A Secure Tracking Automobile System for Oil and Gas Distribution using Telematics and Blockchain Techniques

L. A. AJAO, J. AGAJO, O. M. OLANIYI, I. Z. JIBRIL, A. E. SEBIOTIMO

Abstract— **Crude oil is the major sources of income to most of the developed and developing countries. It is high significance as this natural resource contributed to the development countries wealthy, and cannot be over-emphasized. The distribution of oil and gas products in the developing ecosystem is mostly conveyed through the road networks, by engaging trucks and similar type of automobiles in the goods delivery. This approach of fuel distribution is susceptible to illegal diversion, tampering, vehicles hijacking and many others on-transit route. In this paper, we present the development of a secure tracking automobile system for oil and gas distribution using telematics and blockchain technology. This system helps in tracking the geo-location of automobile route and monitoring the volume of products loaded in automobile using telematics. The hash algorithm based blockchain technology approach helps to secure the system database and accomplished monitoring of the fuel volume records conveyed from agent tampering, diversion and hijacking. It prevents an individual concerned from remote database information altering or unscrupulous parties' intrusion. Also, it manages the archives and linking of the subsequent records through the developed secure distributed database system (blockchain). The secure in-vehicle tracking system uses a GPS (Tx and Rx) for the geo-location tracking, ultrasonic sensor (HCR05), SIM800 and ATmega328 microcontroller unit. This system was tested and evaluated in terms of accuracy and precision of the GPS receiver coordinates with a report of circular error probability radius of 15 meters and precision of 1.24 meters.**

Index Terms— **Automobiles, Blockchain, Database, Global Positioning System (GPS), Telematics.**

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I. Introduction

OVER THE YEARS, aside agriculture and other related occupations in Nigeria, Oil and Gas has been the most source of nation revenue generation and as major dependent economy-driven. This has been the situation since the discovery, exploration and mining of crude oil in the country. Petroleum products in this context refer to the fuel components like premium motor spirit, domestic pure kerosene, and automotive gas oil [1]. The transportation of this products (petroleum) is structured from refineries to the depot through piping networks [2], and to the individual marketers using automobile through road networks. These activities require adequate coordination, monitoring and effective control. Crude oil as a raw materials product mining in large quantities faces terrible challenges of distribution that usually emanate to the fuel scarcity and price inflation. Also, inefficient distribution networks and lack of database record management outcome causes greater percentage of this product being flared off [3].

The Global Positioning System (GPS) is the satellite-based navigation maintained and operated by the government of the United States of America. It provides global geo-location and time services to GPS receivers within line of sight [4]. The origin of GPS started in the sputnik era where scientists determined satellites location by analyzing the doppler effect on the radio signals. Later, the US Navy was able to determine the location of submarines with six satellites orbiting from the north to south poles. This precedent approach helps the US Department of defense's Navigation System with Timing and Ranging (NAVSTAR) in direction finding which became fully implemented in 1993 with 24 satellites [5, 6].

Therefore, the satellites are made to orbit at an altitude of 20,200 km, it revolves round the earth twice every day and is divided into 6 orbital planes, and inclined at 55° to the equator. The GPS satellites transmit information using radio waves at frequency (1 – 2) GHz and wavelength ranging from (15 – 30) cm L-band [7, 8].

The terms telematics was defined in [9, 10] as a French acronym Telecommunication and Informatics. This practice in wireless network applications is responsible for an active role such as Wireless for the Vehicular Environment (WAVE) or Intelligent Transportation System (ITS) and computational system. Telematics approach is used as the broadcast or sending a remote information through telecommunications devices [11].

This technology utilized a GPS-based artificial satellite and onboard diagnostics system (database) to record geographic information on a computerized map. Telematics is also called black box, an intelligent in-vehicle computer that recorded information based on geographic location and its environs in the On-Board Diagnostics System (OBD) [12]. Telematics techniques can be used to acquire large information remotely by integrating wireless sensors, multimedia devices and other connected hardware components.

A full-functional of telematics system can be built with, GPS transmitter and receiver, GSM module with SIM card, accelerometer sensor, ultrasonic sensor, buzzer, intelligent microchips input/output interface (port) and many others. The in-vehicle telematics system covered a wide area of application as in salts and sands spreader tracker, driving cameras, electronic logging displays (ELDs) and weather forecasting alert [13].

Blockchain is newly emerged and notable bitcoin technology for adequate security of distributed ledger in the database. It offers advanced platform of both decentralized and transparent transaction mechanism for all industries and businesses. This characteristics of the blockchain security is adapted in the developed system to improve trust and remote monitoring through the transparency and traceability of transaction of data resources carried out. Despite the initial doubts about this technology, governments and large corporations have recently investigated and improving on this technology in the applications domain like finance, social and legal industries, manufacturing and supply chain networks [14].

Blockchain technology makes it possible to store data in such a way that multiple peers can view, copy and update records in a real time. It is very difficult to make changes on the data secure with blockchain technology illegally or individually which helps to strengthens trust in a blockchain's content [15]. A standout amongst the most important parts of utilizations based on blockchains is that empower business to be directed with untrusted and obscure clients.

The outstanding parts of this article are organized into five sections. The reviewed of the existing related works are presented in section II. Methods and materials involved in this research are details outline in section III. While section IV discussed results, and research is finally concluded and recommended for further research in section V.

II. Related Works

A number of related works exist in literature. A GPS-based vehicle location tracking system using smartphone application interfaced with the google maps API for the location display and other related information was developed in [16]. An in-vehicle tracking system using GPS and GSM modem was developed by [17]. This system transmits information in form of SMS to a mobile phone with encoded format.

An embedded Bluetooth technology system was developed to acquired information about the proof of network location with security measure using blockchain in [18]. This system is used to determine the location of devices in a peer to peer network. The proofs of locations are essential for the proper functioning of location-based services which are dependent on the accuracy of the reported locations. The system functioning with the concept of mutual location verification between peers in the same geographical location through a short-range wireless communication device.

A telematics-based multiple vehicle monitoring was proposed in [19-21] using GPS, cell phone and network facilities for the in-vehicle application. This system renders a remote service communication through the wireless networks connectivity and the satellite positioning.

The dominant distributed networks of the petroleum products in Nigeria are conveyed through the roads and pipelines network. Unfortunately, these distribution networks are associated with various challenges such as pipeline vandalism, automobile fuel hijacking, tampering, robbery and diversion. [2, 22-23].

Our contribution in this research focus on the development of an embedded system-based in-vehicle tracking gadget prototype using GPS (Telematics approach) for automobile fuel hijacking as discussed in sub-section IIIA. This technique helps to monitor the oil and gas volume of an automobile conveyance, tracking the vehicle route and also taking into consideration the geo-location of automobile direction. The implementation of secure hash blockchain techniques is to managing the transaction record in the database, to ensure the cooperative agreement and unanimous consensus of the participant in the chain as discussed in sub-section IIIB. Also, adequate management of dynamic information received, stored, updated, deletion in the database. The section IV illustrates the results and discussion of proposed methods using telematics and SHA-1 based blockchain algorithm.

