Design And Implementation Of Road Traffic Information And Offence Management System With Pictorial Identification

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ABSTRACT

This work is concerned with road traffic offence information management in Nigeria. It focused on trends in road traffic offence information and was carried out with a critical review of current information, communication and technology compliance state of Federal Road Safety Commission of Nigeria 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 result of the research shows that there is high rate of road traffic offences as a result of poor road traffic offence information management. The road traffic offence information system with facial identification was designed using the Object-Oriented Analysis and Design (OOAD) methodology. The system was developed using PHP and MySQL for the database while HTML, CSS, bootstrap was used to develop the interface. The design of the road traffic offence database can be used by the government in making proper laws that will improve the safety of road users.

Key Words: *Road Traffic Offence, Traffic, Federal Road Safety Commission (FRSC), Driver assistance System (DAS), Intelligent Traffic Systems (ITS), Global Positioning System (GPS), Advanced Driver Assistance System (ADAS), Information and Communication Technology (ICT)*

1.0 INTRODUCTION

In Nigeria, road transport is the most commonly used by the majority of citizen, as the easiest option in moving goods and travelers. 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, careless driving, over-speeding and other road traffic offences. These have resulted to numerous consequences including deaths, injuries, disabilities and loss of properties, all of which accelerate to poverty in the country. 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.

Nigeria has a total land area of 910,770 square kilometers and human population of 209,468,964 as of Tuesday, February 16, 2021. Nigeria population is estimated to increase to 211,400,708 by July 1, 2021, based on United Nations estimates and this makes Nigeria the most populous country in Africa, and ranks number 7 in the list of countries by population in the world (World population review, 2021). Its large land mass and population correlate with its high level of vehicular population estimated at over 7.6 million with a total road length of about 194,000 kilometers (comprising 34, 120 km federal, 30,500 Km, State and 129,580 km of local roads). (United Nations Department of Economic and Social Affairs: Population Division, UN, 2019). According to the World Health Organization (WHO) data, Nigeria ranks 191 out of 192 countries in the world with un-safe roads with 162 death rates per 100,000 populations from road traffic accident. The country's ranking indicates the hazards associated with road transportation in a country that is largely dependent on its road network for economic, social and physical activities.

In Nigeria, 35,621 people died in 2013 according to World Health Organization's estimated report on road traffic death (WHO, 2015). Nigeria density which varies in rural and urban areas (approximately 51.7% and 48.3% respectively) translates to a population- road ratio of 860 persons per square kilometers indicating intense traffic pressure on the available road network. This pressure contributes to the high road traffic accidents in the country (FRSC, 2012). Injuries are a growing problem: the three leading causes of death globally from injuries – road traffic crashes, homicide and suicide – are all predicted to rise in rank compared to other causes of death, placing them among the top 20 leading causes of death in the world by 2030. In 2004, road traffic crashes were the ninth cause of death in the world but road

traffic crashes are predicted to become the fifth leading cause of death by 2030 (World Health Statistics, 2008).

