested at seven different locations in Enugu, Nigeria to determine the accuracy of the developed system as discussed below.

(a) Testing of the engine commands at the seven selected locations in Enugu, Nigeria: The commands of 'start', 'stop', 'check' and 'quit' were issued to the vehicle engine from the user mobile phone using the correct password by sending SMS to the registered 4G/LTE SIM in the SIM module of the Raspberry pi 4B controller in the format 'commandcorrect_password' at the different seven locations. Also, the time delay between issuing of commands by the user mobile phone and the execution of the commands by the vehicle tracking system was recorded as delay time in each of the seven different selected locations in Enugu. At each location, the commands were repeated ten times to determine the failure rate. The results of these testing will be shown and discussed in section 4.0.

(b) Tracking of the vehicle at the seven selected locations in Enugu, Nigeria: Since, the GPS module attached to the Raspberry pi 4B controller receives these coordinates in latitude and longitude from the satellite, it always sends them to the cloud while only sends to the user mobile phone on request via SMS with the correct password. When a user needs location coordinate of the vehicle, the user has to use the mobile phone to call the registered 4G/LTE SIM in the SIM module of the Raspberry pi 4B. The call will ring three times and drop. Once, it drops, the coordinates of the vehicle is sent to the user phone from the registered SIM in the SIM module of the Raspberry Pi 4B. Then on clicking the received message, the installed Google map visualizes the location of the vehicle on a map. The vehicle was parked at seven different locations and the coordinates sent to the cloud and google map of the phone were used to perform location identification of the vehicle. At each of the selected location, the actual distance between the vehicle and the road; and the distance between the vehicle and the road on the cloud map and Google map were equally determined and used to calculate the accuracies of both the Baanool cloud and the Google map. These results will be shown and discussed in section 4.0.



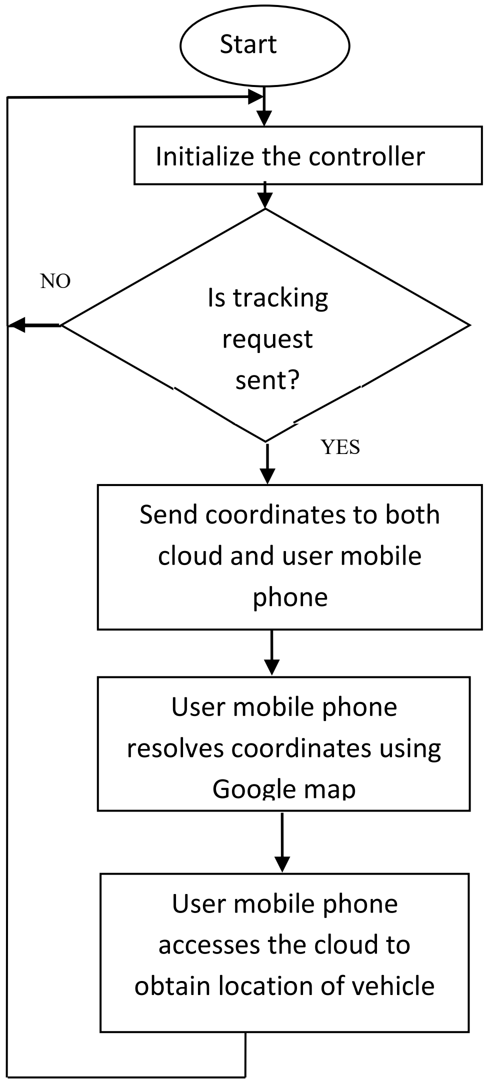


Figure 4: Control flow chart for commands to the vehicle **Figure 5: Flow chart for vehicle tracking**

IV. Results and Discussions

The results of the different testing carried out in section 3.4 will be presented and discussed here as detailed below.