III. Methods and Materials

The methods adopted in this research are in two folds. These are hardware system design and secured software coding using synergistic combination of telematics approach and secure hash blockchain database management system. The hardware-based telematics component includes GPS module (NEO-6M), GSM module (850-EGSM), Arduino Uno board (ATmega 328), Ultrasonic sensor (HC-SR04), printed circuit board and jumper connectors. The software used for coding are C-language for hardware programming in Arduino IDE, Python language for secure hash algorithm, HTML and manipulation query language for secured distributed ledger database development (Blockchain). The complete developed system architecture is illustrated in "Fig. 1" which help to monitor, tracking and transmit the geo-location information to the database in a real time, as well as the information about petroleum volume level in the automobile. This acquired information is transfer to the remote server (secure database) through the telematics system in a real-time.

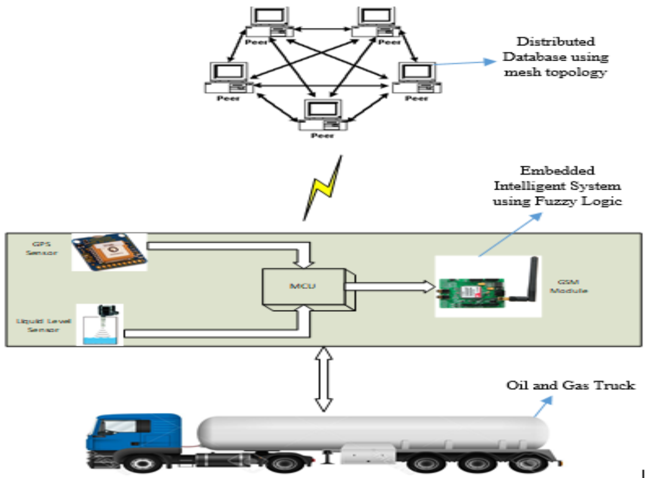

Fig.1. In-vehicle based telematics and blockchain architecture

A. Hardware System Design

The hardware system consists of the controller unit, sensor unit, power supply unit, and the communication unit, all are integrated to function as telematic system. The system circuit sketch was designed and simulated in proteus virtual simulation model (PVSM) as demonstrated in "Fig. 2".

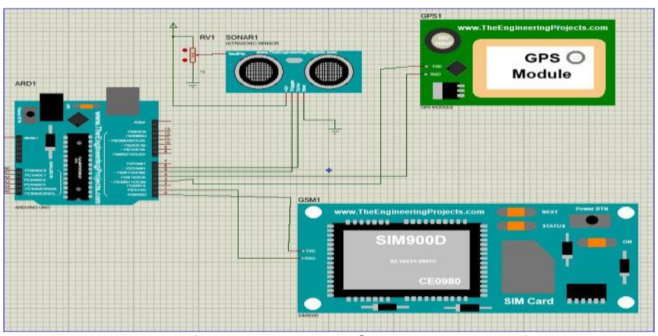

Fig.2. System circuit simulation in Proteus VSM

The sensing and communication unit comprises of the GPS (Ublox Neo 6M) transmitter-receiver (Tx/Rx), GSM and ultrasonic sensor. The GPS Tx/Rx used to obtain the latitude and longitude of geo-location, while the ultrasonic sensor used to determine the level of the liquid volume and measure distance to itself. This result obtained are sent to the microcontroller via transistor-transistor logic (TTL), and the controller transmit it to the server database periodically through the GSM module which utilize short messaging service (SMS).

The configuration of this GSM module with microcontroller is achieved through serial pins or communication port (UART) as illustrated in "Fig. 3". This SIM800L communication module supports TCP and IP protocols, AT commands, and it was selected because of its proliferation (network frequencies, and relatively small size). The power supply of 7.4v LiPo battery with a DC-DC step-down buck converter was used to regulate the voltage output.

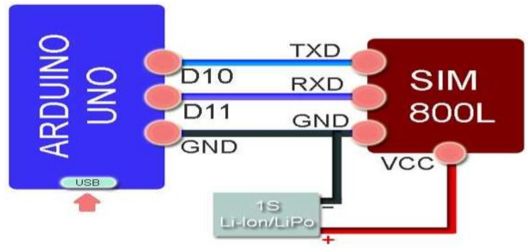

Fig.3. GSM module (Sim800L) logical connection

B. System Operation Principle and Design

The ultrasonic sensor (HC-SR04) is mounted on top of the automobile tank for liquid level monitoring which operates on the principle time of flight. This emitted waves from ultrasonic sensor used to determine the distance from a target (fluid surface) in the tank. The distance covered was used to determine the liquid level by setting trigger ultrasonic sensor to a logical high for 10 microseconds, then return to low, after the sensor emits waves and waits for reflected waves. Then, the echo pin of the sensor goes high for a duration time that is proportional to the distance of the target which allow the acquired data to be communicate to the microcontroller. The operation flowchart is illustrated in "Fig.4".

The implementation of in-vehicle tracking system prototype (using telematics method) is integrated with automobile oil and gas tanker as shown in "Fig. 5" and "Fig. 6". This prototype accomplished the objectives of geo-location tracking, volume monitoring in case of leakages or stealing and remote communication of geo-information to the server database.

