

Real-time Vehicle Inspection and Security Management System

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Abstract

The recurrent incidences of car theft in our society today, has made it necessary to research on a lasting formula that will put paid this menace. In another dimension, the time wastage encountered during the usual routine stop-and-checks carried out by our security agencies in Nigeria cannot be over emphasized. This study is intended to analyse how on one hand, the process of vehicle checks by Stop-and-search police officers can be successfully carried out from any spot including remote areas without subjecting vehicle owners or users to untold hardship and harassment. On the other hand, this study will also experiment on how stolen vehicles can be detected in the course of routine vehicle checks. Summarily therefore, this paper seeks to design a Real-time vehicle inspection and security management system that will send a short message to a particular designated short code, which in turns brings back all necessary information needed by the vehicle inspection team to verify the authenticity of the vehicle documents presented for review and validity of acclaimed vehicle ownership. The Structured System Analysis and Design Methodology was used for this work. The system is designed using PHP and MYSQL server. If the system is implemented with the right technology, the unnecessary time wastage during the routine stop-and check activities and the incidences of car snatching will be reduced to the barest minimum.

Keywords — GSM, Nigerian Police Force, Vehicle, Inspection, Security

I. INTRODUCTION

The advancement of technology has created a huge opportunity for technologists to dig deep into finding lasting solutions to several manual processes that have wasted valuable time of individuals thereby taking a chunk out of available man hour the world over. In this work, an analysis is done, to show how on one hand, the process of vehicle checks by Stop-and-search police officers in Nigeria, can be successfully carried out from any spot including remote areas without subjecting vehicle owners or users to untold hardship and harassment. On the other hand, a look is given to how stolen vehicles can be detected in the course of routine vehicle checks. The fact that it is not only car owners that are permitted to

drive them on our roads makes it difficult for authorized agencies to establish whether or not, a vehicle under routine check is stolen. Thus merely scanning through photocopies of vehicle documents on the road cannot provide the needed answer to whether a vehicle is stolen or not. Also, this work seeks to facilitate easy access to requisite information about the authenticity and validity of documents presented in respect of a vehicle under routine check while at the same time satisfying oneself that same vehicle is in safe hands, we are taking advantage of gamut of functions to which mobile communication devices can be applied.

The whole process of vehicle checks by Stop-and-Search Police Officers is meant to produce a dual effect of safeguarding the vehicles of the citizenry while at the same time, ensuring that the citizens obey extant traffic laws, pay their vehicle related bills, taxes and levies including yearly renewal of their vehicle documents which translate to huge income to the coffers of the nation. However, the officers saddled with this responsibilities of vehicles check in Nigeria, do not carry out these functions without having face to face encounters with difficulties of various kind and dimensions. If it is possible, many citizens will evade any process that will take away money from their pockets. Thus it is not uncommon to encounter vehicle owners confidently driving vehicles with invalid documents faked to look valid. The fact that they are not constrained to drive around with the originals of such documents makes the matter even worse. It is possible to superimpose letters or figures that will distort the true state of any document thus making it pass as valid when the reverse is the case. On the other hand, the fact that anybody can be seen at the driver's seat of any car whether or not he/she is the rightful owner makes it an uphill task for the authorized agencies to conclude that the vehicle under check is stolen even though it may or may not have been, in actual sense. Also, most road users are constantly overwhelmed by the habitual tendency by the stop and search police officers at innumerable checkpoints on the Nigerian roads to line up unnumbered vehicles in the name of official duty while their owners stand helplessly in wait of their turn to be checked or dispossessed of their hard earned money. You can never estimate in monetary terms the value of man hour lost in the

process globally but however any one feels about it notwithstanding, the officers do not forget to remind you that they are on official duty. Observed also is the fact that the current system of stop and check activities of our police officers has no device in place to detect forged documents which obviously pass through the check points undetected. This is a serious leakage to the revenue base of the government. It is also noteworthy that stolen vehicles travel through hundreds of kilometres on our roads and even pass through check points undetected.

