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Road Offence Information Management System in Nigeria

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ABSTRACT

This study is concerned with road traffic offence information management in Nigeria. It focused on trends in road traffic offences information and carried out a critical review of current information and communication and technology compliance state of FRSC with a view to identifying its defects in road traffic offence information management. A system to correct road traffic offence information management failure as identified in the existing system was then proposed. Road traffic offence records and details of current safety measures obtained from FRSC and online in addition to research works, provided the basic data for the study. The system was designed using the object OOAD methodology and implemented using rapid Php IDE on a Windows 7 system, using PHP, HTML,CSS and mySQL technologies and Apache server as the application server. The result showed the high rate of road traffic offence as a result of poor road traffic offence information management and failure to improve on the existing road traffic information management.

1. Introduction

Nigeria ranked as the country with the second largest road network in Africa in 2011. It population density which varies in rural and urban areas (approximately 51.1% and 48.3% respectively) translates to a population-road ratio of 860 persons per square kilometres showing intense traffic pressure on the available road network [1].This pressure contributes to the high road traffic offence mishap in the country. In Nigeria, road transport is the most commonly used by the majority of citizen, as the easiest option in moving goods and travellers. Despite the important role played by road transport, the sector has encountered a number of challenges emanating from poor road traffic offences information management, resulting to incessant road accidents. Road accidents, resulting from lack centralized database, making road traffic offence information manipulation and accessibility of the database difficult. There is no proper offenders' identification hence wrong persons could be accused. Also the system has no room for pictorial diagram display of the offence committed, as well as the penalty of offence as an evidence to facilitate prosecution. Hence the offender often sees himself as being compelled to accept responsibility of offence he did not commit. The poor road offence information management situation in Nigeria has reached such an alarming proportion even to the point of sheer frustration and near helplessness, resulting to numerous consequences including deaths, injuries, disabilities and loss of properties, all of which accelerate to poverty in the country. The death of the most productive member exerts a devastating impact to the families, pushing many into poverty with long lasting effect to their children and their community at large [2]. While many developing and developed countries have made concerted efforts to reduce road traffic offence through the adoption of improved management information technology, Nigeria seems to be lagging behind.

Global trends in road transportation have shown that efficient and safe transportation management models are becoming highly dependent on Information and Communications Technologies [3]. ICTs' adoption in road traffic offence information management operations will

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help to achieve the ambition of drastic reduction in road traffic offences and road accidents prevalent in Nigeria.

A report of the United Nations on Road Safety shows that 1.3 million people die each year in traffic related accidents and another 20 million to 50 million people are injured mainly in developing countries around the world [4]. Statistics show that while developing countries own only 32% of the world's vehicles, they account for 75% of annual accident fatalities [2]. Information and Communication Technology in road safety technologies is usually applied through the collation, storage, analysis and processing of vital electronic data including: weather readings, accident location co-ordinates, precise remote traffic light adjustment, warning thresholds, speed chart, driver alertness, and other data attributes [5].Use of Information and Communication Technology to facilitate safe transportation, promote easier dissemination of road traffic information, ensure comfortable manipulation of road machineries, improve the efficiency of road traffic signs/alerts, promote mass awareness of

safety consciousness, facilitate more effective rescue operations and improve the monitoring of the changing conditions of roads and machineries is therefore a necessity. Management cannot plan, deploy, and control resources without essentia l information [11]. The road traffic agencies need such information to judge whether the road traffic agencies is using resources efficiently and providing road users with value-for-money. A comprehensive management Information System (MIS) normally consists of a computerized road management system for planning, programming, budgeting and preparation of road works [11]. Information and Communication Technology (ICT) has been effective in improving road safety in developed countries and some developing countries through prudent management of road traffic offences , In Bangalore for instance, in the author observed that, in 2007, before the introduction of technology, the city's Police had booked nearly 1.4 million cases of traffic offence, which had risen to 3.3 million in 2010,at the introduction of information technology, the number of fatal accidents were brought down from 957 in 2007 to 816 in 2010,non-fatal accidents have come down from 6,591 to 5,343,through improved compliance and managing traffic better[12].