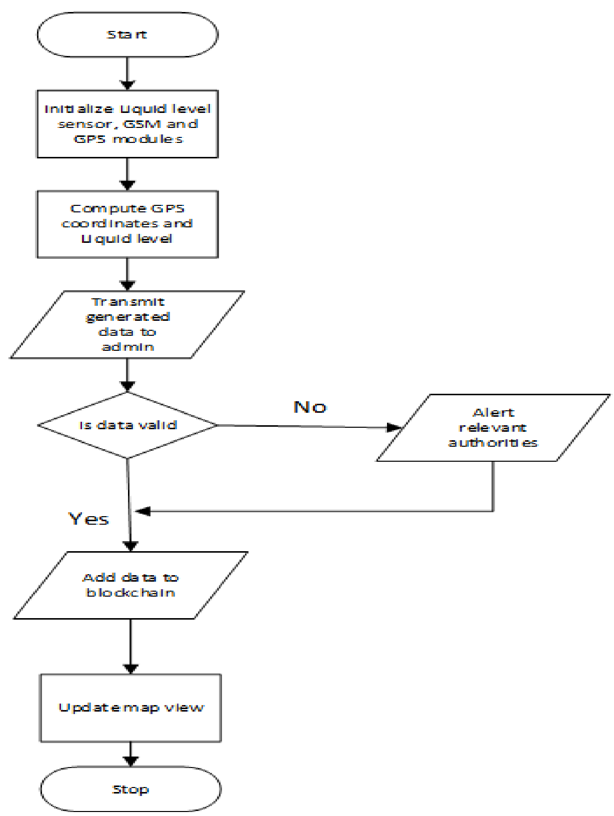

Fig.4. The hardware system operation flowchart

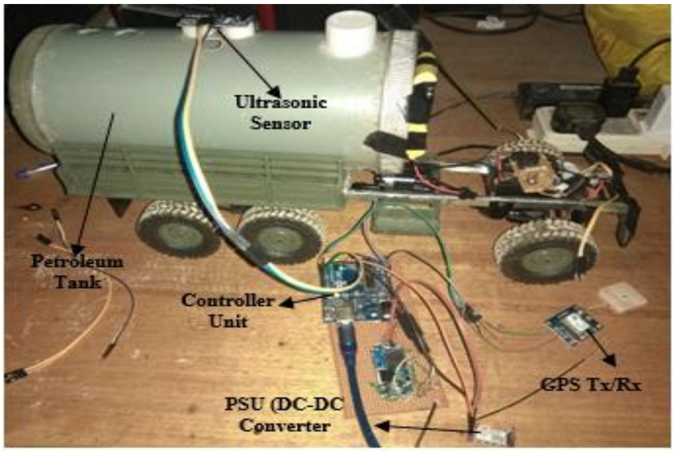

Fig. 5. A developed oil and gas automobile tanker tracking system prototype


Fig. 6. Packaging of oil and gas automobile tanker tracking system prototype

1) Time of flight (ToF) of emitted ultrasonic waves to determine distance

The Time of Flight (ToF) of sound wave produced by ultrasonic sensor can be described as a speedy dimension of distance for the various application of the in-vehicle based telematics system. These are motorized driver assistance system, drones, and some graphic user interfaces. This method require technicality in the design for the system performance benchmark which includes the system response time, accuracy, power consumption range and the available footprint. “Fig. 7” illustrate technical approach of measuring distance that correlate the transmitted and reflected signal to a target of the in-vehicle telematics system. In this scenario, a transmitter produces a square wave modulated signal while the target reflects sound back to the receiver which is correlated to the transmitted signal of an intelligent controller. The time of flight is measured by computing the range of distance to the target.

Therefore, amplitude of the reflected wave signal (Ar) emits can be express as in Eq. (1), refraction of emits wave signal transmitted from one medium to other experiences changes in its medium which can be calculated as expressed in Eq. (1).

$$A_r = \frac{R_1 - R_2}{R_1 + R_2} \quad (1)$$

Where,

R1 = ρ1c1
R2 = ρ2c2
ρ = Density of each material
c = Speed of the signal wave source
Ar = Ratio between the reflected wave signal and incident amplitude.

$$\frac{\sin(\theta_1)}{\sin(\theta_2)} = \frac{c_1}{c_2} \quad (2)$$

The critical angle (θ_c), when there is total refraction ray can be calculated as express in Eq. (3).

$$\theta_c = \theta_1 = sin^{-1}\frac{c_1}{c_2} \quad (3)$$

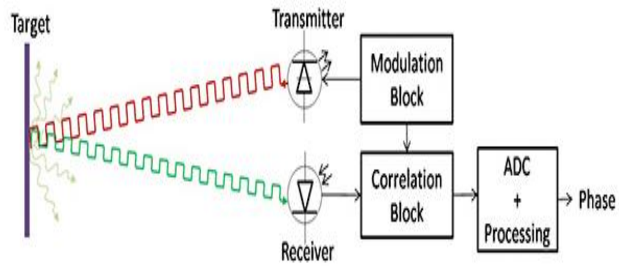

Fig.7. Time of flight computation to measure distance of signal transmitted to a target

2) Determining Vehicle Geo-location using the trilateration principle

The GPS receivers determine vehicle geo-location using the principle of trilateration. That is, principle of determining the absolute or relative geo-locations of a points in a geometry circle by measuring distances. This can be achieved when the distance of the receiver from the known locations is taken (four different satellites). Then, measurement of time taken for a signal to travel from a satellite to the receiver is used to determine the distance of the receiver from the satellite. The distance of the receiver (d), from a satellite illustrate that the receiver is located on a sphere (s) of radius (r) which found at centered on the location of the satellite [23].

The distance of the satellite from the location of the receiver can be shown by relating the coordinates of the receiver and GPS satellites in [19] from Eq. (4) to (7).

$$Pu_1 = \sqrt{(X - x_1)^2 + (Y - y_1)^2 + (Z - z_1)^2} - cd(T) \quad (4)$$

$$Pu_2 = \sqrt{(X - x_2)^2 + (Y - y_2)^2 + (Z - z_2)^2} - cd(T) \quad (5)$$

$$Pu_3 = \sqrt{(X - x_3)^2 + (Y - y_3)^2 + (Z - z_3)^2} - cd(T) \quad (6)$$

$$Pu_4 = \sqrt{(X - x_4)^2 + (Y - y_4)^2 + (Z - z_4)^2} - cd(T) \quad (7)$$

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Where
P_{u_n} = distance from satellite n.
(X, Y, Z) = coordinates of the receiver's location.
(x_n, y_n, z_n) = coordinates of any of the satellites.
cd(T) = time correction from satellite clock.

3) Distance calculation the target and ultrasonic sensor

The ultrasonic sensor sound wave is used to determine the distance from itself to any target or obstacle in its front. The distance is calculated using the principle of time of flight of sound waves where the time taken for emitted sound waves to travel away from and back to the sensor is proportional to the distance. The relation is as follows:

$$Distance\ (d) = \frac{s * t}{2} \quad (8)$$

Where
s = speed of sound in air.
t = time taken for reflections to reach sensor.
Data charts which are typically black and white, but sometimes include color.

C. Secured Software System Design

The software system programming was used for hardware coding, building of web applications and secure database (blockchain) development. The database and web application were created using structured query language (SQL), PHP, JavaScript, HTML and CSS programming languages. Also, for the implementation of secure hash algorithm, permissioned blockchain type was used for securing the database which consist of four basic nodes. The administrator, oil and gas depot, distributed filling station and the in-vehicle transporter. The login page from the web application are shown in "Fig. 8" and "Fig. 9". The C-language program was used for coding microcontroller functions and telematics system in Arduino integrated development environment (AIDE) as a cross-platform application written in java programming language. A secure-tracking system and distributed database architecture is shown in "Fig. 10". The processes and implementation of the secure hash algorithm based on blockchain technology are highlighted here.

1: Takes input text and splits it into an array of the characters' ASCII codes.
2: Converts ASCII codes to binary.
3: Pad zeros to the front of each bit until they are 8 bits long.
4: Join them together and append them to one (1).
5: Pad the binary message with zeros until its length is 512 mod 448.
6: Take binary 8-bit ASCII code array from step 3, get its length in binary.
7: Pad with zeros until it is 64 characters.
8: Append to your previously created binary message from step 5.
9: Break the message into an array of chunks of 512 characters.
10: Break each chunk into subarray of sixteen 32-bit words.
11: Loop through each chunk array of sixteen 32-bit words and extend each array to 80 words using bitwise operations.
12: Initialize some variables.
13: Looping through each chunk: bitwise operations and variable reassignment.
14: Convert each of the five resulting variables to hexadecimal.
15: Append them together and the result is your hash value or message digest.