4.1 Results of testing of the engine commands at the seven selected locations in Enugu, Nigeria: The details of the results are represented in table 1 and table 2. Table 1 shows the delay time between when the user mobile phone issued a command to the vehicle engine to when the engine executed the command. From equa. 1, the delay has average value of 11.71milli seconds which is very nice and highly acceptable in data communication since data communication accepts time delay (latency) below 100milli seconds. Hence, the response of the vehicle engine to the issued commands was very timely. Also, the figure 6 showed that in areas of heavy user mobile traffic like markets and parks (LOC 2, LOC 3, LOC 6 and LOC 7) showed high time delay for the engine commands while residential areas like LOC 1, LOC 4 and LOC 5 showed low time delay due to less user mobile traffic in those areas in the day time. Table 2 shows the attempt of ten commands and failed commands in each of the selected locations. Equation 2 is used to determine the failure rate at each of the seven locations using ten commands attempts as shown in table 3.Also equation 3 was used to calculate the average engine command failure rate as 14.29% which is reasonably low and acceptable.

Table 1: Time delay between command and engine execution of command at the seven different locations

Serial NO	Locations	Locations ID	Time delay (milli seconds)
1	8,Umuaniachi Street, Enugu.	LOC 1	6
2	Timber Market, Kenyatta, Enugu	LOC 2	20
3	Mayor Market, Enugu.	LOC 3	17
4	5, Awuda Street, Enugu.	LOC 4	4
5	12, Press Lane, Enugu.	LOC 5	5
6	Old park, Enugu.	LOC 6	16
7	IMT, Enugu.	LOC 7	14

$$\text{Average delay time} = \frac{(6+20+17+4+5+16+14)}{7} = \frac{82}{7} = 11.71\text{milli seconds} \qquad \text{Equa.1}$$

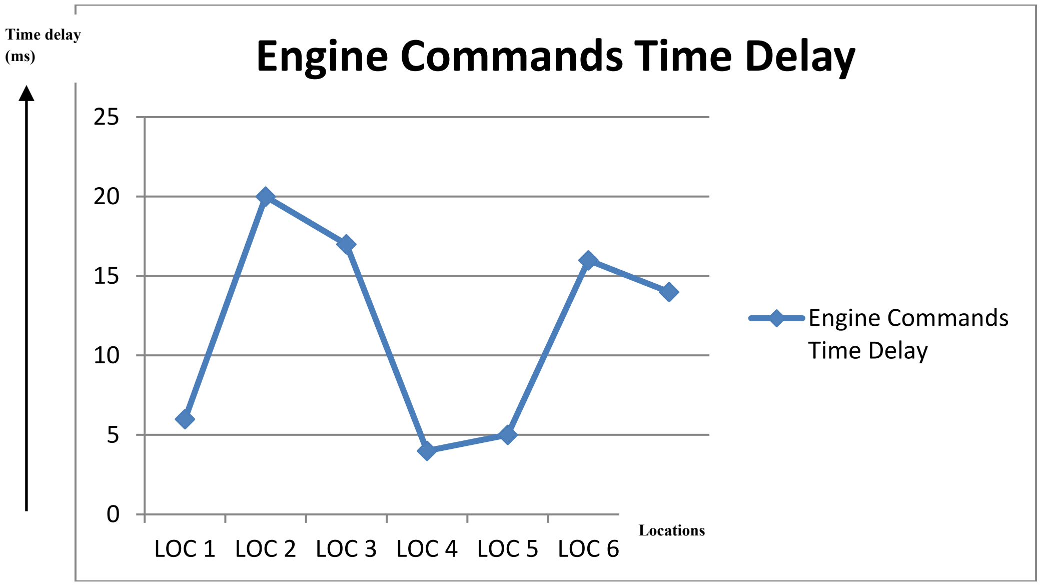


Figure 6: Time delay of engine commands at different locations

Table 2: Number of failed and successful commands in each of the selected locations

