AN AUTOMATED CAR TRACKING INFORMATION MANAGEMENT SYSTEM

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ABSTRACT

The global issues related to a constantly increasing crime rate needs to be urgently addressed by both developed and developing countries. On average, thousands of cases of car theft are reported each year in Nigeria, and the number is still increasing. If not recovered early, stolen vehicles are generally sold, revamped or even burned if the resale price is considered to be too low. Once a vehicle is stolen, it becomes hard to locate and track, which considerably decreases the chances of recovering it. Nowadays, insurance companies suggest to their clients to equip their vehicles with a Global Positioning System (GPS) that can locate in real time their cars all over the country. In this work, we present the design and implementation of a Car Tracking System that protects and secures vehicles in real time. This paper adopts a software component; this deploys a web application and an Android application whereby end users and/or car owners monitor and locate their cars in an interactive map anytime and anywhere using geo-location system that will help in locating the car and tracing it fast in case it is stolen. This will increase the chances of recovering stolen cars.

INTRODUCTION

Every car tracking system consists of software with Global Positioning System (GPS) features so that the location of the car could be tracked by its owner or a third-party. Most of today's vehicle tracking system use GPS to get an accurate reading of the vehicle position. Communication components such as cellular (GSM) and satellite transmitter will be combined to transmit the vehicle's position to remote user (Alex *et al*., 2011). Vehicle's information can be viewed by using software on a computer. Vehicle tracking systems are commonly used by fleet operators for fleet management functions such as routing, dispatch, on-board information and security. Other applications include monitoring driving behavior, such as an employer of an employee, or a parent with a teen driver. Car tracking systems are also popular in consumer vehicles as a theft prevention and retrieval device. The tracker can simply follow the signal emitted by the tracking system and locate the vehicle. When used as a security system, a vehicle tracking ssystem may serve as either an addition to or replacement for a traditional car alarm. Vehicle tracking device then can be used to reduce the insurance cost, because the loss-risk of the vehicle drops significantly. Vehicle tracking is also useful in many other applications such as Asset tracking. Companies needing to track valuable assets can now plot the real-time asset location on a map and closely monitor movement and operating status (Alex *et al.*, 2011). Meanwhile, in mobile field sales situation, the location of sales professionals can easily be accessed in real-time. Also, in unfamiliar areas, they can locate themselves as well as prospective customers, get route guidance and add nearby last-minute appointments to itineraries. Benefits include increased productivity, reduced travel time and so on.

Several types of vehicle tracking devices exist. Typically, they are classified as "passive" or "active". "Passive" devices store GPS location, speed, heading and sometimes a trigger event such as key on or off, door open or close. Once the vehicle returns to a predetermined point, the device is removed and the data downloaded to a computer for evaluation. Passive systems include auto download type that transfer data via wireless download. "Active" devices also collect the same information but usually transmit the data in real-time via cellular or satellite networks to a computer or data center for evaluation. As opposed to the passive technology, Active tracking technology is employed in this work. Passive trackers do not monitor movements in real-time and do not follow every last move that a tracked person or object makes (Adelabu, 2017. The information stored inside of a passive tracker must be transfer to a computer to enable viewing of tracked details. After all of the information gathered from a passive tracker, the tracker can be placed back on the same (or different) vehicle. Aside from the fact that a passive tracking device is not real time, and hence less reliable, the main reason people choose passive trackers is that these devices are less expensive than active trackers. Most passive GPS tracking devices are not attached to a monthly fee, which makes these trackers affordable. In contrast, active GPS trackers will allow one to view tracked data in real-time. As soon as active tracker is mounted on a vehicle, the location, stop duration, speed, and other tracking details can be accessed from any location. Active GPS trackers are ideal when it comes to monitoring vehicle that need to be tracked at regular time interval. However, they are justifiable more expensive (most come with monthly fees). An active GPS tracker that comes with a reliable interface (and excellent tracking software), and you will be able to track anything or anyone quickly and efficiently. These trackers can be attached to any object while a person monitors all activities from a computer located anywhere. For example, if a real-time tracker is placed on a vehicle, then all the states of the vehicle could be watch as the vehicle makes stops, takes alternate routes, and sits idling – all in real-time (Adelabu, 2017).