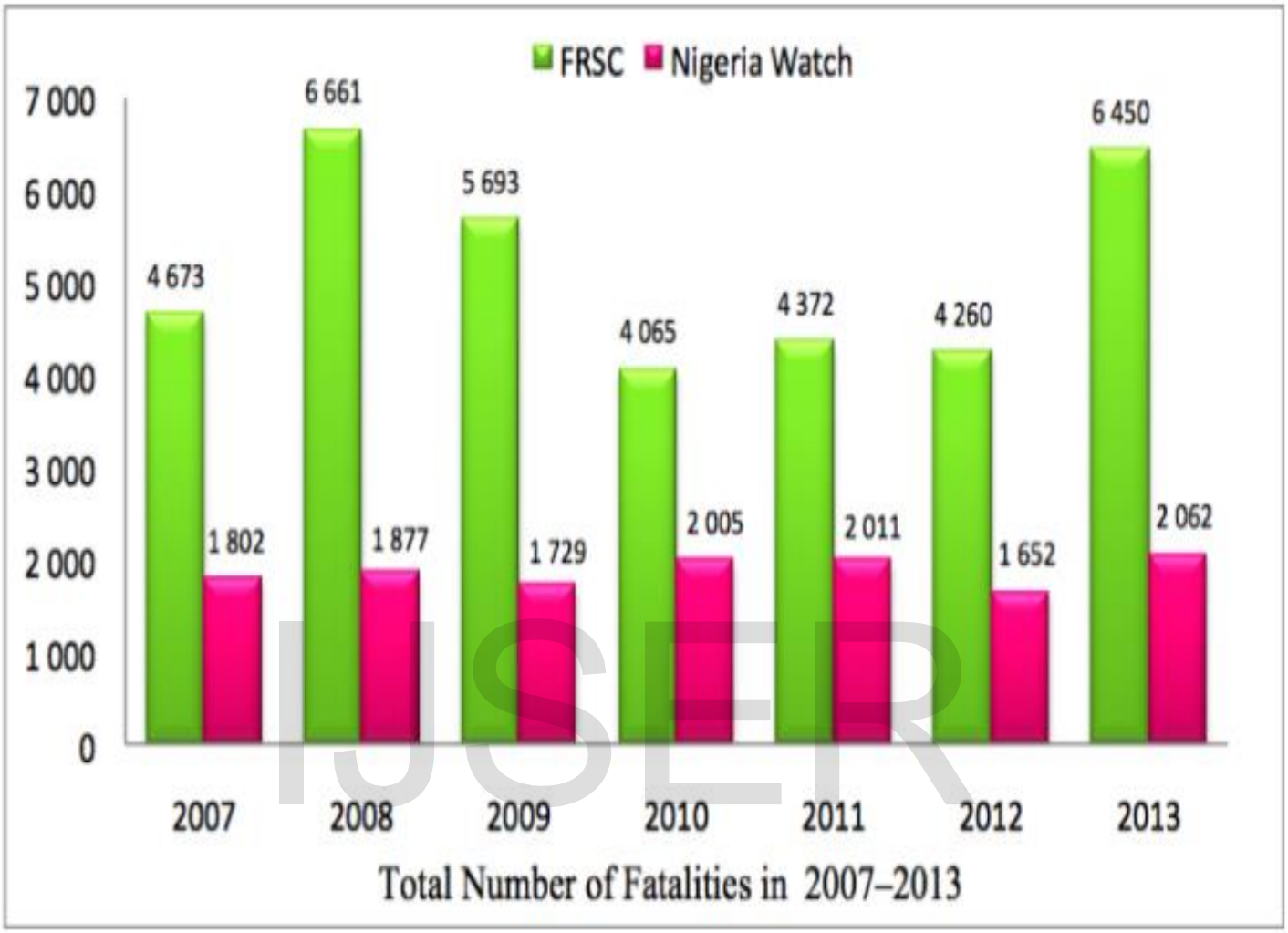

Figure 1: Records of Road Traffic Crashes (2007-2013) (FRSC, 2013)

From road traffic crashes (2007-2013) chart in figure 2.1, about 6,500 road traffic crashes were recorded in the year 2007, while in the year 2008, about 8,400 road traffic crashes were recorded. 7,500 road traffic crashes were recorded in the year 2009, while in 2010 a total of about 6,000 road traffic crashes were recorded. In 2011, 6,300 road traffic crashes were recorded, while about 6,000 road traffic crashes were recorded in 2012. In 2013, about 10,500 road traffic crashes were recorded by the FRSC in Nigeria (FRSC, 2013).

1.1 Statement of the Problem

From the available population-based studies, Nigeria reported the highest number of road traffic injury and death rates at 4120 per 100 000 population and 160 per 100 000 population, respectively. The road traffic injury rate is the highest recorded in any single study in Africa (WHO, 2016). It is in view of this that the federal road safety corporation is mandated with making the highways safe for motorist and other road users, and also preventing or minimizing road traffic crash on the high ways. Vehicle drivers take delight in driving on wrong lanes and even abuse the right of way rules, thereby creating conflict in the use of traffic, cause delay and sometimes accident. This has led to enormous road traffic offence on our roads particularly in the cities and this can be attributed to poor road traffic offence management.

Improved computerized Information Systems is the fundamental and the bedrock for increase in Information Technology. Because of the importance of the improved information technology, measures are taken to evolve all sectors of the economy into improved Information Technology compliant. The road traffic offence information sector should not be left out, because an increase in the use of improved information management technology has greater advantages, where process of collecting, processing, storage, retrieval and dissemination of road traffic offence information for the purposes of planning, controlling, coordinating and decision coincides with times. The existing system of road traffic offence gives no room for pictorial identification of offenders. The system is decentralized making road traffic offence information manipulation and accessibility of the database difficult. In addition, 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.

1.2 Aim and Objectives of the Study

The aim of this work is to design and implement a computerized road traffic information and offence management system with pictorial identification. The specific objective is to design a system that will achieve the following:

- Centralized road traffic offence information database where road traffic offence information can be easily accessed by all authorized user.
- Reduce error in offenders' identification, as lots offenders escape offence due to wrong identification (pictorial identification) during and after documentation which makes prosecution of offenders' difficulty.
- Display and print a monetary penalty that the offender has to pay for the specific traffic offence committed, into a designated bank account.