Serial NO	Locations	Locations ID	Number of failed commands	Total number of commands
1	8,Umuaniachi Street, Enugu.	LOC 1	0	10
2	Timber Market, Kenyatta, Enugu	LOC 2	3	10
3	Mayor Market, Enugu.	LOC 3	2	10
4	5, Awuda Street, Enugu.	LOC 4	0	10
5	12, Press Lane, Enugu.	LOC 5	0	10
6	Old park, Enugu.	LOC 6	4	10
7	IMT, Enugu.	LOC 7	1	10

$$Failure\ rate\ of\ command = \frac{(No\ of\ failed\ commands)}{Total\ No\ of\ Commands}\ X\ \frac{100}{1} \qquad \text{Equa. 2}$$

Table 3: Engine commands failure and success rates at the seven selected locations

Serial NO	Locations	Locations ID	Engine Commands' Failure rate(%)	Engine Commands' Success rate(%)
1	8,Umuaniachi Street, Enugu.	LOC 1	0	100
2	Timber Market, Kenyatta, Enugu	LOC 2	30	70
3	Mayor Market, Enugu.	LOC 3	20	80
4	5, Awuda Street, Enugu.	LOC 4	0	100
5	12, Press Lane, Enugu.	LOC 5	0	100
6	Old park, Enugu.	LOC 6	40	60
7	IMT, Enugu.	LOC 7	10	90

$$\text{Average commands}'\text{failure rate} = \frac{\text{Total commands}'\text{failure rate}}{\text{Total no of locations}} = \frac{100}{7} = 14.29\%$$
Equa. 3

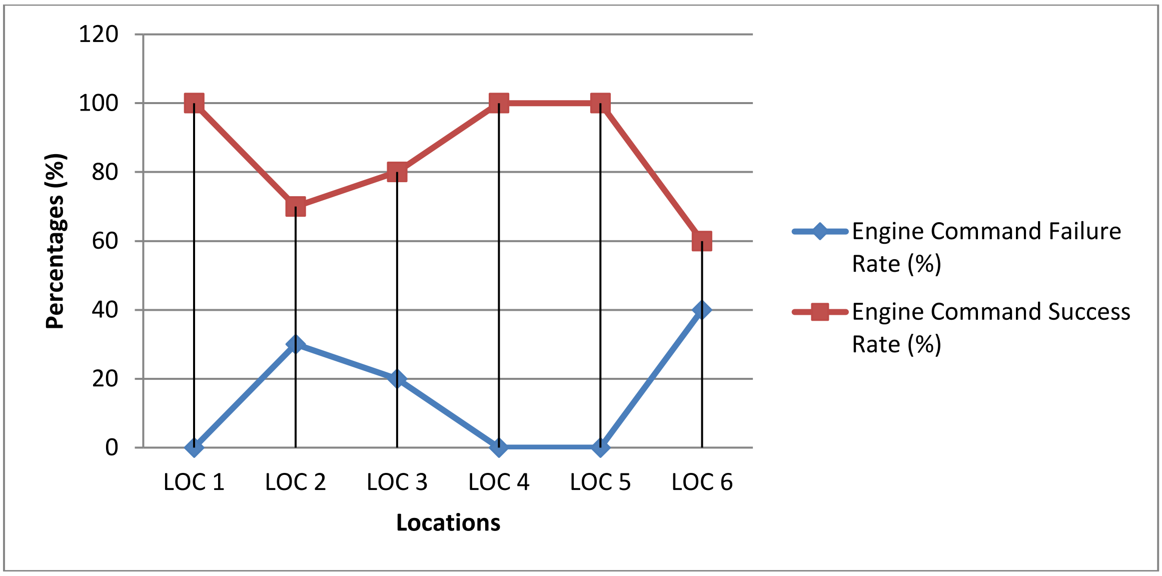


Figure 7: Engine commands success and failure rates at the different locations

Figure 7 showed the overall success and failure rates of the engine commands at the different selected locations where 60% to 100% success rates of engine commands were recorded across the locations. Also, 0% to 40% failure rates of engine commands were recorded across the seven different locations. Areas of high telecommunication traffic like markets and schools showed higher engine command failure rates with lower engine command success rate unlike residential areas with low telecommunication traffic in the day showed 100% engine command success rate with 0% engine command failure rates.