Generally, crime is increasing at alarming rates (especially car theft) therefore requires urgent solutions. This obnoxious crime rate needs to be urgently attended to especially in the developing countries. On the average, thousands of car thefts are reported each year by Nigerians (Mohamed, 2000). There is dire need for a car tracking system that will trace vehicles in real time so as to secure them from theft and other antecedents. This paper proposes a methodology for tracing, locating and monitoring cars in real time so as to protect and secure vehicles are global issues that require urgent attention using GPS.

SYSTEM METHODOLOGY

The system development life cycle (SDLC) methodology was used in this study as it is considered one of the best methodologies for system development. The automated Car Tracking Information Management system was developed using PHP, a web – based scripting language embedded in HTML for flexibility, while MySql was used to develop the database for the system. Scripting was done in PHP, and JavaScript to facilitate simultaneous processing. manual car tracking systems are quite tedious, time consuming, less efficient and inaccurate in comparison to the computerized or an automated system. The existing systems have problems such as; delay in searching for car from one location to another, inability of user to know the exact vehicle etc.

Analysis of the Developed System

In this system GPS traces are used for detecting car location. The user quickly switches on the tracking software to search for car location. The GPS will give longitude, latitude, beacon strength, speed and altitude values of the car. From the location coordinates car location information can be determined. Hence the rescue team can immediately trace the location by putting geographical location coordinates in Open street map application or any other GPS trace viewer application. The system has the ability to report the different location and parameter of the car to the user. It can track the car surrounding, monitor the movement of car from one location to another.

The GPS chip outputs the position information of the car which is transferred over 3G cellular network to a mobile operator`s infrastructure and then to a remote server over HTTP connection. The HTTP server stores the incoming location data in a MySQL database. When a client logs in to the vehicle tracking webpage, a PHP web application embedded with JavaScript code. The JavaScript runs in the browser and integrates this information into Open street Maps through the

Map API which displays the position. Since the location information is retrieved every second and the maps updated at the same frequency, a real time GPS tracking effect is achieved.

RESULTS AND DISCUSSION

Systems Design

System design is the process of defining the architecture components, modules, interfaces, and data of a system to satisfy specific requirement. It is the application of system theory to produce development.

A. Design Model:

The design model used in this work is the waterfall model. The waterfall model is a sequential design process used in software development process, in which progress is seen as flowing steadily downward through the phases of conception, initiation, analysis, design, construction, testing, implementation and maintenance. The following phases were observed in the adapted waterfall model used for developing the vehicle tracking system; requirements specification (produces product documentation), design (software architecture), construction (software implementation and coding), integration, testing and debugging, installation, and maintenance. The advantage of the waterfall model is that it allows for departmentalization and management control. A schedule can be set with deadlines for each stage of development and a product can proceed through the development process, and theoretically be delivered on time.

B. Design Tools - UML, DFD:

Design tools are tools which are used to show graphical representative of the “flow” of data through an information system and modelling its process aspects. Some design tools include: i) Unified Modeling Language (UML) ii) Data Flow Diagram (DFD). The UML is a general-purpose modeling language in the field of software engineering, which is design to provide a standard way to visualize the design of a system. It offers a way to visualize a system’s architectural blueprint in a diagram, including element such as: any activities, individual components of the system, and how they can interact with other software components, how the system will run, how entities interact with others external interface. DFD is a graphical representation of the “flow” of data through an information system. DFDs can also be used for the visualization of data processing. On DFD, data item flow from an external data source or internal data store to an external data store or external data sink. A DFD provide no information about the timing or ordering of processes, or about whether processes will operate in sequence or in parallel. It is therefore quite different from a flowchart which shows the flow of control through an algorithm, allowing a reader to determine what operations will be performed, in what order, and under what circumstances, but not what kinds of data will be input to and output from the system, nor where the data will come from and go to, nor where the data will be store

UML Design

The UML design approaches adopted for this work, are use case diagram, class diagram and sequence diagram. For the purpose of this study we will be using the use case diagram; sequence diagram and the class diagram. This is because; the sequence diagram is one of the most effective diagrams to model object interaction in a system. A sequence diagram is modelled for every Use Case. Whereas the Use Case diagram enables modelling of a business view of the scenario, the sequence diagram contains implementation details of the scenario, including the objects and classes that are used to implement the scenario, and message passage between the objects. The class diagram shows the interaction details between objects and classes.