International Telecommunications Union (ITU), the United Nation Agency in charge of Information and Communication Technology (ICT) has been assisting, through the aid of Intelligent Transportation Systems (ITS). Among these systems is the Driver Assistance System (DAS) that applies specific electronic components in a vehicle that help the driver with the task of driving. For example, a vehicle with DAS has a Global Positioning System (GPS) that makes use of satellites which can provide up- to- date traffic information. Drowsiness and blind spot detection; night-vision and lane change assistance; and a collision avoidance system that uses in-car radars can be experienced with the use of DAS [13]. Speed management cameras can be used to prevent drivers from speeding. These infrared cameras can find out precisely the speed at which a vehicle is moving and are connected to a computer to identify a vehicle's registration number. Road worthiness of vehicles can b e examined using computer technology, for instance to check the braking system and seat belts. Special software is then used to find out precisely if the data is in accordance with law making requirements of the country [13]. Laser scanners, cameras or dig ital photographs can be used to identify potholes, cracks and defective bridges, when conducting road safety inspections. It has been affirmed [14], that intelligent car safety systems reduce the proportion of accidents attributed to human factor (95%). The systems make use of ICT to provide solutions for improving road safety especially before a crash occurs. The author observed that ICT used in smart cars are designed to ensure safe speed, lane support, pedestrian protection, improved vision, driver monitoring and intersection safety. According to the author, the two major contributions of intelligent car safety system are, they prevent collisions during lane changes or lane departure and provide vehicles with an automatic emergency call system, eCall. Emergency call (eCall) is a communication system that assigns a unique telephone number (often toll-free) exclusively for reporting emergencies and distress conditions eCall can also be connected into web-based road safety

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portals to give it wider access beyond the bounds of the cellular network's coverage area [5]. eCall system could be made to start working either manually by the people in the car, or automatically by sensors within the vehicle. Upon activation, eCall connects the vehicle's occupants to the nearest Public Safety Answering Point (PSAP). eCall, according to the author, ensures a faster rescue time and a higher survival probability, during emergency Speed Alert systems warns the driver when he is driving at a speed that exceeds the legal speed limit or self-imposed speed limit, the driver is then able to reduce his speed leading to a decrease in road fatalities. Autonomous cars are also now very common. These are robotic cars which require no human input due to sensors inside and outside the vehicle [13]. In 2013, [15] proposed a GPS based system for tracking in real time the school transportation to avoid over-speeding and reckless driving. The system is modelled to track school buses which are fitted with GPS tracker of which send the information to school via GSM network and monitoring station. The proposed approach provides an overview of the GPS technology adoption and how it can be employed in over speeding detections with auto email and short messaging (SMS) alerts. In 2014, [2] proposed a model that constantly track buses in real time and central database. The model is capable of promptly popping up warning messages in case of over-speeding for appropriate action. The analysed data from the central database could be used as the evidence in case of traffic case prosecution. The system allows for easy tracking of drivers with a habit of over-speeding and therefore appropriate disciplinary action could be taken against them, such as ceasing of their driving license. The proposed system makes use of the potential of Global Positioning System (GPS), Global Positioning Satellites and Global System for Mobile communications (GSM) Technology in delivering its services [2]. No measures to capture offenders' pictures for proper offender's identification. Also there is need to have a singled integrated road traffic offence information database for prudent road traffic offence information management. To facilitate prosecution, a system that displays offender crime sketch diagram/picture has to be developed Thousands of motorists are still being apprehended daily and sanctioned for various traffic offences on the roads, notwithstanding the laws and regulations put in place to curb the increasing rate of traffic offences and violations on the Nigerian highways [6]. This is as a result of inadequate information and communication technology interventions and poor road traffic offence information management. According to FRSC 2013 records, speed limit violation (SLV) was the major causative factor of crashes which accounted for 32% of all crashes recorded in 2013,totalling 13,583 crashes (A chart illustrating road traffic crashes as a result road traffic offence in Nigeria from 20072013 [16].