1.3 Existing System

Intelligent Traffic Systems (ITS) uses ICTs to manage driving, traffic, and all factors that are important in one way or the other to transport safety design and education. ITS systems could be in-vehicle systems, or external infrastructure support. Interfacing road infrastructure hardware with in-vehicle warning and control systems is another road safety ground-breaking technology. Intelligent Transport Systems differ in technologies applied, from basic management systems like car navigation, traffic signal control systems, variable message signs, automatic number plate recognition or speed cameras to monitor applications. Example is the Closed-Circuit TV (CCTV) systems and other advanced applications that combine live data and feedback from sources, such as parking guidance and information systems. Among the Intelligent Transport Technologies include:

1. **IP-based CCTV and surveillance cameras:**

Traffic Closed Circuit TV (CCTV) systems combined together with surveillance cameras are video-based vehicle/motion detection systems used for remote surveillance of traffic situations to track offenders, to build usable traffic data and to provide an archive for future road transport enhancements. Specifically, the use of Internet Protocol (IP) based CCTV systems and surveillance cameras introduce a lot of interactivity in the remote manipulation of the cameras, and also ease the task of searching for specific reference scenes.

2. Speed monitors:

Speed sensors are two-way electronic communication devices that estimate the relative speed of road vehicles, and compare it with the stipulated speed limits. In advanced implementations, any speed over-shoot beyond the stated limit triggers a zoom-in from the nearest camera and the vehicle is instantly traced while video capture/recording is automatically activated.

3. Web-based road safety portals:

The World Wide Web (www), also called the web. The web represents the huge volume of resources, multimedia content and data bank which are limitlessly accessible using client browsers, and other web applications through networking technologies. Road safety web portals enable the continuous publication of interactive resources which can equip stakeholders with vital statistics concerning the true nature of traffic conditions, accident spots, nearby health institutions, and real-time distress calls.

4. Automated 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 portals to give it wider access beyond the bounds of the cellular network's coverage area. 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 ensures a faster rescue time and a higher survival probability, during emergency

5. Point to point communications (PPC):

Enables road safety officials to use high-speed radio systems to communicate between multiple locations and for vehicle-to-vehicle driver communications. Radio frequency (RF) channels, allocated by the telecoms regulatory body (For instance, the Nigeria Communications Commission NCC) are meant to be used to communicate from one location to the other among mobile road users.

6. Wireless networks (Wifi and WiMAX):

Hand-held, portable electronic devices influence existing cellular and private wireless networks to provide a one-touch access to traffic data, weather condition reports, transport news. The efficiency of the systems builds on the prevalence of their data which updates in real-time and fully accessible from web applications (web apps) within contemporary Smartphone, blackberries, android, iPad and other handheld electronic devices.

ICT allows road users and vehicles to be managed based on real-time road status information (Angela-Aida et al., 2013). In the work, Role of ICT in Monitoring and Solving Traffic Issues, Pešić (2012) proposed a system that uses the power of smart phones in delivering real time information pertaining to the events happening on the major roads. The application can synchronize web application with the mobile application, both of which share the same database. The important thing is that user can send his information through application about conditions on the road where he is and to choose event, which is the reason for the delay (road works, traffic accidents). Users use mobile and web application for monitoring and informing about traffic problems that they meet (Pešić, 2012). In addition to that, the application is equipped with map to locate the location with the reported road incident. The introduction of ICT into traffic systems will contribute to reducing of gas emissions, traffic accidents, save the time and money (Pešić, 2012).

Kurt et al. (2010) proposed a GPS based system for tracking in real time the school transportation to avoid over-speeding and reckless driving. The system is modeled 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.

It is not gainsaying that Road safety problem and offences are a major area of concern in the transport industry especially in developing countries. As more vehicles involved in the road, car accident and offences rates are increasing. Therefore this work presented an information and communication system that consists of a great collection of Intelligent system that will improve driver's behavior and decision making, thus will reduce car accidents and traffic offences. Driver Assistance Systems (DAS) have become popular in vehicle technology most importantly road safety, as drivers are normally unaware of committing potentially dangerous actions daily. The interaction between drivers, vehicles, and the environment is the main concept behind the DAS system, because it links the drivers to their physical environment. Real-time analysis and auditory alerts of risk is a DAS that increases a driver's overall attentiveness and maximize safety. These intelligent systems prevent road accidents by providing supportive information on approaching traffic in various circumstances. Driving assistance applications such as lane-keeping assistance systems, forward collision warning systems and emergency braking systems have been introduced lately by vehicle manufacturers in an attempt to address driver safety. Driver assistance innovation is an important focus in the design, development and manufacturing of new vehicles, and includes among other functionalities such as automated lighting, predictive emergency braking, navigation assistance, traffic detection and rerouting, an in-vehicle mobile device interface, driver alerts, important vehicle or weather condition notifications, and live video footage of blind spots while driving or rear-view imagery during parking.