4.2 Results of tracking of the vehicle at the seven selected locations in Enugu, Nigeria:

This tracking result is divided into two: One carried out using the coordinates received by the user mobile phone and analyzed by the installed Google map in the phone and the second result was from the analysis of the tracking done by the Baanool cloud. In the first testing, the location precision of the vehicle by the GPS coordinates received by the user mobile phone was analyzed by the Google map and the distance from the vehicle to the access road was determined on the map and compared with the actual vehicle location from the road. This helped to determine the accuracy of the tracking using the Google Map. Also, the actual distance between the vehicle and the access road was measured by the resetting and turning on the use of GPS distance feature on the android phone and move from the vehicle to the selected access road and the distance apart will be displayed on the phone screen. Figures 8 and 9 showed the Google map of some of the selected locations in Enugu, Nigeria. Also, Table 4 showed the actual distance between the vehicle and the access road and the estimated distance between the vehicle and the access road as measured by the Google map.

Table 4: Actual distance between the vehicle and access road compared to the estimated distance by the Google map

Serial NO	Locations	Locations ID	Actual distance (m)	Distance estimated on the Google map (m)
1	8,Umuaniachi Street, Enugu.	LOC 1	10.00	7.80
2	Timber Market, Kenyatta, Enugu	LOC 2	6.00	4.68
3	Mayor Market, Enugu.	LOC 3	14.00	10.92
4	5, Awuda Street, Enugu.	LOC 4	5.00	3.90
5	12, Press Lane, Enugu.	LOC 5	8.00	6.42
6	Old park, Enugu.	LOC 6	6.50	5.00
7	IMT, Enugu.	LOC 7	8.70	6.50

Figure 8: Red indicator for the tracked vehicle at IMT Enugu on Google map.

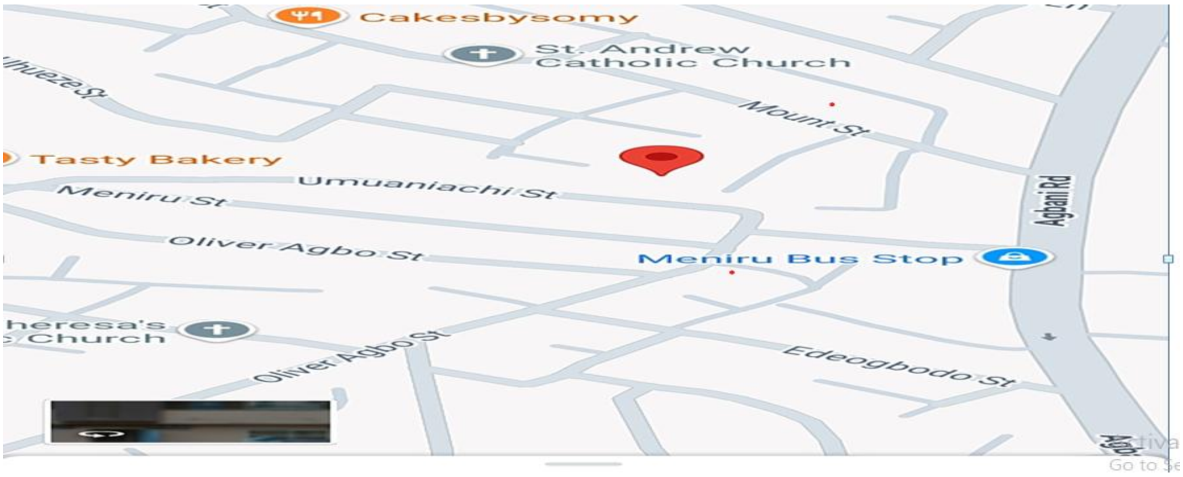


Figure 9: Red indicator for the tracked vehicle at Umuaniachi street Enugu on Google map.