2. Method

This study relied on information obtained from secondary sources especially online materials, Newspapers and documents of relevant agencies like the Federal Road Safety Corps. From these documents required information was obtained on the performance, road traffic crashes records, operational activities and strategies of the corps, enforceable laws and regulation including safety offence and their penalties and its data management system. The author also examined reports, academic research papers, articles and newspaper reports on essence of information and communication technology on road safety. The obtained information enables the critical review of current state of FRSC in information and communication technology compliance measures.

Object Oriented Analysis and Design (OOAD) methodology was used during the software development. Object Oriented Analysis and Design methodology is a software engineering approach that modules a system as a group of interacting object. OOAD models are pictures that illustrate the system's objects from various perspectives such as structures and behaviours. Two stages are involved in the approach; Object Oriented Analysis and Object Oriented Design. Unified Modelling Language (UML) notation is the design tool used for modelling in this research.UML used in the research includes: Use Case diagrams, Sequence diagrams and Class diagrams.

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2.1 System Architecture

The architecture of the system design is 3-tier. The tiers are presentation tier, middle tier and data tier. The presentation tier is the user interface and it is designed using HTML. The middle tier connects the presentation tier and data tier together. The middle tier is also called application tier or business logic. The middle tier was designed using PHP and it runs on the server. The data tier is the part of the system that is responsible for storing data (database). The database management system used for developing this system is MySQL database server. Architecture of the system is shown below.

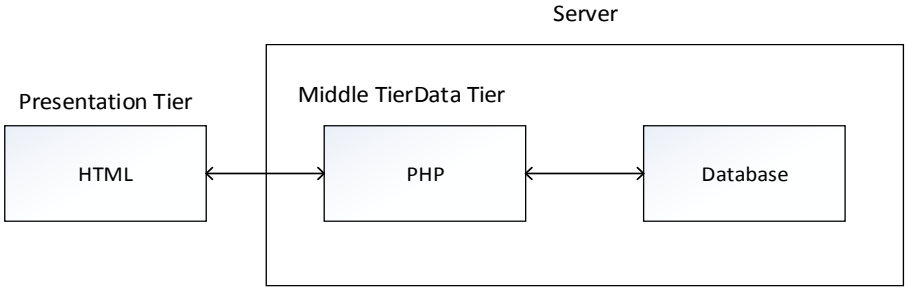

Figure 1. System Architecture

The program was designed using top-down approach. The whole system was broken down into its component parts and designed in modules.