It is worthy to note that, these applications are actively used to address safety issues but they do not have the capacity to store all road traffic offence information in a single database which enhances fast, timely and secured accessibility and sharing of road traffic offence reports for the purpose of planning, controlling, coordinating and decision making. In addition, these applications cannot identify traffic offenders in a pictorial identification form; also these applications have no room for pictorial diagram display of the offence committed, as well as the penalty of offence as an evidence to facilitate prosecution. Therefore this research work will provide the deficiencies of the existing system.

The computerized road traffic information and offence management system with pictorial identification provides road traffic information that is needed to manage road traffic organizations efficiently and

effectively. With the growth in information technology, the study offers numerous benefits to the Federal Road Safety Commission and other organizations that deal with road traffic offence information management. The following are the reasons why a work on the road traffic offence information system with pictorial identification is considered important in Nigeria at this time. The chief reasons being that:

- Road traffic offence information management system uses integrated database-which stores all road traffic offence information in a single database. This enhances fast, timely and secured accessibility and sharing of road traffic offence reports for the agency's decision making
- Identifying road traffic offenders with their pictorial images will aid the agency in authentic documentation and avoid prosecuting wrong persons.
- Printing out the traffic offence penalty fee and instructing the traffic offender to pay into a designated bank will help reduce corruption and bribery among the organizations that deal with road traffic, such as Federal Road Safety Commission, and this will enhance the agency's credibility.

2.1 Methodology Adopted

The methodology that was adopted for this project is object-oriented analysis and design methodology (OOAD) and Unified modeling language (UML) notation is the design tool used for modeling in this research. UML used in the research includes use case diagram and object diagram.

2.2 Analysis of Proposed System

The new system is made up of well-designed modules containing all of the information required to manipulate an object. Figure 2 is the class diagram of the new system. It shows the building blocks of the road traffic system. The class diagram describes the types of objects in a system and the various kinds of static relationships that exist among them. In Figure 2, the following classes are depicted and each class has attributes and functions and each class can also share its information with other classes.

• Administrator class: The administrator (staff) contains attributes such as username, password and functions such as update, search, view, delete.

• Register offender class: The register offender class contains attributes such as offender name, address, penalty, date, crime picture and functions such as submit.

• View offender class: This has attributes such as offence list and function such as print.

• Generate ticket class: This has attributes such as offender name, phone number, penalty, amount and function such as print

• Add new crime class: This has attributes such as crime name, crime point, crime code, crime penalty, and function such as update.

In figure 2, the administrator registers road traffic offenders, generate ticket for the offender to make payment as the penalty for the traffic offence committed. The administrator can also view the list of registered offenders and also add new crime.