This second testing was carried out using the coordinates received and analyzed by the Baanool cloud accessed by the user mobile phone over the internet. Just as in the first testing done with Google map, the location precision of the vehicle by the GPS coordinates received by the Baanool cloud from the registered 4G/LTE SIM in the Raspberry pi 4B was analyzed by the Baanool cloud and the distance from the vehicle to the access road was determined on the cloud and compared with the actual vehicle location from the road. This helped to determine the accuracy of the tracking using the Baanool cloud. Also, the actual distance between the vehicle and the access road was measured by the resetting and turning on the use of GPS distance feature on the android phone and move from the vehicle to the selected access road and the distance apart will be displayed on the phone screen. Figures 10, 11 and 12 showed the maps generated by the Baanool cloud of some of the selected locations in Enugu, Nigeria. Also, Table 5 showed the actual distance between the vehicle and the access road and the estimated distance between the vehicle and the access road as measured by the Baanool cloud.

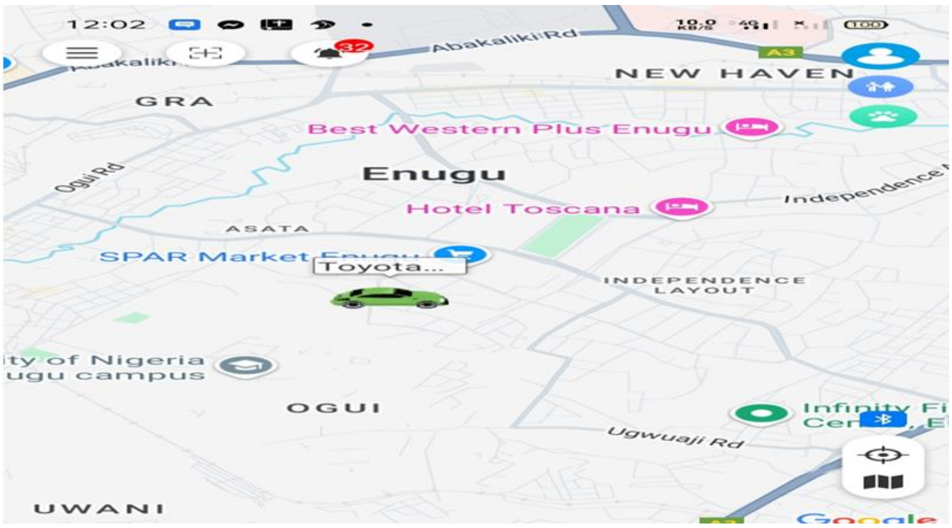


Figure 10: The tracked Toyota vehicle at IMT Enugu on the Baanool cloud

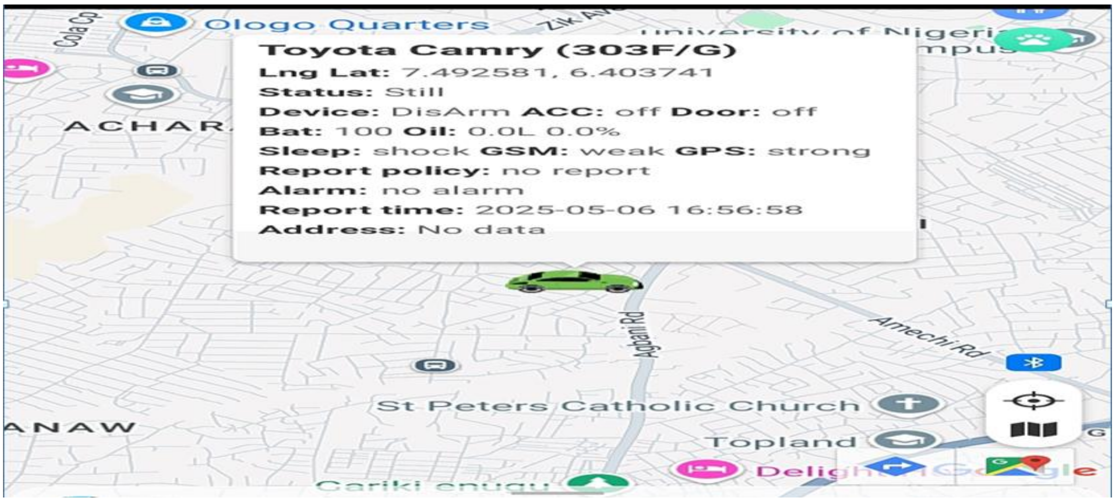


Figure 10: The tracked Toyota vehicle at Mayor market, Agbani road, Enugu on the Baanool cloud