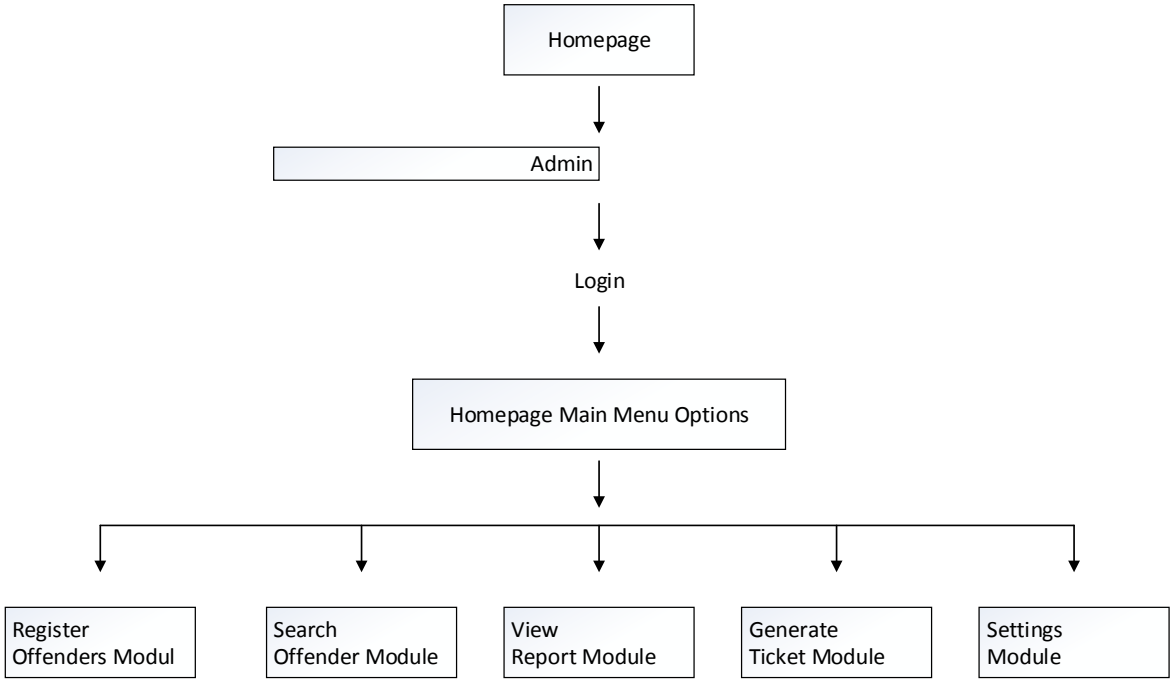

Figure 2. Program Procedure Chart

Implementation of the system is concern with the preparation of resources (hardware and software) that are required for effective functionality of a newly designed system, testing these resources to ensure that they meet the designed objective and eventually change over to the new system.

Choice of Development Environment: Rapid PHP is the IDE used in implementing the client code and the web service code of this application. Rapid PHP editor is a faster and more powerful PHP editor for Windows, combining features of a fully-packed PHP IDE with the speed of the Notepad. Rapid PHP is the most complete all-in-one software for coding PHP, HTML, CSS, JavaScript and other web development languages with tools for debugging, validating, reusing, navigating and formatting your code. With Rapid PHP editor one can code smarter, save time and increase

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productivity. It supports tabbed browsing, offering flexibility when working with multiple documents at once. The application has a handy code explorer that will facilitate code search, especially functions, classes, variables and other commands of each supported language. The program includes small wizards for creating CSS documents and the structure of HTML documents. The programme has some other powerful features like auto-completion, code-highlighting in bright colours, syntax correction, and the ability to visualize your own projects within the editor.

The scripting language selected to accomplish actualize the project is PERSONAL HOMEPAGE PREPROCESSOR popularly known as PHP. This choice was informed by the following features of the PHP scripting language: (i) It is Open Source, and closely integrated with mySQL database (ii) Has an inbuilt XML parser (iii) It is light weight and does not consume much server resources to render page (iv) Easy syntax flow supports

In the proposed implementation architecture, the presentation layer designed using HTML as the User Interface, the application layer designed using PHP that runs on the server and the data layer designed using MySQL database server (XAMPP control panel) is installed in the computer systems. The computer system captures road traffic offence, saves the information in the road traffic offence information database, where each computer system can easily access the database information.