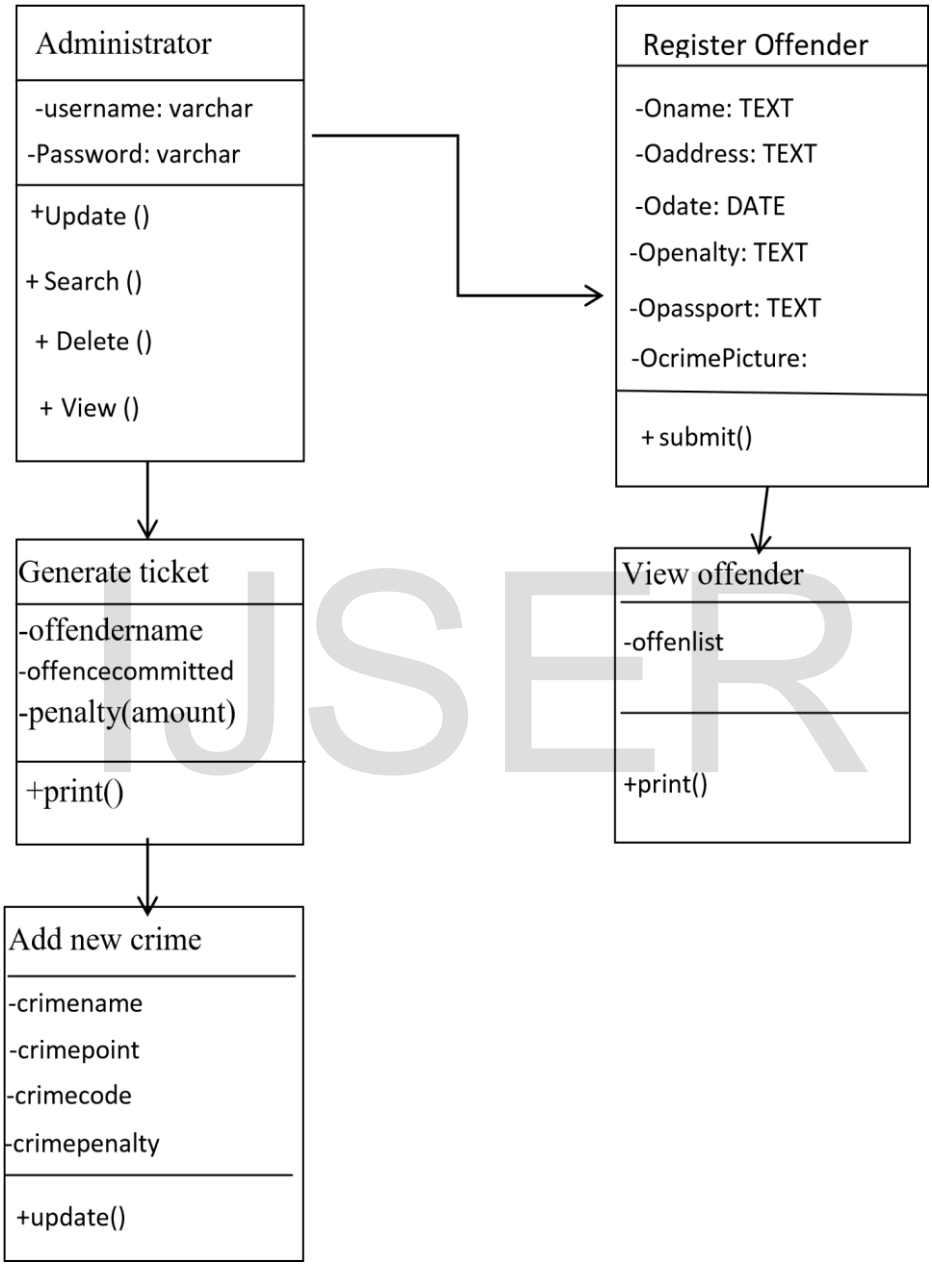

Figure 2: Class diagram of road traffic offence system

2.3 Use Case Diagram

Figure 3 shows the Use Case diagram for the traffic offence system. Here, the admin (staff) will be able to login with their details, access the system's setting, register offenders, view offences, search for an

offender on the system database and also generate ticket for offenders. Finally, the offender can make payment with the ticket generated as penalty for the traffic offence committed.