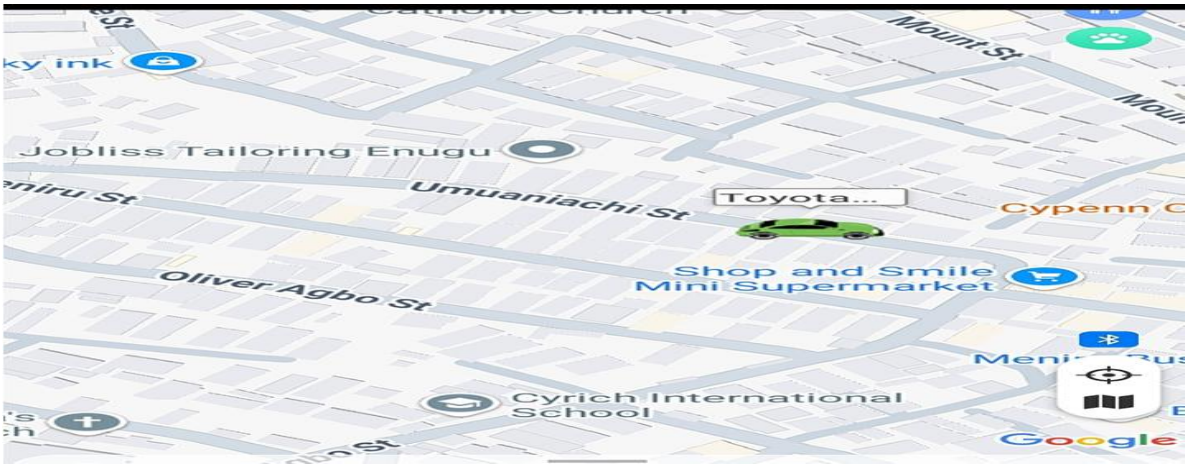


Figure 11: The tracked Toyota vehicle at Umuaniachi street, Enugu on the Baanool cloud

Table 5: Actual distance between the vehicle and access road compared to the estimated distance by the Baanool cloud

Serial NO	Locations	Locations ID	Actual distance (m)	Distance estimated on the Baanool cloud map (m)
1	8,Umuaniachi Street, Enugu.	LOC 1	10.00	9.80
2	Timber Market, Kenyatta, Enugu	LOC 2	6.00	5.58
3	Mayor Market, Enugu.	LOC 3	14.00	13.70
4	5, Awuda Street, Enugu.	LOC 4	5.00	4.90
5	12, Press Lane, Enugu.	LOC 5	8.00	7.79
6	Old park, Enugu.	LOC 6	6.50	6.34
7	IMT, Enugu.	LOC 7	8.70	8.45

4.3: Result of comparing the accuracies of the tracking by Google map and Baanool cloud

Using the equa. 4, the accuracies of the tracking by the Google map and Baanool cloud were calculated as shown in table 6. Also, Figure 12 showed that the accuracy of the tracking by Google map was consistent at 78% on the average while the tracking by the Baanool cloud showed very high accuracy of 98% on the average.

$$Accuracy\ of\ a\ tracking\ system = \left(\frac{Distance\ of\ tracked\ vehicle\ to\ the\ road}{Distance\ from\ actual\ point\ to\ the\ road}\right) \times \frac{100}{1}$$

equa. 4

Table 6: Actual distance between the vehicle and access road compared to the estimated distance by the Baanool cloud