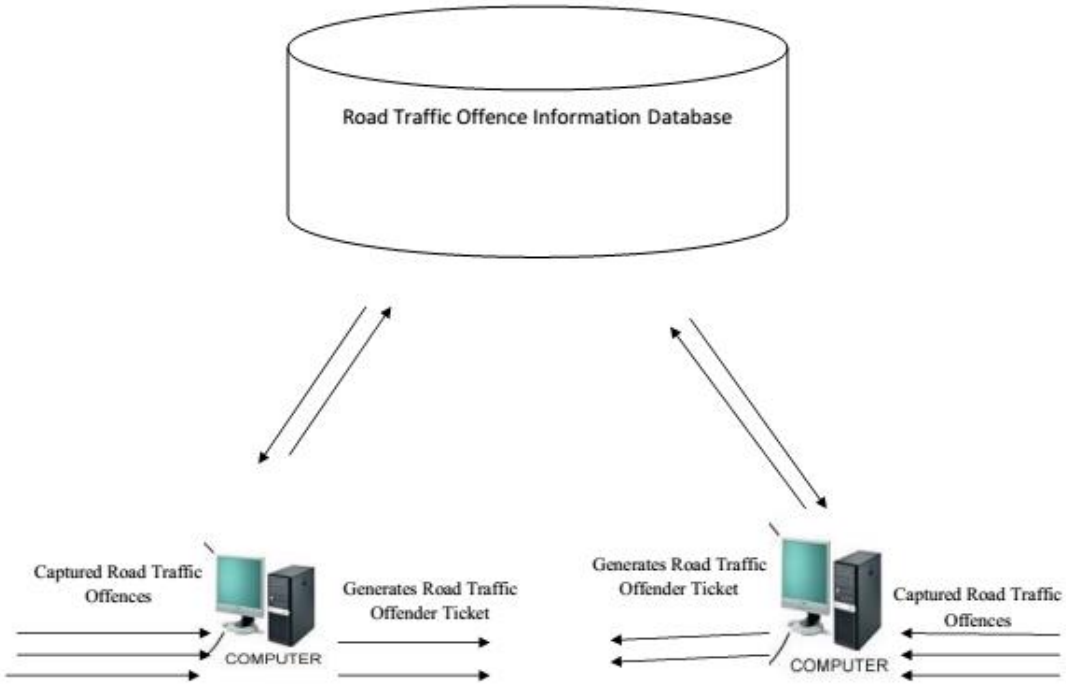

Figure 3. Implementation Architecture

The unit testing approach was adopted in testing the codes written. The procedure adopted for the unit test is; (i) The module interface is tested to ensure that information properly flows into and out of the program unit under test. (ii) The local data structure is examined to ensure that data stored temporarily maintained its integrity during all steps in an algorithm's execution. (ii) All the statements are executed at least once and error handling paths are tested.

3. Results and Discussion

The existing approach of decentralised road traffic offence information [12] is not efficient as having single integrated road traffic offence information enhances fast, timely and secured accessibility and sharing of road traffic offence information for the agency's decision making. Manual means of identifying offender with only information about an offender is not enough, Identifying road traffic

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offenders with their pictorial images will aid the agency in authentic documentation and avoid prosecuting wrong persons. In the same line, as pragmatic beings who believe what they see, showing offender a display diagram sketch of his crime will convince him .This also will provide forensic evidence that will facilitate prosecutions. The research shows that significant reduction of road crashes can be achieved by the prudent management of road traffic offence information through application of adequate ICT infrastructure, increasing access to road safety information. Not just amassing huge data for road safety management [14], every electronic data, including sensitive road traffic offence information is useless if it is not accessible and proper identification of road traffic offenders made during documentation to ensure reliability and credibility of the process. The proposed model is anticipated to offer an improved solution in road traffic offe nce information management in real time despite the geographical locations. If the proposed model will be implemented it is expected to improve transparency and accountability and therefore strengthening road safety.

3.1 Description Of Existing System

Nigeria's lead road safety agency, the FRSC in 2013 through the use of o electronic reporting. system by the launch of three online reporting portals: (i) e-Dashboard: The dashboard reports on a weekly basis, all activities of the corps from field commands (units, sectors and zonal commands) to the Headquarters, providing real time dynamic management information system based operation system and providing decision makers with visibility and data. (ii) e-ticketing: The Corps initiated an e-Ticketing platform which enhances enforcement capacity. Ticketing enabled online verification of drivers and Vehicles using new Driver's License or Number Plates. (iii) FRSC Intranet: The corps utilised social networks such as Facebook, Twitter, and YouTube accounts to communicate its activities to the public updating information on an hourly basis These portals enabled electronic transmission of situation reports, weekly, monthly and quarterly reports from field commands to the National Headquarters, Abuja [4].

3.2 Merits of the existing system

(i) There is prompt reportage of situation reports from FRSC field commands, as situation reports are transmitted on weekly, monthly and quarterly basis. (ii) The system utilizes social media networks like Facebook, Twitter and YouTube accounts to communicate its activities to the public. Updating information on hourly basis. (iii) The system enables online verification of drivers and vehicles using new Driver's license or Number Plates made possible through e-ticketing process..