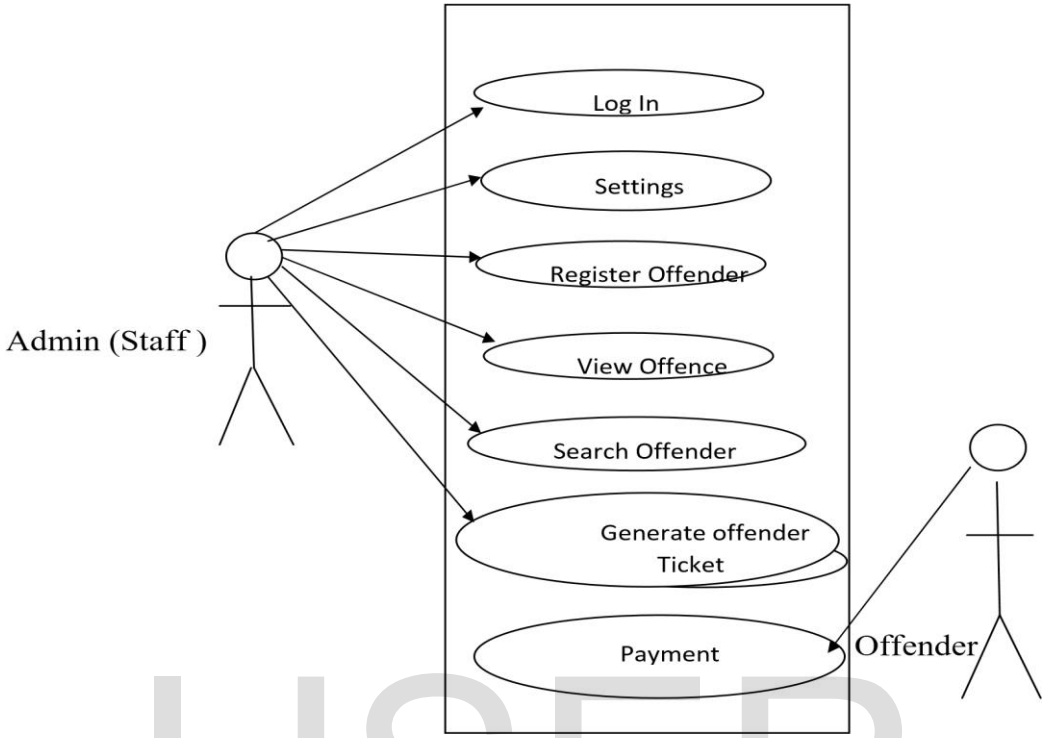

Figure 3: Use Case diagram of road traffic offence system

2.4 Hierarchical Input Process Output (HIPO) of the Proposed System

HIPO diagram represents the hierarchy of modules in the software design. It is used in order to obtain high level view of the system functions. The whole system was broken down into its component parts and designed in modules and was designed using top-down approach. Figure 4 shows the Hierarchical Input Process Output diagram of road traffic offence system. The diagram shows how each module of the system is decomposed into its lowest level.

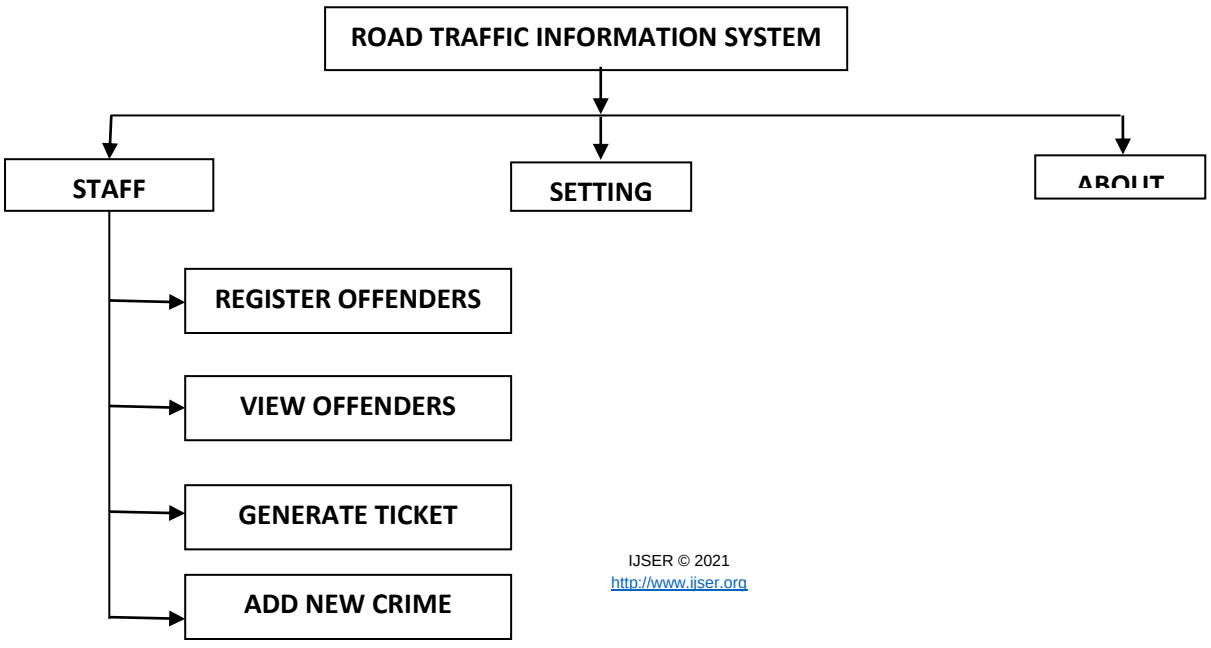

Figure 4: Hierarchical Input Process Output Diagram

2.5 Control Centre/Main Menu

In developing a new system, main menu is very important because it serves as the engine of the system. The new system under research has menus which control the activities of the system. Figure 4.1 depicts the main menus of the traffic offence system. It contains the following modules:

- Staff: This module allows authorized staff to login to the system.
- Setting: This page allows staff or admin to update new crime to the system.
- About: About page is a page that contains details about the software and its application. It also gives detail about the developer.

2.6 The Submenu/Subsystems

The traffic offence system has links to other forms which includes:

- Register Offender Page: This page allows authorized staff to register new traffic offender.
- Generate ticket: After registering new traffic offender, offence ticket is generated.
- View Offenders: This page allows to search and view registered offenders on the traffic offence database.
- Add new Crime: This page enables crime information to be updated.