Serial NO	Locations	Locations ID	Accuracy of Google map (%)	Accuracy of Baanool cloud (%)
1	8,Umuaniachi Street, Enugu.	LOC 1	78	98
2	Timber Market, Kenyatta, Enugu	LOC 2	75	95
3	Mayor Market, Enugu.	LOC 3	74	96
4	5, Awuda Street, Enugu.	LOC 4	80	98
5	12, Press Lane, Enugu.	LOC 5	78	98.5
6	Old park, Enugu.	LOC 6	75	96
7	IMT, Enugu.	LOC 7	78.1	98

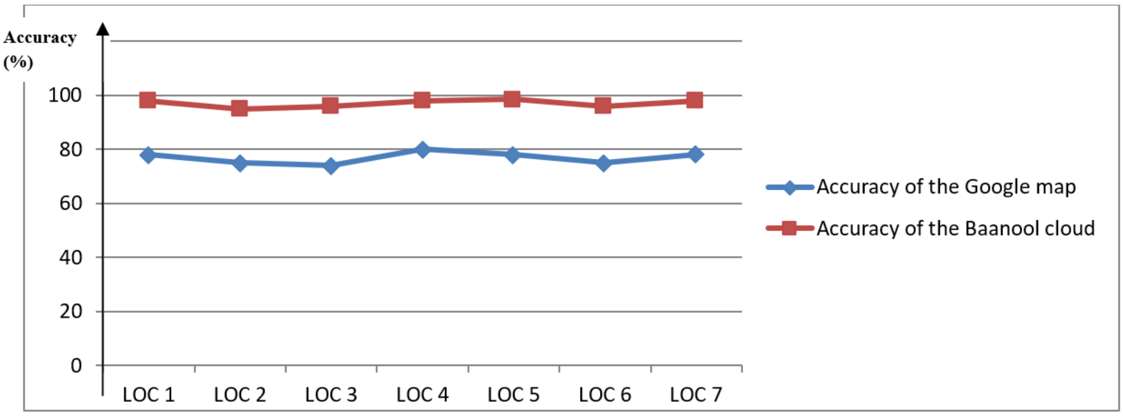


Figure 12: Accuracies of tracking by the Google map and Baanool cloud based on IoT

V. Conclusion

This project has been able to show the implementation of vehicle tracking based on the GPS coordinates received by the user mobile phone from the registered 4G/LTE SIM of the Raspberry pi 4B controller and analyzed by the Google map. It equally demonstrated the tracking of vehicle based on internet of things using Baanool cloud. It showed the accuracy of 78% on the average for tracking a vehicle with Google map over seven selected locations in Enugu and also accuracy of 98% on the average for the same tracking in the same locations using Baanool cloud. The commands of start, stop, check, tracker and quit were programmed using python programming language to control the engine of the vehicle at the selected locations with the success rates ranging from 60% to 100% while failure rates ranging from 0% to 40%. The engine commands showed time delay of 11.71 milli seconds on the average for the seven selected locations. Hence, the design showed that tracking of vehicle using internet of things based on Baanool cloud has better accuracy of location than using of Google map installed in the phone. It also showed that the engine commands recorded very high accuracies with minimum and acceptable time delays within the seven selected locations in Enugu, Nigeria.

Reference

[1]. Mohamad Izzul Sham Abd Rahman1, Syabillah Sulaiman1* and Muhamad Asri (2023). Remote Vehicle Monitoring System Starting and Tracking Using IoT System. Journal Of Automotive Powertrain And Transportation Technology Vol. 3 No. 1 (2023) 33-41 © Universiti Tun Hussein Onn Malaysia Publisher's Office **JAPTT** http://publisher.uthm.edu.my/ojs/index.php/japtt Journal of Automotive Powertrain and Transportation Technology e-\: 2821-286X **.**

[2]. NVIDIA. (2022). *Jetson Nano Developer Kit*. NVIDIA Developer. https://developer.nvidia.com/embedded/jetson-nano-developer-kit .