3.3 Demerits of the Existing System

(i) The system as the system gives no room for pictorial identification of offenders. Hence wrong person could be accused. (ii) The system is decentralized making road traffic offence information manipulation and accessibility of the database difficult. (iii) The Manual system has no room for pictorial diagram display of the offence committed, as well as the penalty of offence as an evidence to facilitate prosecution. Hence the offender often sees himself as being compelled to accept responsibility.

3.4 Demerits of the Proposed System

No system is without deficiencies, road traffic offence information management system has two areas not covered: (i) To capture road traffic offence information from the scene of offence, the system uses the aids of the field staff, rather than Global Positioning Satellites technology. (ii) Registration of the offenders' information cannot be done using mobile devices; therefore registration can only be done in FRSC offices, using computer system with the road traffic offence information system application

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3.5 Use Case Diagrams

Use case diagrams are used during requirements collection and analysis as a graphical means of representing the functional requirements of the system. Use cases are developed during requirements collection and are further refined and corrected as they are reviewed (by stakeholders) during analysis.

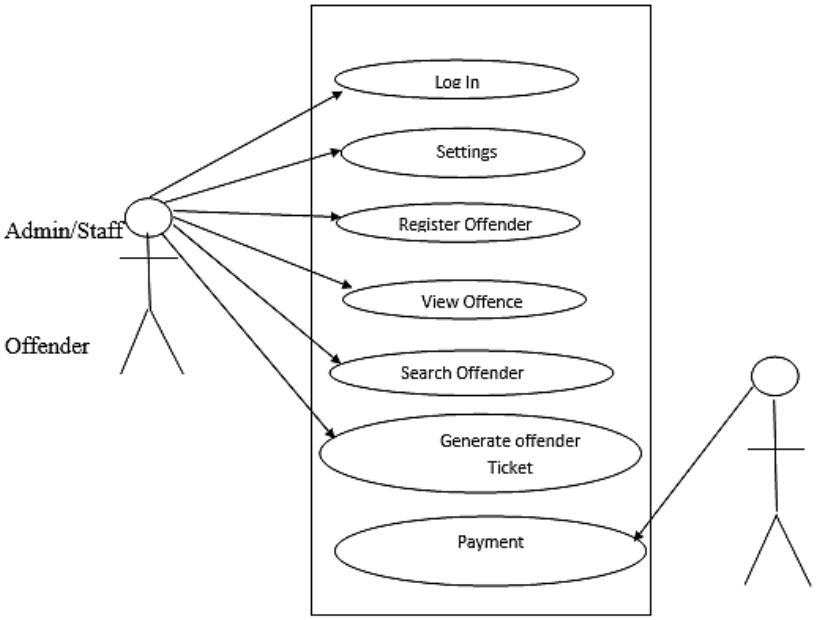

Figure 4. Use Case Diagram of Road Traffic Offence Information Management System

3.6 Sequence Diagrams

A sequence diagrams are used in the analysis and design phase. Sequential diagram shows how messages are sent and received between classes of a given use case, and the exact timing of those messages. The sequence diagram for Road Traffic Offence Information Management System seen figure 3.2.