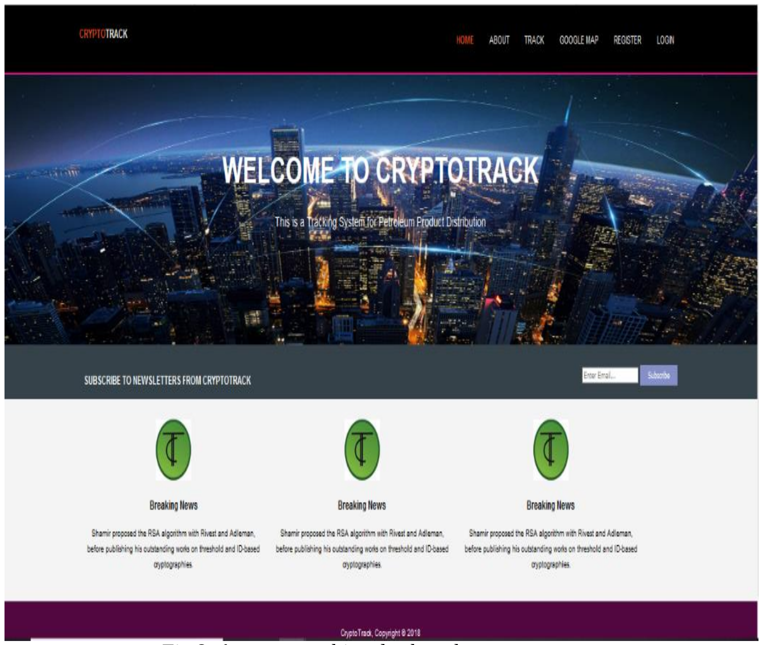


Fig.8. A secure-tracking database home page

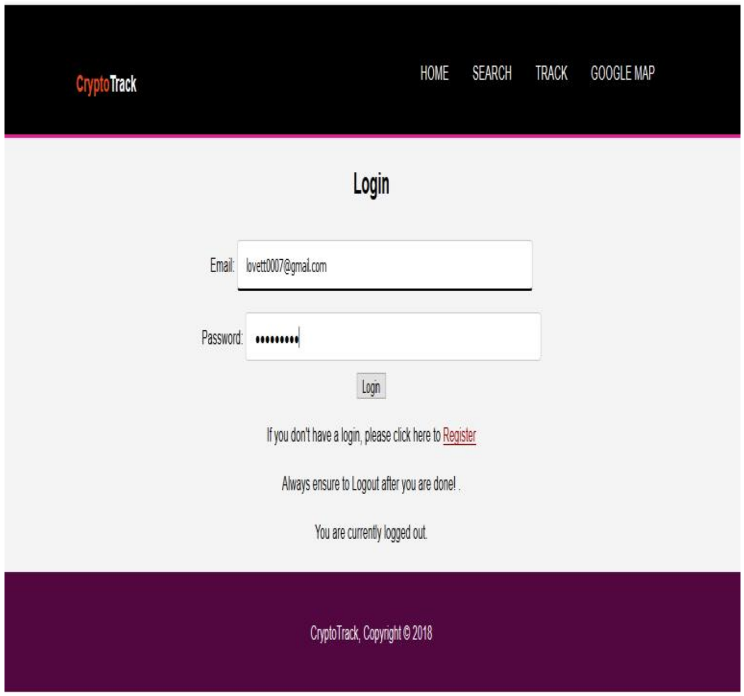


Fig. 9. Database login page

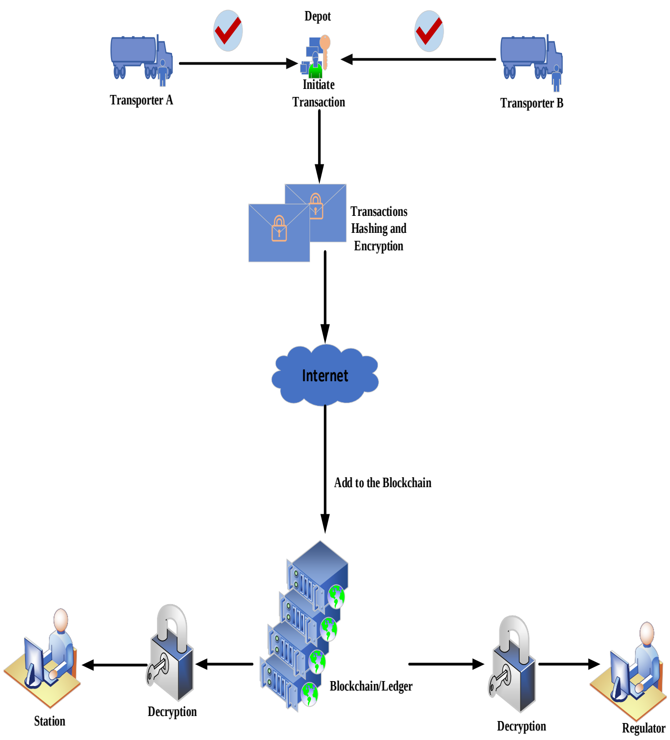
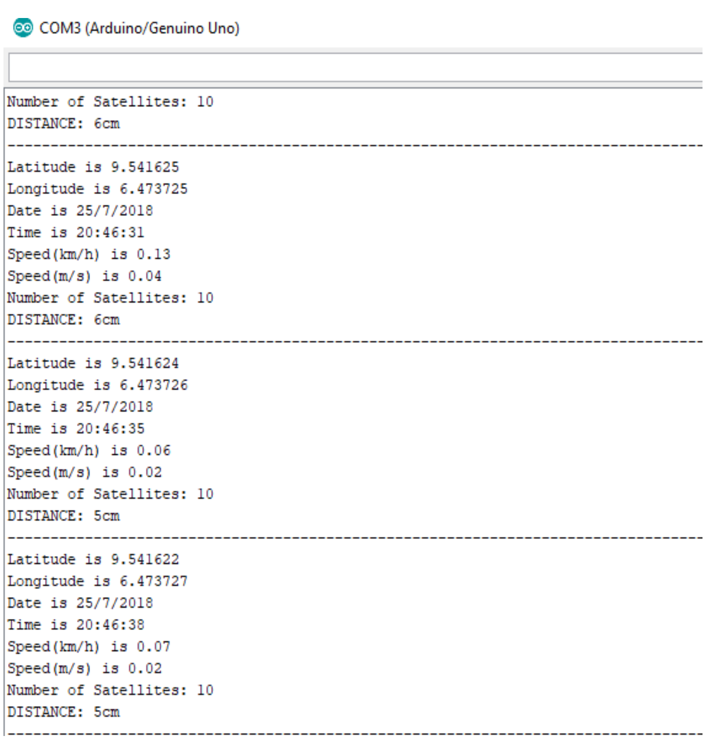


Fig.10. A secure-tracking system architecture

IV. RESULTS AND DISCUSSIONS

The result for telematics-based tracking system of the automobile geo-location during simulation in the Arduino IDE is illustrated in “Fig. 11”. This information includes longitude, latitude, distance, speed, date and time.



```
COM3 (Arduino/Genuino Uno)

Number of Satellites: 10
DISTANCE: 6cm
--------------------------------------------------------------------------------
Latitude is 9.541625
Longitude is 6.473725
Date is 25/7/2018
Time is 20:46:31
Speed(km/h) is 0.13
Speed(m/s) is 0.04
Number of Satellites: 10
DISTANCE: 6cm
--------------------------------------------------------------------------------
Latitude is 9.541624
Longitude is 6.473726
Date is 25/7/2018
Time is 20:46:35
Speed(km/h) is 0.06
Speed(m/s) is 0.02
Number of Satellites: 10
DISTANCE: 5cm
--------------------------------------------------------------------------------
Latitude is 9.541622
Longitude is 6.473727
Date is 25/7/2018
Time is 20:46:38
Speed(km/h) is 0.07
Speed(m/s) is 0.02
Number of Satellites: 10
DISTANCE: 5cm
--------------------------------------------------------------------------------
```

Fig. 11. Sensor readings displayed on serial monitor

Also, the data aquired from the GPS module are in NMEA format which was simulated and visualized in GPSview software as shown in “Fig. 12a” and “Fig. 12b” This GPS visualizer contains the position of the GPS receiver, dilutions of precisions, relative positions and number of the satellites connected to as obtained from the GPS signals. The secure automobile tracking database is depicted in “Fig. 13”.