These challenges are what inspired the need to fall back on the use of information technology to redress the anomalies mentioned above without fear of victimization on the part of the vehicle users/owners and litigation on the part of the investigating officer. This work is merely taking advantage of the instant message facility resident in every GSM to facilitate information retrieval as it relates to any given vehicle from any location by the law enforcement officer with particular reference to the Nigerian Police Force. GSM simply means according to [4], Global System for Mobile Networks. Thus, the idea is to design a vehicle checking & security management system, anchored on the Global System Mobile Communication (GSM) technology that enables law enforcement officers, in this case officers of the Nigerian Police Force, to access all required information of any vehicle from any location (including remote areas) where there is network connectivity. This starts with a simple process of sending the vehicle plate number to a unique code which reverts instantly with the required information of the vehicle including the name of the owner via text message response. This will help to facilitate quick and on-the-spot vehicle checks and investigation process *on our roads.

II. LITERATURE REVIEW

[1] proposed a system which is “Automated Global System For Mobile-Based Vehicle Inspection Using Short-Code. They designed a GSM-based vehicle inspection system that will send a short message to a particular designated short code, which in turns brings back some information about the vehicle.

In the work by [2], a GSM based Vehicle Inspection and Verification System was proposed. They proposed a system that could handle vehicle verification problems. Their system grants an authorized agent access to the company's database to view information about any type of vehicle at any given time and anywhere, even in remote areas provided there is GSM network coverage. The data or code which can be used to view the Vehicles details could be the chassis number or the engine number; this is a number that no two vehicles can have.

In the work by [3] the development of a Low-Cost GSM SMS-Based Humidity Remote Monitoring and

Control system for Industrial Applications was proposed. They introduced a wireless solution, based on Global System for Mobile Communication networks for the monitoring and control of humidity in industries. Their system provides a solution for monitoring critical plant on unmanned sites. The system is Wireless therefore more adaptable and cost-effective. Utilizing Humidity sensor HSM-20G, ARM Controller LPC2148 and GSM technology. This system offers a cost effective solution to a wide range of remote monitoring and control applications. Historical and real time data can be accessed worldwide using the GSM network.

[4] proposed a system that used GSM module for receiving short message service (SMS) from user's mobile phone that automatically enable the controller to take further action like switching ON and OFF electrical appliances such as fan, air-conditioner, light etc. The system was integrated with microcontroller and GSM network interface using C language. MPLAB software was utilized to accomplish the integration. The system is activated when user sends the SMS to the controller at home (regarded as Smart Home). Upon receiving the SMS command, the microcontroller unit then automatically controls the electrical appliances by switching ON or OFF the device according to the user's order. In other words, it reads messages from the mobile phone and responds by controlling the devices in line with the instructions contained in the received message.

The work by [5] proposed an Embedded Automobile Engine Locking System, Using GSM Technology, the proposed system deals with the design & development of an embedded system, which is being used to prevent /control the theft of a vehicle. This device is an embedded system based on GSM technology installed in the engine of the vehicle. An interfacing GSM modem is also connected to the microcontroller to send the message to the owner's mobile.

Another GSM based vehicle management systems was by [6] which proposed secure car parking and reservation system using wireless technologies. The system has three modules, parking lot vacancy monitoring module, parking lot reservation module, and security module. The Parking lot vacancy module has infrared sensors for infrared connectivity. The entire system is called a ZIGBEE device/system. The vacancy monitoring module checks for the presence of vehicles in the parking area and provides the user with the status in real time. The Reservation module has a GSM modem that is interfaced with a coordinator system. The user can book their parking spots through SMS. The security module ensures security in the system by making sure that unauthorized users do not park on the lot.

GSM based train tracking system was proposed by [7]. This system uses mobile networks to support public

transportation. Their solution was implemented in Sri Lanka, to provide an intelligent train tracking and management system to improve the existing railway transport service. This solution is based on powerful combination of mobile computing, Global System for Mobil Communication (GSM), Global Positioning System (GPS), Geographical Information System (GIS) technologies and software. The in-built GPS module identifies the train location with a high level of accuracy and transfers the information to the central system via GSM. The availability of this information allows the Train Controller to take accurate decisions with respect to the location of the train.