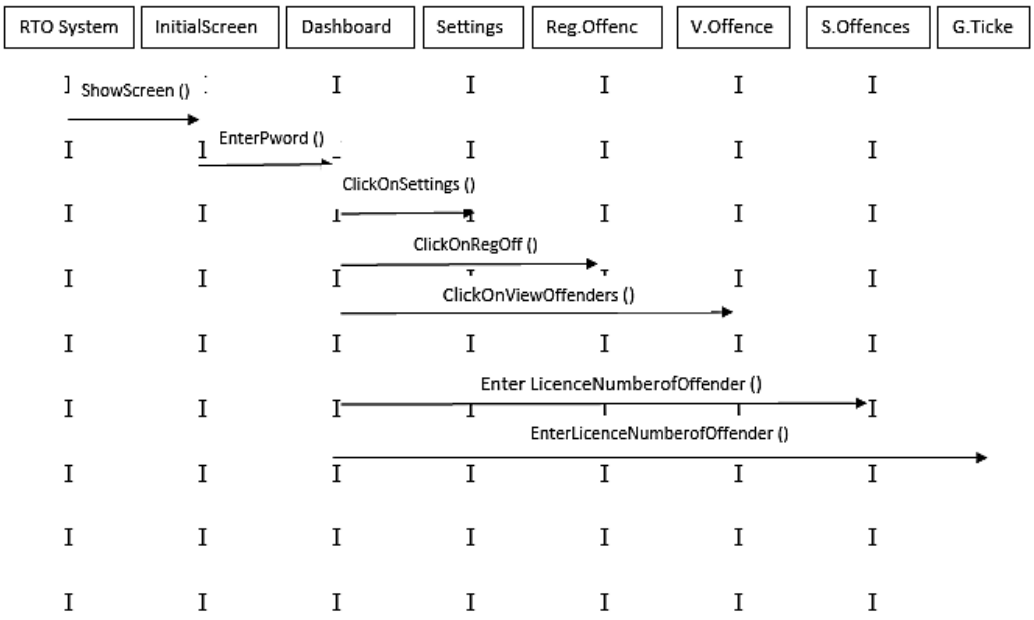

Figure 5. Sequence Diagram of Road Traffic Offence Information Management System

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3.7 Class Diagram

The class diagram describes the types of objects in a system and the various kinds of static relationships that exist among them. In UML, a class is represented by a rectangle with one or more horizontal compartments. The upper compartment holds the name of the class. The name of the class is the only required field in a class diagram. By convention, the class name starts with a capital letter. The (optional) centre compartment of the class rectangle holds the list of the class attributes/data members, and the (optional) lower compartment holds the list of operations/methods.

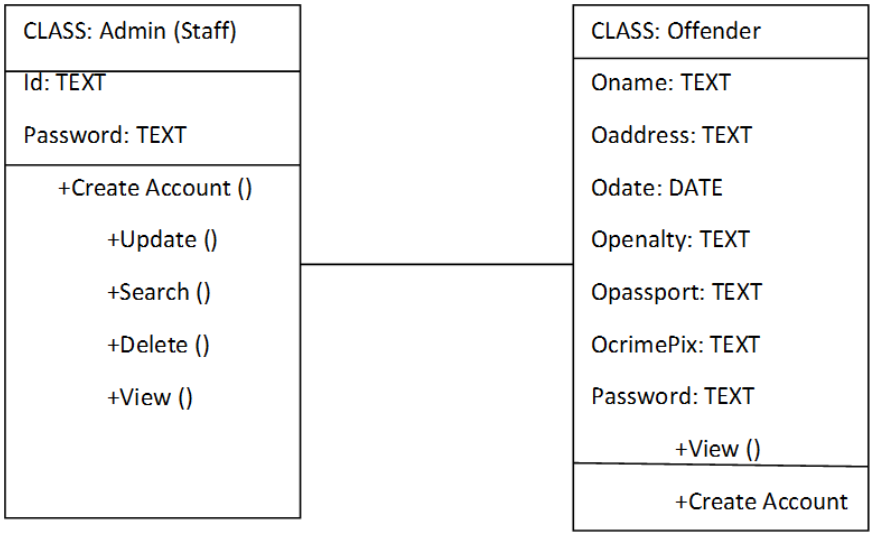

Figure 6. Class Diagram of Road Traffic Offence Information Management System and their Relationships

Note: 1----------* One---many---relation.