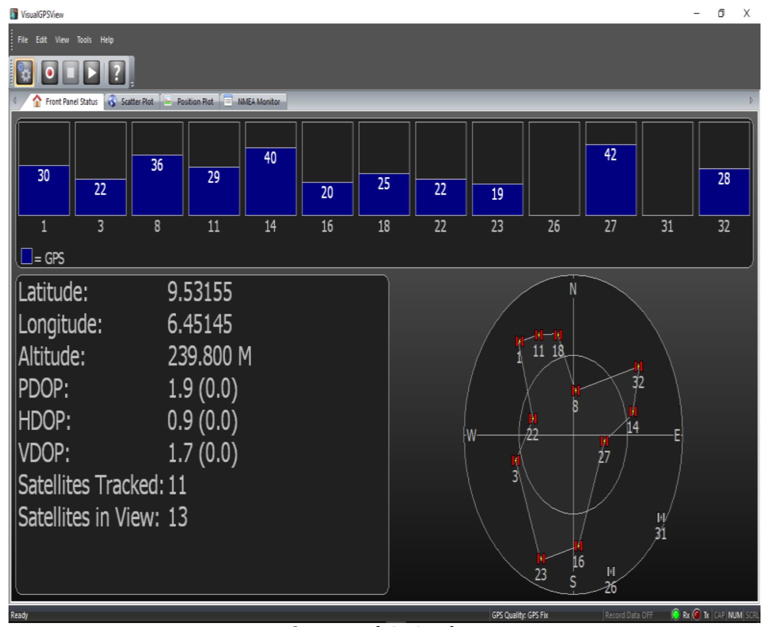


Fig. 12a. Visualization of GPS information

The remote data acquired based on geographic location, tracking, monitoring, automobile ID, Driver ID, filing station ID, time and date that are contained in the secure-database server using SHA-1 built-in blockchain technology for securing information. The result of geographic location tracking of automobile movement within the campus is displayed on a map interface as shown in “Fig. 14”.

The result gotten as shown in table 4.1 shows a disparity with the number of satellites captured. From the results It was observed that as the numerical strength of satellite captured intensifies, the longitude and latitude also vary correspondingly, and the larger the numbers of satellites captured the more accurate the GPS device as compared to the values of the coordinate obtained from google map. The system assessment was based on three elementary metrics which are; sensitivity, accuracy and success level. “Fig. 15” shows the tracking information stored in a secure database system. The “Table 1” contains detail analysis of tracking information send to secure database during testing of the prototype, and “Fig. 16” illustrate the graph of sensitivity, satellite level and the success level based on geo-location.