III. MATERIALS AND METHODS

The Methodology adopted for this work is the Systems Analysis and Design Methodology (SSADM). Research methodology is the method and principls involved in data collection during a research work. Some of the methodologies used in information technology research are expert system methodology, usability engineering methodologies, prototyping which is the most beneficial in systems that will have many interactions with the user and structured system analysis and design methodology.

IV. SYSTEM DESIGN

Design principles are necessary for efficient software design. Top down and bottom up strategies help implement these principles and achieve the objectives [8]. The top down approach which was adopted in this work, starts from the highest-level module of the hierarchy and proceeds through to lower level. On the contrary, bottom up approach starts with lower level modules and proceeds through higher levels to the top-level module..

A. Instrumentation

The programming language used as the instrument for achieving this work is PHP. PHP Version 5.3.13 was used to design this system. PHP (PHP: Hypertext Preprocessor) is a programming language that can run on Microsoft windows platform and other major operating systems platform like Unix, Linus, etc. It is a server side scripting language for web development. It is also a general purpose programming language which can be deployed on most web servers and as a standalone shell on almost every operating system platform. The interface with which the end user interacts with the system is the short code technology which is provided by a telecommunication firm.

B. Data Collection Procedure

The observation method of data collection was adopted in this research work. This was done by observing several processes of vehicle stop-and-check operations on our roads carried out by several

officials of the Nigerian Police Force at different times.

C. Data Analysis Techniques

Data analyses in this research work was done via system flow charts. Data flow diagram was also used in the earlier section of this system analysis.

D. The system flow chart

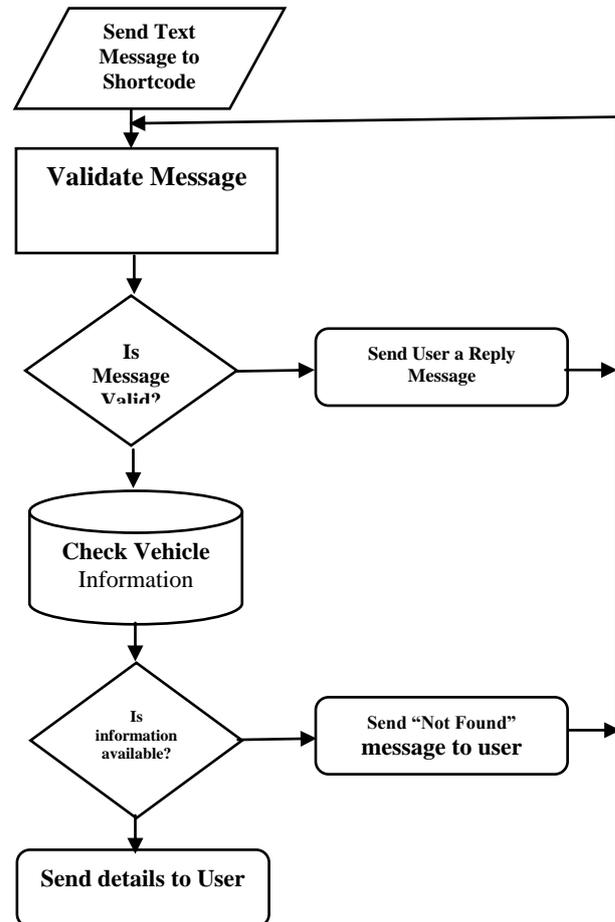


Fig..I. The system flow chart

V. RESULT AND DISCUSSION

It is important to remember that the objectives of this research were; to develop a framework that guarantees fast and reliable on-the-spot vehicle checks & security management system, anchored on the Global System Mobile Communication (GSM) technology and to achieve a dual purpose effect of stemming the tide of revenue loss by the government via evasion of vehicle related fees by vehicle owners while also curbing the menace of wastage of valuable man-hour on our roads under the guise of vehicle checks.

VI. DATABASE AND FORM DESIGN

MySQL is a Relational Database Management System (RDBMS) that can be used to develop

database applications both locally and on the internet. The Version used in this work is Version 5.5.24. MySQL storage engine provides good flexibility and performance. It can host millions of database simultaneously.

This application contains a form for adding vehicle information and three other forms that displays different lists of information from the database. When data is entered, the system communicates with the user through the messages displayed in the screen, the system processes and returns a message to inform the user whether the operation is successful or not.