2.7 Database Development Tool

The database development tool used in the design of the road traffic offence system is MySQL. MySQL is a freely available open source relational database management system that uses Structured Query Language (SQL). SQL is the most popular language for adding, accessing and managing content in a database. It is the most noted for its quick processing, proven reliability, ease and flexibility of use. MySQL runs on virtually all platforms, including Linux, UNIX and windows. Although it can be used in a wide range of applications and online publishing.

2.8 Database Design and Structure

The database design and structure for the road traffic offence system comprises of the login table, register offender table, generate ticket table.

Table 1 is the login table and it depicts the username and password for authorized users to login into the road traffic offence system. If the username or password is incorrect, the user will not be allowed to access the road traffic offence system.

Table 1: Login Table

id	Username	Password
1	NAME	********

Table 2 is the offence table and it depicts details of the offender such as id, name, offence, penalty, location, phone number, description etc.

Table 2: Offence Table

id	name	Offence	Penalty (₦)	License	location	Phone no	description
1	ChiomaIkpo	over speeding	5,000	3422613	Awka	08076544263	Drove roughly
2	OkekeIlo	Light violation	2,000	6788937	Imo	07076462621	Disobeyed the stop sign

Table 3 is the register crime table. It depicts the offences stored in the road traffic offence system.

Table 3: Register crime table

id	Crime name	Code	Crime point	Crime penalty(₦)
1	Overloading	OVL	10	10,000
2	Route Violation	RTV	10	10,000
3	Road obstruction	ROB	5	5,000
4	Seat belt use violation	SUV	5	5,000
5	Use of phone while driving	UPD	4	4,000

Table 4 is the generate ticket table. It contains information about an offender's detail and the penalty (monetary payment) for an offence committed.

Table 4: Generate Ticket Table

id	Full name	Vehicle	Offence	Penalty(₦)	Location	Date
1	Micheal Eze	Lexus 350	Over speeding	5,000	Awka	10/01/2021

2	Rose Agu	Camry 200	Route Violation	10,000	Agulu	02/02/2021
3	Newton John	Volvo	Seat belt use violation	5,000	New heaven,Enugu	04/02/2021
4	Tolu Ayo	Benz 350	Road obstruction	5,000	Ibadan	4/03/2021

2.9 Program Module Specification

Table 5 depicts the program module specification of the road traffic offence system. It shows the precise statement of what the modules provide.

Table 5: Module in the system

1	ConnectionClass	Handles connection to the Server Database
2	SampleController	Handles all the function or actions of the application
3	Admin Registration	This is the Test registration class. It is used to populate the Registration table
4	User Registration	This is the Text Result class. It used to populate the Result table
5	XML	Creates the interface for the System setup

2.10 Input/output Format

Input Analysis: The input forms are designed based on the necessary data that needs to be entered into the system. The data are captured using keyboard and store in the database of the system, the traffic offence system is composed of crime and penalty and offender and vehicle inputs. Figure 5 shows the crime registration page with attributes such as crime name, crime code, crime penalty, and crime picture.

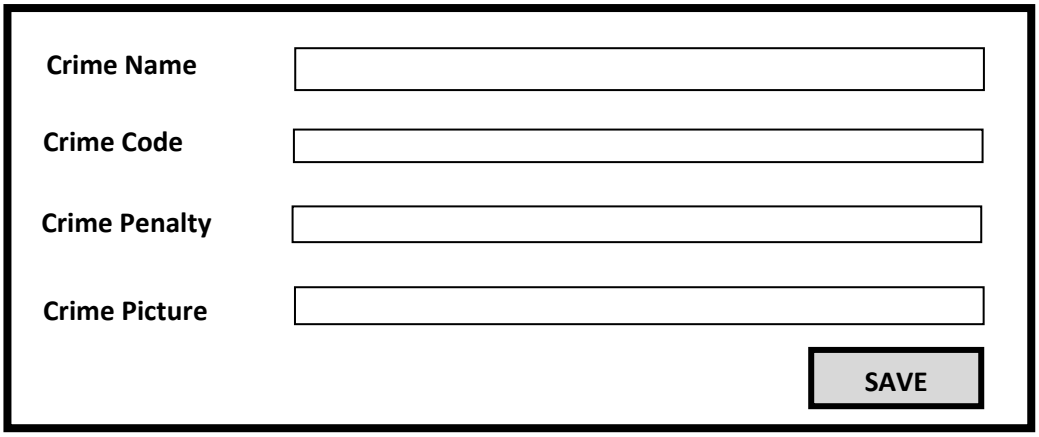

Figure 5: Crime Registration Screen

Figure 6 below shows offence registration page with attributes such as vehicle owner, vehicle name, vehicle make, vehicle model etc.