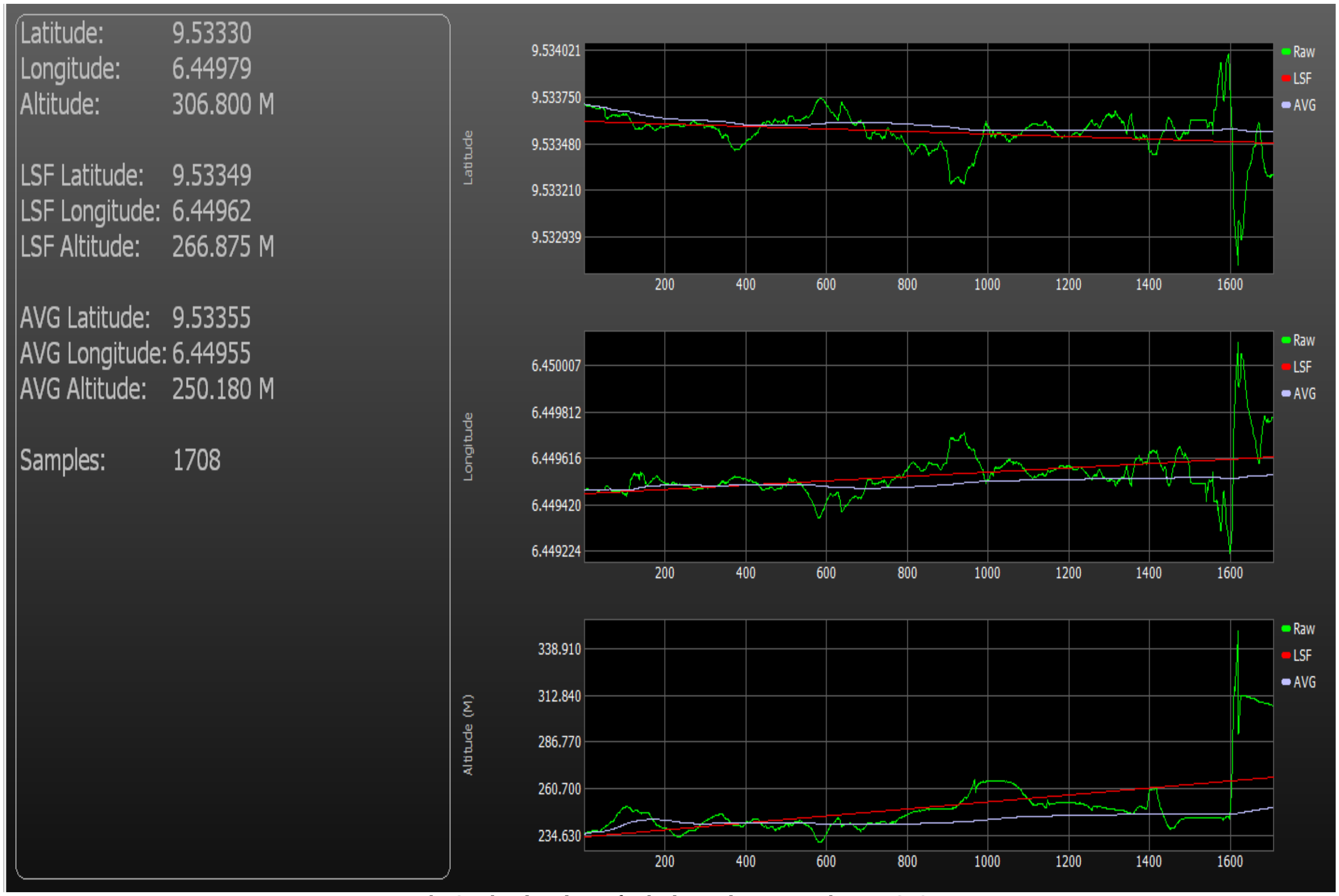


Figure 12b. Graphical analysis of vehicle geo-location tracking in GPS view

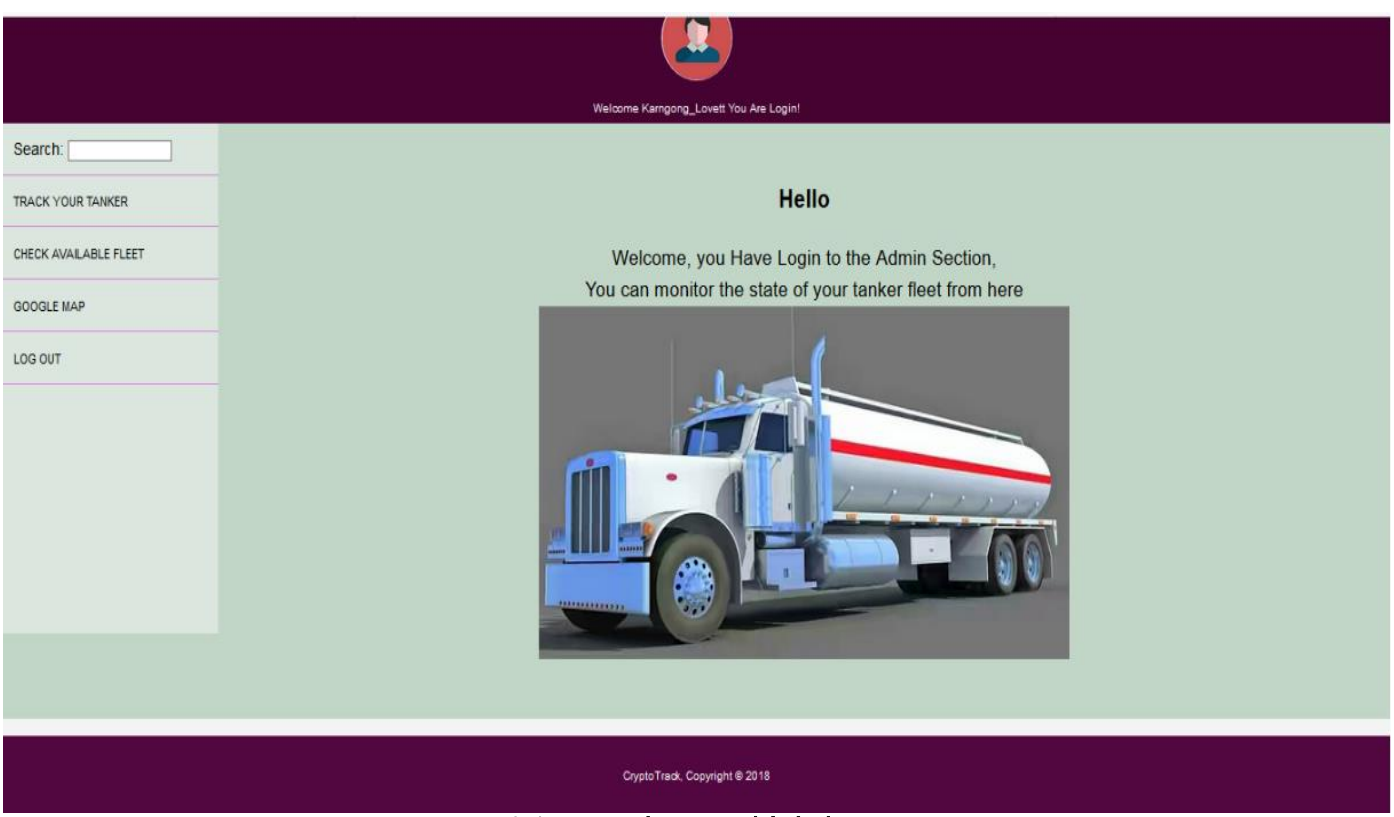


Fig. 13. A secure-tracking automobile database system

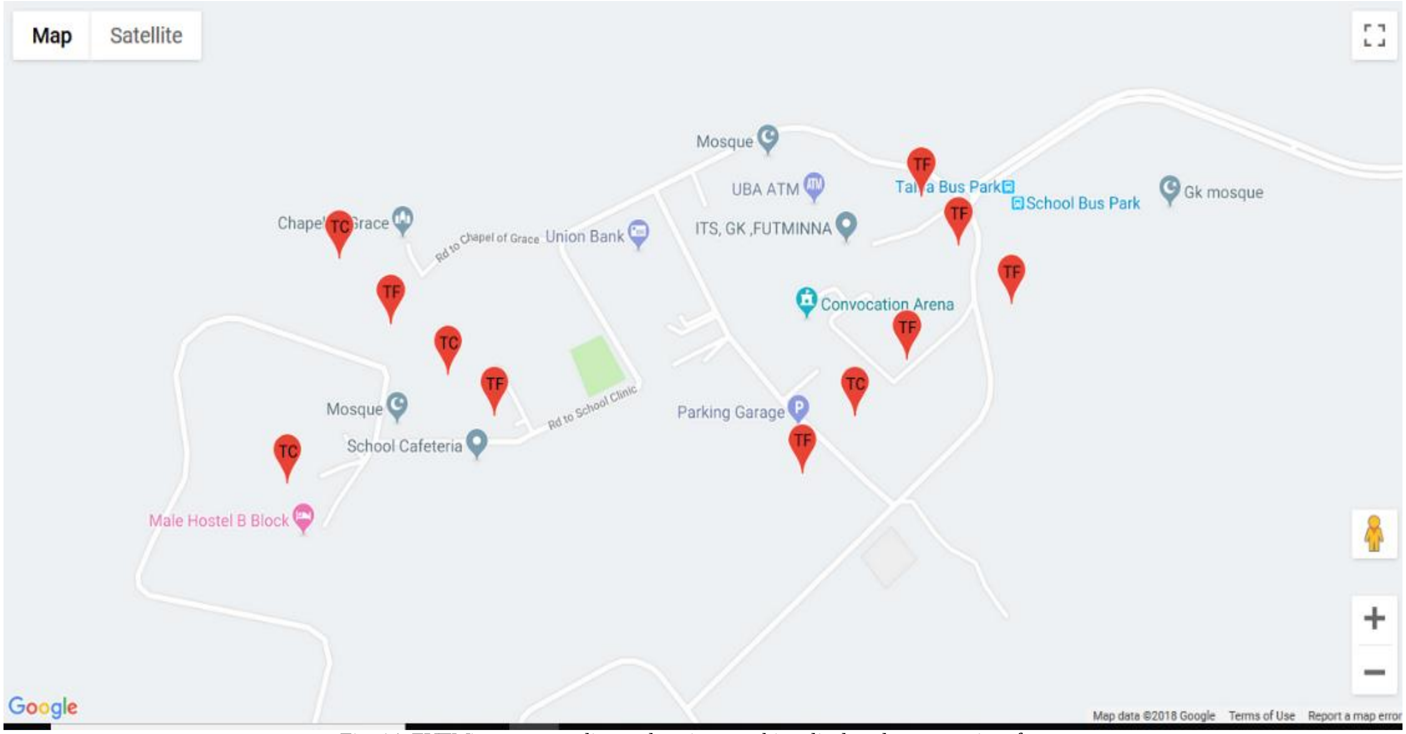


Fig. 14. FUTMinna metropolis geo-locations tracking displayed on a map interface

CRYPTOTRACK

HOME SEARCH TRACK GOOGLE MAP LOGOUT

LOCATION DATA

S/N	TANKER ID	TIME	DATE	NO OF SATELITES	HDOP	LIQUID LEVEL (%)	SPEED(KMPH)	LATITUDE	LONGITUDE
149	865210031078669	6:15:44	8/10/2018	5	2.19	66	0.35	9.531407	6.451446
150	865210031078669	6:16:17	8/10/2018	6	1.92	89	0.37	9.531438	6.451479
151	865210031078669	6:16:50	8/10/2018	5	1.98	89	0.59	9.531368	6.451441
152	865210031078669	6:17:23	8/10/2018	6	2.03	89	0.44	9.531471	6.451372
153	865210031078669	6:17:56	8/10/2018	5	1.60	97	1.19	9.531489	6.451346
187	865210031078669	7:55:25	8/10/2018	5	2.56	100	1.20	9.530928	6.451571
188	865210031078669	7:55:58	8/10/2018	4	9.51	100	1.81	9.531051	6.451568
189	865210031078669	7:56:32	8/10/2018	5	2.50	100	1.04	9.530858	6.451453
190	865210031078669	7:57:5	8/10/2018	8	2.50	100	1.50	9.530884	6.451460
191	865210031078669	7:57:38	8/10/2018	6	4.99	100	1.98	9.531068	6.451518
192	865210031078669	7:58:11	8/10/2018	5	4.94	100	2.85	9.530917	6.451497
193	865210031078669	7:58:44	8/10/2018	6	2.48	100	1.87	9.530988	6.451460
284	865210031078669	18:20:29	8/10/2018	9	0.81	48	0.20	9.531387	6.451231

Fig.15. Tabular representation of a secure tracking information

TABLE I.
DETAIL ANALYSIS OF TRACKING INFORMATION SENDS TO SECURE DATABASE DURING TESTING

id	Tanker_ID	Time	Date	Satellite number	HDOP	Liquid level	Speed	Latitude	longitude
1.	865210031078669	06:15:44	08/10/2018	5	2.19	66	0.35	9.531407	6.451446
2.	865210031078669	06:16:17	08/10/2018	6	1.92	89	0.37	9.531438	6.451479
3.	865210031078669	06:16:50	08/10/2018	5	1.98	89	0.59	9.531368	6.451441
4.	865210031078669	06:17:23	08/10/2018	6	2.03	89	0.44	9.531471	6.451372
5.	865210031078669	06:17:56	08/10/2018	5	1.6	97	1.19	9.531489	6.451346
6.	865210031078669	07:55:25	08/10/2018	5	2.56	100	1.2	9.530928	6.451571
7.	865210031078669	07:55:58	08/10/2018	4	9.51	100	1.81	9.531051	6.451568
8.	865210031078669	07:56:32	08/10/2018	5	2.5	100	1.04	9.530858	6.451453