i. Use Case Diagram

A use case diagram captures the functional aspects of a system. More specifically, it captures the business processes carried out in the system. As you discuss the functionality and processes of the system, you discover significant characteristics of the system that you model in the use case diagram. Due to the simplicity of use case diagrams, and more importantly, because they are shorn of all technical jargon, use case diagrams are a great storyboard tool for user meetings. Use case diagrams have another important use. Use case diagram define the requirements of the system being modelled and hence are used to write tests scripts for the modelled system. Interaction among actors is not shown on the use case diagram. If this interaction is essential to a coherent description of the desired behaviour, perhaps the system or use case boundaries should be re-examined. Alternatively, interaction among actors can be part of the assumptions used in the case as follows: Use cases — a case describes a sequence of actions that provide something of measurable value to an actor and is drawn as a horizontal ellipse., Actors (a person, organization, or external system that plays a role in one or more interactions with the system) and ssystem boundary boxes which are optional. A rectangle is drawn around the use cases, called the system boundary box, to indicate the scope of system. Anything within the box represents functionality that is in scope and anything outside the box is not.

ii. Class Diagram

UML is a standardized general-purpose modelling language in the field of software engineering. The standard is managed, and was created by, the Object Management Group. UML includes a set of graphic notation techniques to create visual models of software-intensive systems. We make use of class diagrams (Figure 1) here to represent our model for the proposed system operations.

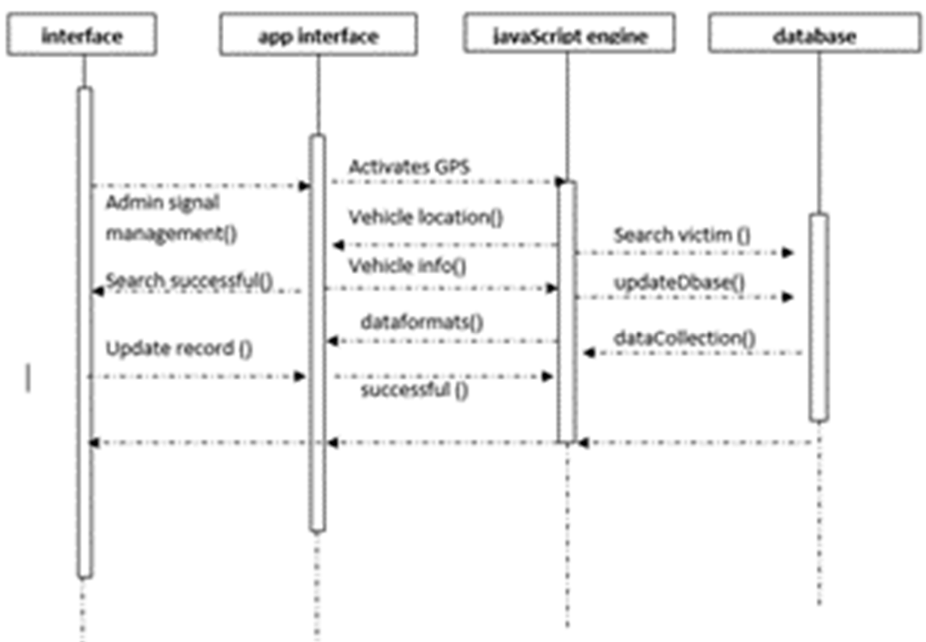

Figure 1: Class diagram for the proposed system

iii. Sequence Diagram

The sequence diagram is focused on the overall working sequence of the proposed system. The program sequence is triggered from the main interface which has methods for receiving signal and search for victim. The checkpoints section handles entering data to checkpoint database and retrieval to the main interface. The database manages all data from command center regarding accident information. Sequence returns a trace to the main interface.