Figure II below is the welcome page. It is the validation page and it gives access to the users. The user is prompted to enter a USERNAME and a PASSWORD, the system verifies the correctness of the information entered and either grants or denies access to the user. Note that the user in this case is the security official.

Table I. Users

Field Name	Field Type	Field Size	Field Description
User_Id	Varchar	50	Username
Password	Varchar	50	Password

The form is titled "Login to Continue". It contains two input fields: "Username" and "Password". Below these fields is a "Login" button.

Fig. II.. User Logon sample

Figure III is the first screen the administrator sees after he/she logs on to the system. There are four information shown on this page which will help the administrator to have an idea of what the application is about.

The menu is titled "ADMIN" and contains five items: Home, Add-Vehicle, View-list, Logs, and Log out.

Fig. III. Main Menu Design

A. Add Vehicle page

In order for the system to be useful to the public, vehicles' information have to be added to the database via the Add-Vehicle information page as shown in figure 4.4 below. This page has a form which needs to be completed with valid vehicle information and then submitted. This system ensures that no two vehicles have same Reg No. (Plate number), chasis number or engine number. If a user tries to add information to the database which already exists, then the information is rejected with a corresponding message that explains why.

Table II. Add – Vehicle

Field Name	Field Type	Field size	Field specification
ID	Int	11	Reg. Number
Maker	Varchar	50	Vehicle maker
Model	Varchar	50	Vehicle mode
Chasis_no	Varchar	50	Chasis number
Engine_no	Varchar	50	Engine number
Body_style	Varchar	50	Body style
Transmission	Varchar	50	Transmission
Owner	Varchar	50	Owners name
Date_created	Time	50	Date created
Colour	Varchar	20	Colour

The form is titled "ADMIN" and contains a navigation menu with Home, Add-Vehicle, View-list, Logs, and Logout. Below the menu is a section titled "Enter Vehicle Information" with fields for Reg. no, Maker, Model, Colour, Chasis no., Engine no., Body style, Transmission, and Owners name. There is also an "Add Vehicle" button.

Fig. IV. Add - Vehicle form

B. View – List

This is the page that lists all vehicle information currently in the database. The information listed have details of each vehicles and the corresponding owner’s name. The information listed includes:

C.Owner

This includes the full name of the owner. Like the owners first, middle and last names.

D.Details

this is the details of the vehicle. Like: Registration no. (Plate number) Make, Chasis number, Body style, Transmission, and Model.

E. Date added

this is the date the vehicle information was added to the system by the administrator.

F. Logs

The logs page is a page that displays all queries that have been sent by users through the shortcode. The items displayed in this page include:

1. Number- this is the phone number that sends the shortcode request. The number is displayed in international format.
2. Message – this is a description of the message the user sent to the shortcode.
3. Date – this is the date and time the user sends the request to the shortcode.

Table III. Logs Form

Field name	Field Type	Field Size	Field Description
Number	Varchar	20	Phone number
Message	Varchar	200	Message sent
Created	Time	Stamp	Time and date sent