9.	865210031078669	07:57:05	08/10/2018	8	2.5	100	1.5	9.530884	6.45146
10.	865210031078669	07:57:38	08/10/2018	6	4.99	100	1.98	9.531068	6.451518
11.	865210031078669	07:58:11	08/10/2018	5	4.94	100	2.85	9.530917	6.451497
12.	865210031078669	07:58:44	08/10/2018	6	2.48	100	1.87	9.530988	6.45146
13.	865210031078669	18:20:29	08/10/2018	9	0.81	48	0.2	9.531387	6.451231
14.	865210031078669	18:21:02	08/10/2018	9	0.88	0	0.15	9.531398	6.451261
15.	865210031078669	18:21:35	08/10/2018	10	0.82	0	1.11	9.53142	6.451247
16.	865210031078669	18:22:08	08/10/2018	10	0.78	0	0.2	9.531483	6.451261
17.	865210031078669	18:22:41	08/10/2018	9	0.87	0	0.74	9.531522	6.451264
18.	865210031078669	18:23:14	08/10/2018	10	0.87	0	2.63	9.531484	6.451257
19.	865210031078669	18:23:47	08/10/2018	10	0.98	0	2.57	9.531505	6.451173
20.	865210031078669	18:24:20	08/10/2018	10	0.78	0	0.44	9.531486	6.451322
21.	865210031078669	18:24:53	08/10/2018	9	0.85	0	0.61	9.531514	6.451376
22.	865210031078669	18:25:26	08/10/2018	9	0.85	0	0.61	9.531542	6.451425
23.	865210031078669	18:25:59	08/10/2018	5	1.82	0	14.26	9.531661	6.451532
24.	865210031078669	18:26:32	08/10/2018	7	2.88	0	8.72	9.531518	6.451762
25.	865210031078669	18:27:06	08/10/2018	0	99.99	0	14.93	9.531453	6.452001
26.	865210031078669	18:27:40	08/10/2018	9	1.01	0	4.63	9.531857	6.451674
27.	865210031078669	18:28:13	08/10/2018	8	0.9	0	0.24	9.531544	6.451401
28.	865210031078669	00:37:47	09/12/2018	9	0.98	0	0.74	9.531361	6.451714
29.	865210031078669	00:38:34	09/12/2018	9	0.85	0	0.11	9.531422	6.451569
30.	865210031078669	00:39:21	09/12/2018	9	0.88	0	0.06	9.531407	6.451598
31.	865210031078669	00:40:08	09/12/2018	9	0.8	0	0.33	9.53139	6.451566
32.	865210031078669	00:40:55	09/12/2018	11	0.76	0	0.17	9.531413	6.451585
33.	865210031078669	00:41:42	09/12/2018	9	0.99	0	0.48	9.531431	6.45158
34.	865210031078669	00:42:29	09/12/2018	10	0.88	0	1	9.531427	6.4516
35.	865210031078669	00:43:16	09/12/2018	10	0.92	0	0.63	9.531411	6.45163
36.	865210031078669	00:44:03	09/12/2018	9	0.92	0	1.98	9.531393	6.451665

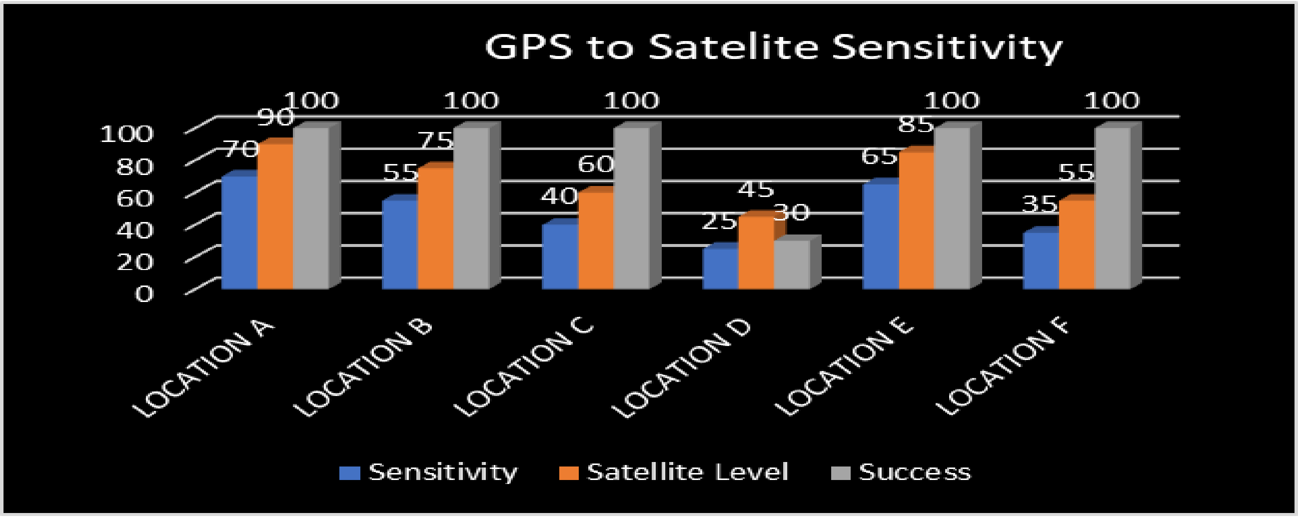


Fig. 16. GPS to satellite sensitivity of the tanker truck information

The graphs of change in speed against time and change in liquid level against time are depicted in "Fig. 17" and "Fig.18" respectively.