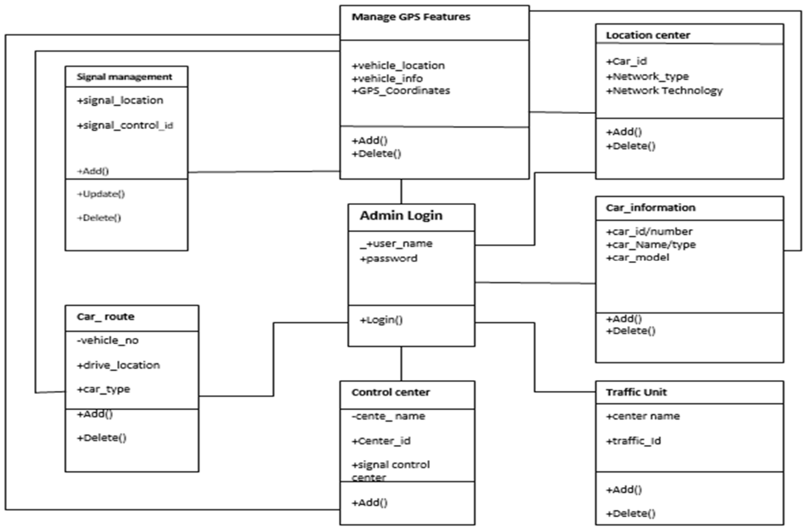

Figure 2: sequence diagram for the developed system

System Modules

This system consists of three main units, which cooperate with each other. Thus our system is divided into following three units; car, control and the traffic unit. The system screen shots showing the central location of vehicles are given in Figures 3 and 4 and the results of track the exact location of a moving or stationary vehicle in real-time are presented in Table 1.

i. Car/Vehicle Unit

In this section, information regarding vehicle are store in the database that can be use by the software system in tracking the car. According to our system, every car should have a car number, car type and other relevant details. The GPS system finds out the current position of the vehicle (latitude and longitude) which is the location of the car spot and gives that data to the main system.

ii. Control Unit

The controller acts as an administrator can manage the different unit of the system. The controller then sends can inform the traffic unit in case of car loss or in the case of accident. The administrator can add and remove car to and from the system, activates the GPS location.

iii. Traffic Unit

Whenever traffic signal section receives the information about car loss or accident, the quickly setup parameters for that particular car and help in the search of the car based on the information from the control center.

Figure 3: initial vehicle location

Figure 4: System screen location interface

Table 1: real time vehicle location information

Veh_ID	**Veh#1**							
Date	***Time***	***Long.***	***Lat.***	***Operator name***	***Net. Tech.***	***Rx. Level***	***Sp.***	***Alt.***
2018.07.12	08.00.12	5.600773	6.426048	Airtel_NG	3G	-87	59	129
2018.07.12	08.00.12	5.600822	6.425907	Airtel_NG	3G	-87	60	129
2018.07.12	08.00.13	5.600865	6.425762	Airtel_NG	3G	-85	61	129
2018.07.12	08.00.14	5.600907	6.42562	Airtel_NG	3G	-85	61	129
2018.07.12	08.00.15	5.600948	6.425477	Airtel_NG	3G	-85	58	129
2018.07.12	08.00.16	5.600992	6.425337	Airtel_NG	3G	-85	58	129
2018.07.12	08.00.17	5.601038	6.425193	Airtel_NG	3G	-85	60	129
2018.07.12	08.00.18	5.601085	6.425047	Airtel_NG	3G	-87	60	129
2018.07.12	08.00.19	5.601133	6.4249	Airtel_NG	3G	-87	60	129
2018.07.12	08.00.20	5.601183	6.424755	Airtel_NG	3G	-87	61	129

CONCLUSION

We developed the tested car tracking system to track the exact location of a moving or stationary vehicle in real-time. This paper described design and implementation of an automatic car tracking system. A GPS, a server and a Smartphone application are used for the vehicle tracking system. In this work, the vehicle information is stored in the database, the GPS/GSM/GPRS module are used to capture vehicle information and transmit it to a server through GSM/GPRS network. The web interface written in PHP is implemented to directly connect to the database. A vehicle's geographical coordinate and vehicle unique ID can be retrieved from the vehicle information stored in a database. The Smartphone help to display the vehicle's location using open street map. The system was able to track vehicle location anytime from anywhere when demonstrated experimentally.

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