[3]. Ergin, İ. (2021). *Nvidia Jetson Nano Developer Kit - Overview*. Sixfab. https://sixfab.com/nvidia-jetson-nano-developer-kit-a-powerful-developer-kit-for-ai-robotics/

[4]. Anish Khanal, Manoj Shrestha (2024). Research and Appropriate Implementation on Vehicle Tracking System Using IOT. International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com . IJFMR240112591 Volume 6, Issue 1, January-February 2024
BioGecko Vol 12 Issue 02 2023
ISSN NO: 2230-5807
147

[5]. Amarendra Alluri, B.Raju, K.Manoj Kumar, CH.Vinod Kumar, D.Vasantha kumara (2024). Smart Vehicle Speed and Location Tracking System Using IoT. BioGecko Journal for New Zealand Herpetology, Vol 12 Issue 02 2024 ISSN NO: 2230-5807**.**

[6]. Writer, C. B. T., BasuMallick, C., Writer, T., & IZ, L. U. J. (2022). *GPRS working, advantages, applications*. Spice works. https://www.spiceworks.com/tech/networking/articles/what-is-gprs/

[7]. David. (2022). *Assured systems Nvidia Jetson family overview*. Assured Systems. https://www.assured-systems.com/us/nvidia-jetson-family-overview.

[8]. Egwuonwu Adolphus Chinonso, Okemiri Henry Anayo and Chioma Virginia Anikwe (2021).Vehicle Monitoring System based On IOT, Using 4G/LTE. International Journal of Engineering and Management Research e-ISSN: 2250-0758 | p-ISSN: 2394-6962 Volume-11, Issue-4 (August 2021) www.ijemr.net https://doi.org/10.31033/ijemr.11.4.2

[9]. Annamalai, B. (2022). *What are the common vehicle tracking problems?*. Lystloc. https://www.lystloc.com/blog/common-vehicle-tracking-problems/

[10]. Simon. (2023, March 9). *6 problems that are solved with GPS fleet tracking*. Forward Thinking Systems. https://www.ftsgps.com/resource-center/6-problems-that-are-solved-with-gps-fleet-tracking/

[11]. Nwonye C.A, Akpado K.A and Amaefule D.O (2024).Development of a Specie-specific Bird Deterrent System using Birds Classifications by Convolutional Neural Network (CNN) Model. Published in International Journal of Engineering Research and sciences ISSN:2395-6992,Vol-10, Issue-5, May- 2024, Pages 07 – 18 published online in IJOER; **DOI:** https://dx.doi.org/10.5281/zenodo.11452990.

[12]. Nwonye C.A, Akpado K.A and Amaefule D.O (2024).A Convolutional Neural Network Model for Harmful Birds Recognition and Deterrent in a Dynamic Rice Farm Associated With Bird Migration And Climate Changes [Published in International Journal of Engineering Applied Sciences and technology Vol. 8, Issue 12, ISSN No. 2455-2143, Pages 371-379 Published Online April 2024 in IJEAST (http://www.ijeast.com)].

[13]. Nwonye C.A, Akpado K.A, Alumona T.L, Oguejiofor O.S and Amaefule D.O (2024).Monitoring of Migration of Harmful Sparrow Birds in a Rice Farm Using Convolutional Neural Network (CNN) Model [Published in UNIZIK Journal of Engineering and Applied Sciences 3(2), September (2024) Pages 1144 - 1162. Journal homepage: https://journals.unizik.edu.ng/index.php/ujeas PRINT ISSN: 2992-4383 || ONLINE ISSN: 2992-4391].

[14]. Vladoiu, M. (2013). *Challenges in safety, security, and privacy of Vehicle Tracking Systems*. Problem of vehicle tracking.https://www.researchgate.net/publication/257671183_Challenges_in_Safety_Security_and_Privacy_of_Vehicle_Tracking_Systems .

[15]. Paul. (2022). *Vehicle Tracking System, Fleet Tracking Solutions - ScienceSoft*. ScienceSoft footer icon. https://www.scnsoft.com/fleet-management/vehicle-tracking.