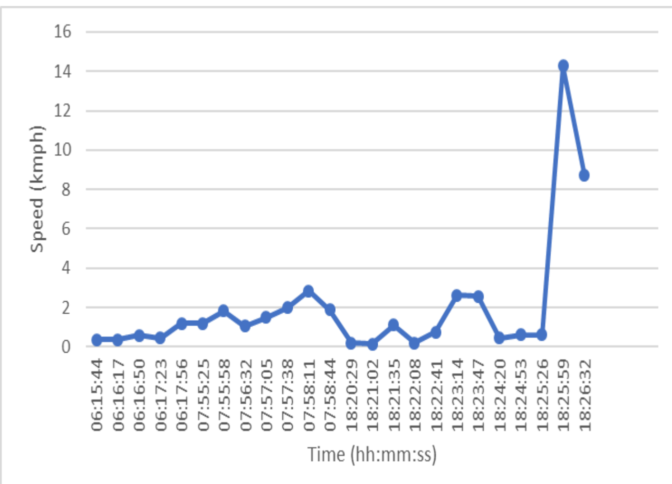


Fig. 17. Graph of speed against time

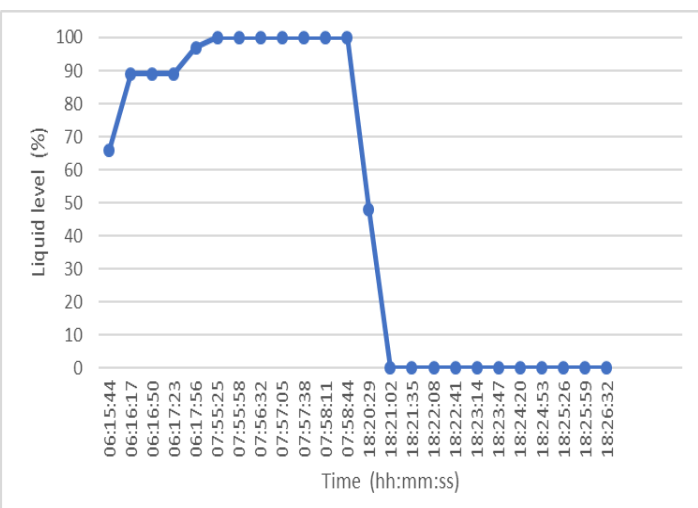


Fig. 18. Graph of liquid level against time

This system was evaluated in terms of accuracy and precision of the GPS receiver readings. The accuracy metric evaluated was the circular error probability of R95 GPS receiver. The circular error probability is the probability of the location information being within a given radius from the true location 95% of the time, the stated radius for the GPS receiver used is 15 meters. The claim was confirmed by testing within 22 location data points of the GPS receiver and determined within a 15meter radius of the true value as illustrated in "Fig. 19".

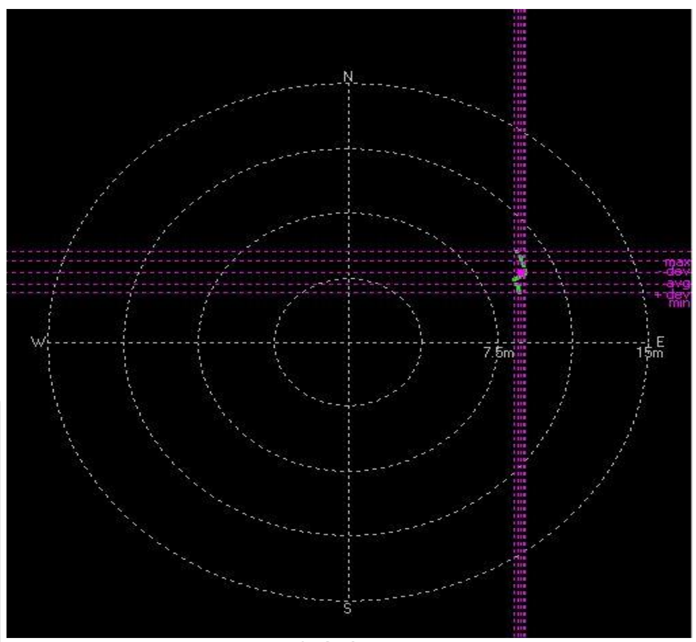


Fig. 19. GPS accuracy

The precision of the GPS readings, which is the measure of how close successive readings of the same location are to one another, was determined from the collected data to be 1.24 meters and this is shown in "Fig. 20".

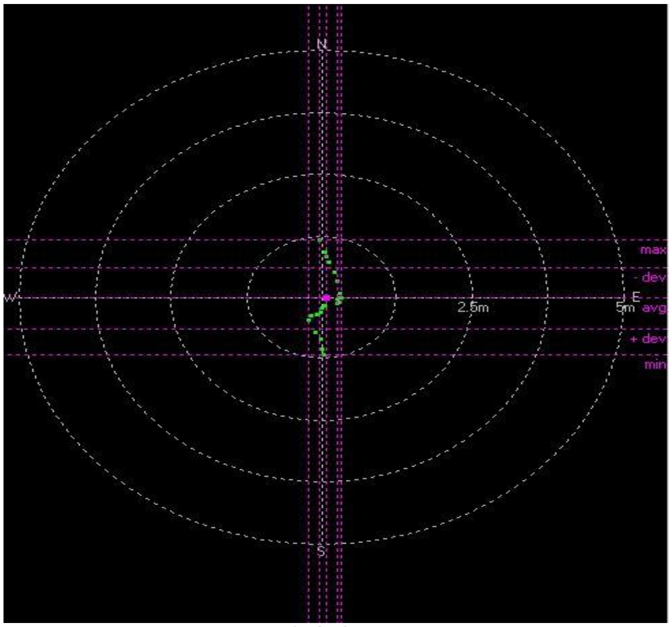


Fig. 20. GPS precision

V. CONCLUSION

The developed system allows effective monitoring of automobile distributed petroleum product. It also secured the remote information stored in the server database of a decentralized system and other related data. The successive truck information received are hashed and then linked to one another system in order to prevent unauthorized manipulation of the records by unscrupulous parties. The theft, diversification and leakages of oil and gas can be optimized by means of efficient tracking of vessel geo-location, monitoring of liquid levels and secured database records management. In this paper, the method proposed will enhanced the model or eliminates a traditional way of tracking systems with adoption of a decentralized server for processing information. This distributed server can be secure against online or offline attacker and hacker using secure hash algorithm (SHA) based blockchain technology. A blockchain based tracking system prevents unscrupulous alteration of information by requested for the approval and permission of majority parties concerned before data can be added to or altered in the database. This research can be further using machine learning approach for automobile geo-location tracking and oil theft or leakages prediction.

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