3.8 User Interface

Home page Road Traffic Offence Information management can be seen Road Traffic Offence Information management System home page allow FRSC staff get to the Admin-Login when their click on Admin menu

Figure 7. Home Page Screen Shot

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3.9 Review of Achievements

Decentralised road traffic offence information is not efficient as having single integrated road traffic offence information enhances fast, timely and secured accessibility and sharing of road traffic offence information for FRSC's management and decision making. Manual means of identifying offender with only information about an offender is poor. Identifying road traffic offenders with their pictorial images will aid the agency in authentic documentation and avoid prosecuting wrong persons. In the same line, as pragmatic beings who believe what they see, showing offender a display diagram sketch of his crime will convince him .This also will provide forensic evidence that will facilitate prosecutions. The proposed model is anticipated to offer an improved solution in road traffic offence information management in real time despite the geographical locations. If the proposed model will be implemented it is expected to improve transparency and accountability and therefore strengthening road safety. Figure 5.1 depicts prospective users' assessment (in %) of the proposed model.

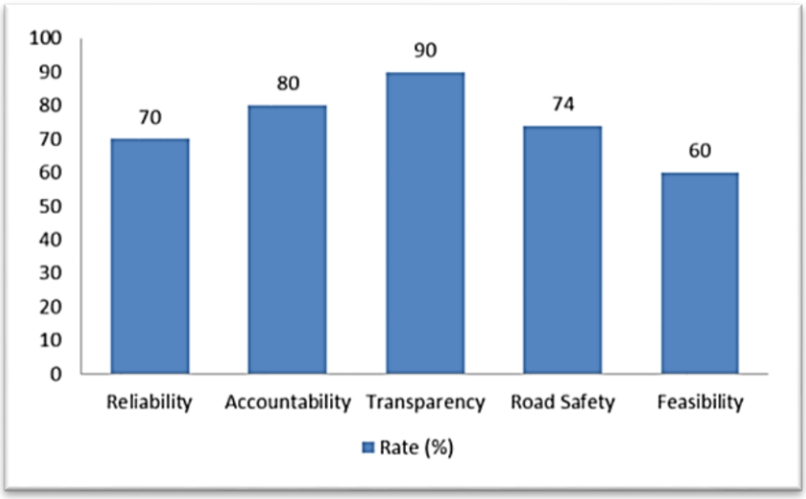

Figure 8. Prospective users' assessment

Prospective users' opinions in rating the practicability of the proposed system was reviewed and analyzed. In summary, the results showed that, the proposed model's advantages would overweigh that of the existing system. Few parameters were used for assessing proposed system to see whether it will improve; Reliability, Accountability, Transparency, Road Safety and how feasible would the solution be.

3.10 Contributions to Knowledge

In the study, the author was able to establish that major cause of road accidents being experienced in Nigeria is due to road traffic offence information management failure and inadequate information and communication technology facilities in road safety activities. Improved road traffic offence information management through single integrated road traffic offence information database and credible offenders' identification measure was proposed and developed. The system model can also display in form of diagram sketch/picture an offenders' crime, to facilitate prosecution

4. Conclusion

FRSC, plays the role as the leading and coordinating agency for road safety management in Nigeria, Unfortunately this has become unattainable due to its current involvement in managing road safety at operational level; a position it shares with several other agencies also duly empowered to perform similar functions. Though shared road safety responsibility provides the benefits of coverage where cross-functional gaps exist, it also portends danger in role submergence and conflict which may arise out of competing interests. It is disturbing to note that such conflict currently characterize road traffic

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offence information management in Nigeria. The main challenge of implementing road traffic offence information management in any developing country is to fully embrace improved information and communication technology in road traffic information management, especially as regards to offence management. This will go a long way to reduce incessant accidents in Nigeria.

The research shows that significant reduction of road crashes can be achieved by the prudent management of road traffic offence information through application of adequate ICT infrastructure, increasing access to road safety information. Not just amassing huge data for road safety management, every electronic data, including sensitive road traffic offence information is useless if it is not accessible and proper identification of road traffic offenders made during documentation to ensure reliability and credibility of the process.

The way in which all officials involved would use the technology and mechanisms provided, will determine the system's effectiveness in enforcing road traffic offence management control. The integrity and dedication of these officials are among important factors in our struggle against road traffic offences. It is trusted that the efforts and investment in Road Traffic Offence Information Management System will result in the much-needed positive benefits toward road traffic offences and accidents reduction in Nigeria.

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