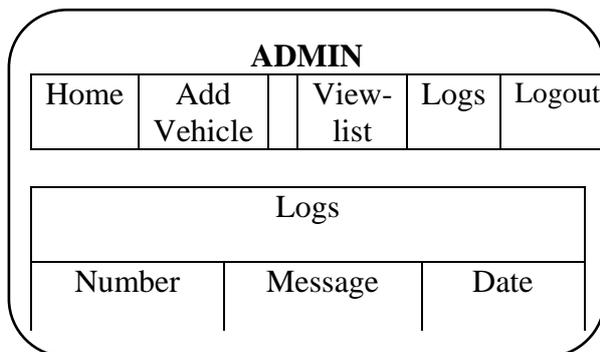


Fig. V.. Logs Form

G. System Block Diagram

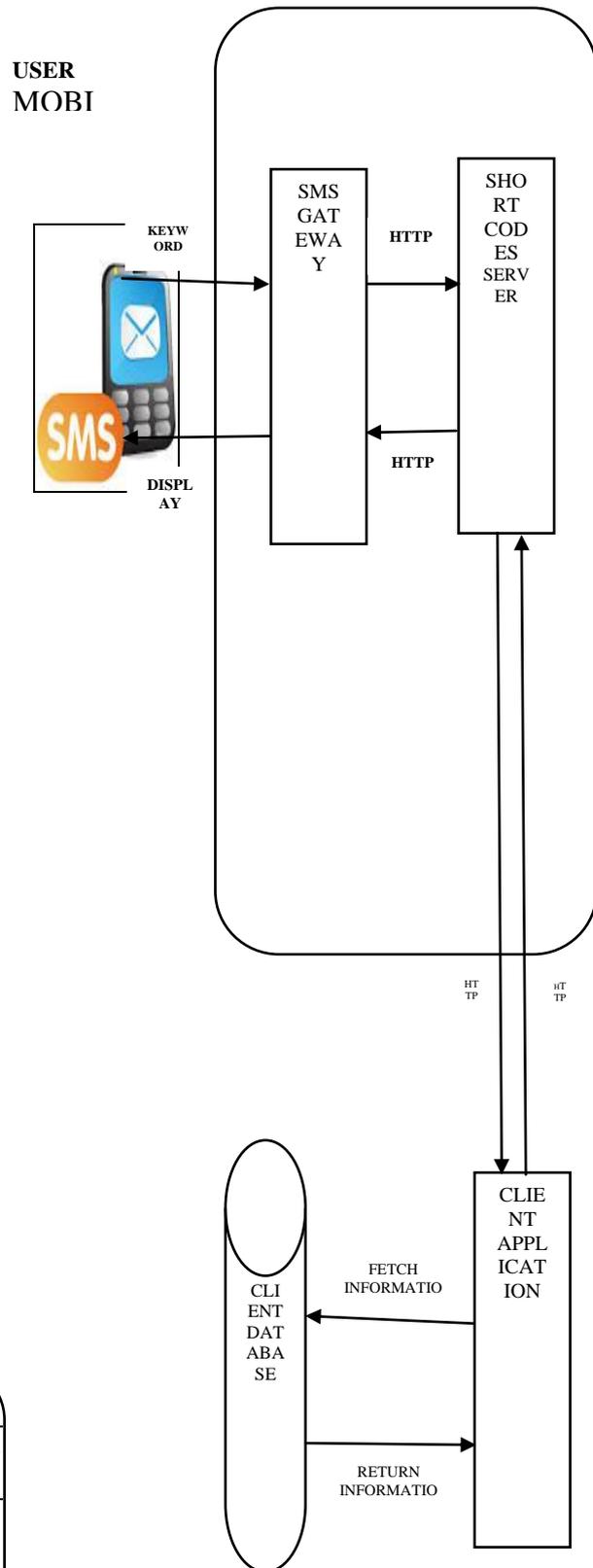


Fig VI.. System Block Diagram

H. Program Flowchart

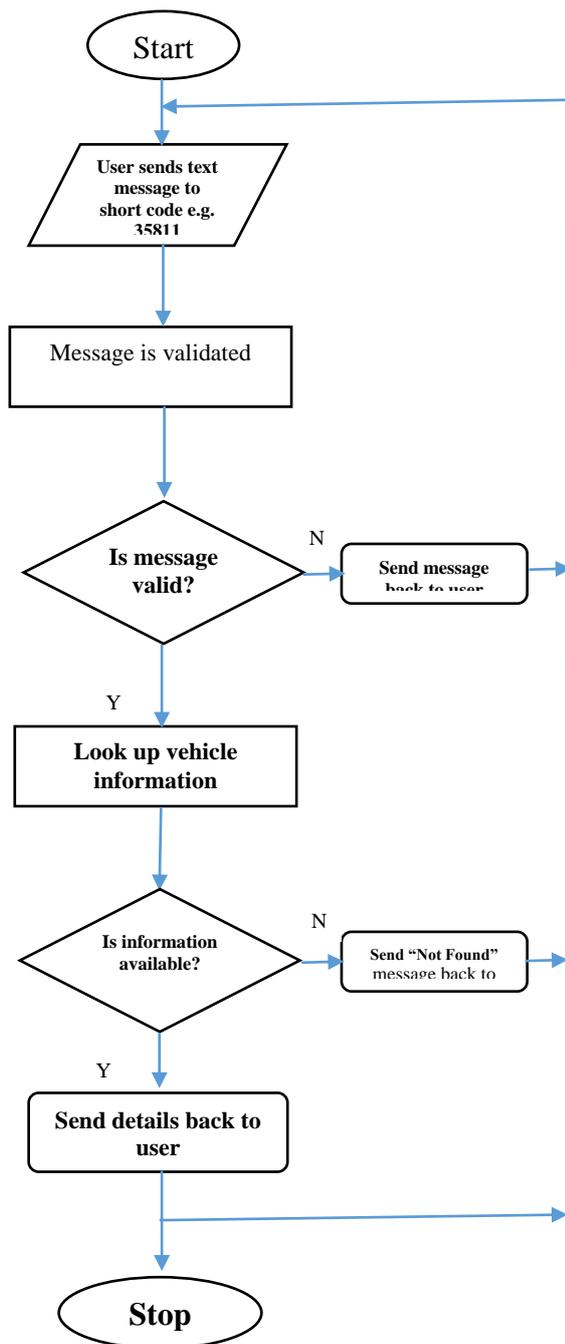


Fig. VII.. Program Flowchart

I. Summary of Findings

The entire system is summarized in the pseudo code presented below

Begin

```

    Display Welcome screen
    Main Menu Display
    Select Menu Option
        Case Home
            Display Welcome Screen
        End Select
    Case Log List
  
```

```

    Display Information about
    the Log List of Vehicles
    End Select
    Case Admin
        Enter Admin Username
        and Password
        If Username and Password
        are correct then
            Display Admin Main
            Menu;
            Select Option;
        Else
            MsgBox "Check
            your Username and Password"
        Endif
    End Select
    Case log list
        Display log list
        information
    End Select
    Case Statistics
        Display Statistics of the
        shortcode usage information
    End Select
    Case Contact
        Display Compose Message
        Box
    End Select
  End
  Stop
  
```

VII. IMPLEMENTATION

A. Installation

The developed system is a user friendly application. The implementation of this system comprises of its installation procedures, how the old system is replaced with the new one, how to prepare users by training the operators of the system and also how the system is documented for reference.

B. Minimum System Requirement

The application should be installed on a system running on a braded machine or an HP compatible clones that runs on Microsoft Windows Environment Operating System (Windows Vistas and above) with at least 1GB RAM and a minimum space of 100MB of Hard Disk.

C. System Requirements

The system requirement includes hardware and software requirements.

1. Hardware Requirement

The hardware requirement refers to the physical parts of the computer. These include all the mechanical and electronic devices or components in the computer system. The hardware devices needed to implement the GSM Based Vehicle Inspection and Security Management System is as follows:

1. Mobile Phone
2. Registered SIM Card from any GSM operator

2. Software Requirements

The software requirements refer to the non-physical parts of the computer system that controls the operations of the computer. It is the program that gives instructions needed to efficiently implement the GSM Based Vehicle Inspection and Security Management System. There are basically two types of software: system software which comprises of the Windows 7 Operating System; and the application software which comprises of the Microsoft Office application which was used to type this work, PHP version 5.3.13 and MySQL version 5.5.24. Amongst others

D. Suggestions for further studies

Several enhancements/inputs can be made to this system to further enhance its functionality. Other researchers can create a system that can incorporate all information of an individual and all the vehicles he/she has plus the particulars of all those vehicles. So that when an individual plate number is keyed in, not only will the details of that vehicle show, but all the other vehicles owned by that owner will also surface.

VIII. CONCLUSION

In conclusion, a Real-Time Vehicle Inspection and Security Management System, which is a system that is capable of delivering “real time” vehicle information from the internet based law enforcement servers to different users, with the expansion of mobile phones was introduced. The system is based on GSM technology, and can enable the security agencies to on the spot, ascertain the true ownership of a vehicle during the routine stop-and-check activity, thereby reducing the setbacks like time wastage experienced during this activity, while also reducing the cases of some people freely moving about with stolen vehicles undetected. Being an interactive system, it is able to assist the Nigerian security agencies, to manage their vehicle information within their organization.

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