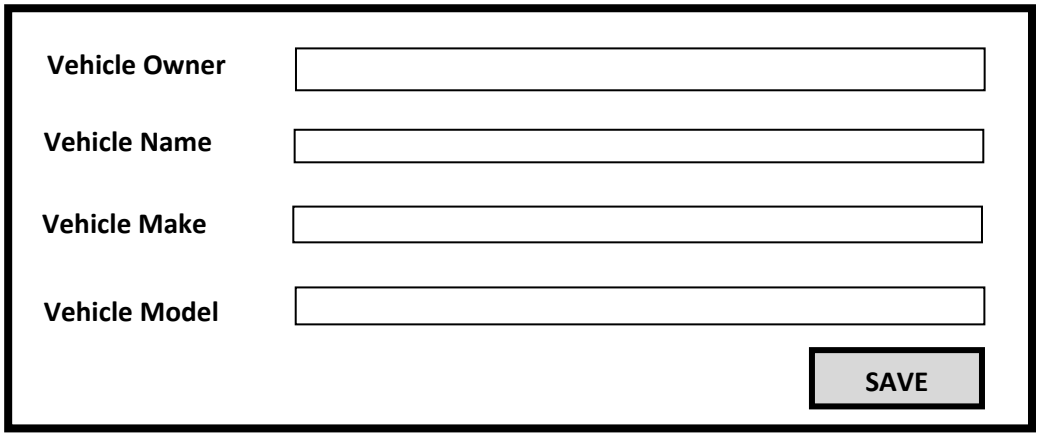

Figure 6: Offence Registration Page

Registration Screen Output Analysis: The output from the system is generated from the system inputs and this output generated is traffic offender's information. These outputs can be printed in hard copy.

2.11 Pseudo code

function Login () Enter your username;
Enter your password;

If username = username and password = password

Return "Login successfully"; else Print ("Wrong username or password") function search ()
Enter name into the search box;

If name = trafficOffenceDatabase.user.name [0] Return User.name

else return ("Record not found");

This pseudo code shows how the login functionality is implemented.

2.12 Data Dictionary

Data dictionary is the centralized collection of information about data. It stores origin and meaning of data, its relationship with other data and data format for usage. Table 6 shows the crime information table with attributes such as field name, code, Point, Penalty, crime picture.

Table 6: Crime Information

Field Name	Description	Character Length	Data Type
Id	Identification number of the registered offence.	2	INT
Name	A word or term by which an offence is known	30	VARCHAR
Code	Crime Code	5	VARCHAR
Point	Crime Point	2	INT
Penalty	Monetary payment for an offence	10	TEXT
Crime picture	Crime Picture	250	VARCHAR

Table 7 shows the vehicle and offender information with their respective data such as vehicle owner, vehicle name, vehicle model, etc.

Table 7: Vehicle and offender information

Field Name	Description	Character Length	Data Type
Id	Identification	5	INT
Vowner	Vehicle Owner	30	VARCHAR
Vname	Vehicle Name	30	VARCHAR
Vmake	Vehicle Make	30	VARCHAR
Vmodel	Vehicle Model	30	VARCHAR
Vtype	Vehicle Type	30	VARCHAR
Vchasis	Vehicle Chassis	10	INT
Vinsurance	Vehicle Insurance	10	INT
Vstateofp	Vehicle State Of Purchase	30	VARCHAR
Ctype	Crime Type	30	VARCHAR
Cdate	Crime Date	30	VARCHAR
Cplace	Crime Place	30	VARCHAR
Croute	Crime Route	30	VARCHAR
Oname	Owner's Name	30	VARCHAR
Address	Owner's Address	50	VARCHAR
Odate	Date	30	DATE
Penalty	Monetary payment for an offence	50	VARCHAR
Oocc	Offenders occupation	30	VARCHAR
Opassport	Offender's Passport	200	VARCHAR
Crimepicture	Crime Picture	200	VARCHAR

Table 8 shows the staff information table with attributes such as field name, description, gender, date of birth, phone number, rank, password and marital status.

Table 8: Staff Information

Field Name	Character Length	Data Type	Description
Id	2	INT	The identification number of the registered staff
Full name	30	VARCHAR	The full name of the staff
Gender	5	VARCHAR	Male or female
Dob	2	INT	Date of birth of the staff
Phone	10	STRING	The phone number of the staff
Rank	250	VARCHAR	The position occupied by the staff
Marital status	20	VARCHAR	Married or single.

2.13 System Flowchart

Figure 7 depicts the system flowchart of the road traffic offence system. It shows how data flows in the road traffic offence system and how decisions are made to control events. Different symbols are used and they are connected together to show what happens to data and the arrow shows where the data goes.

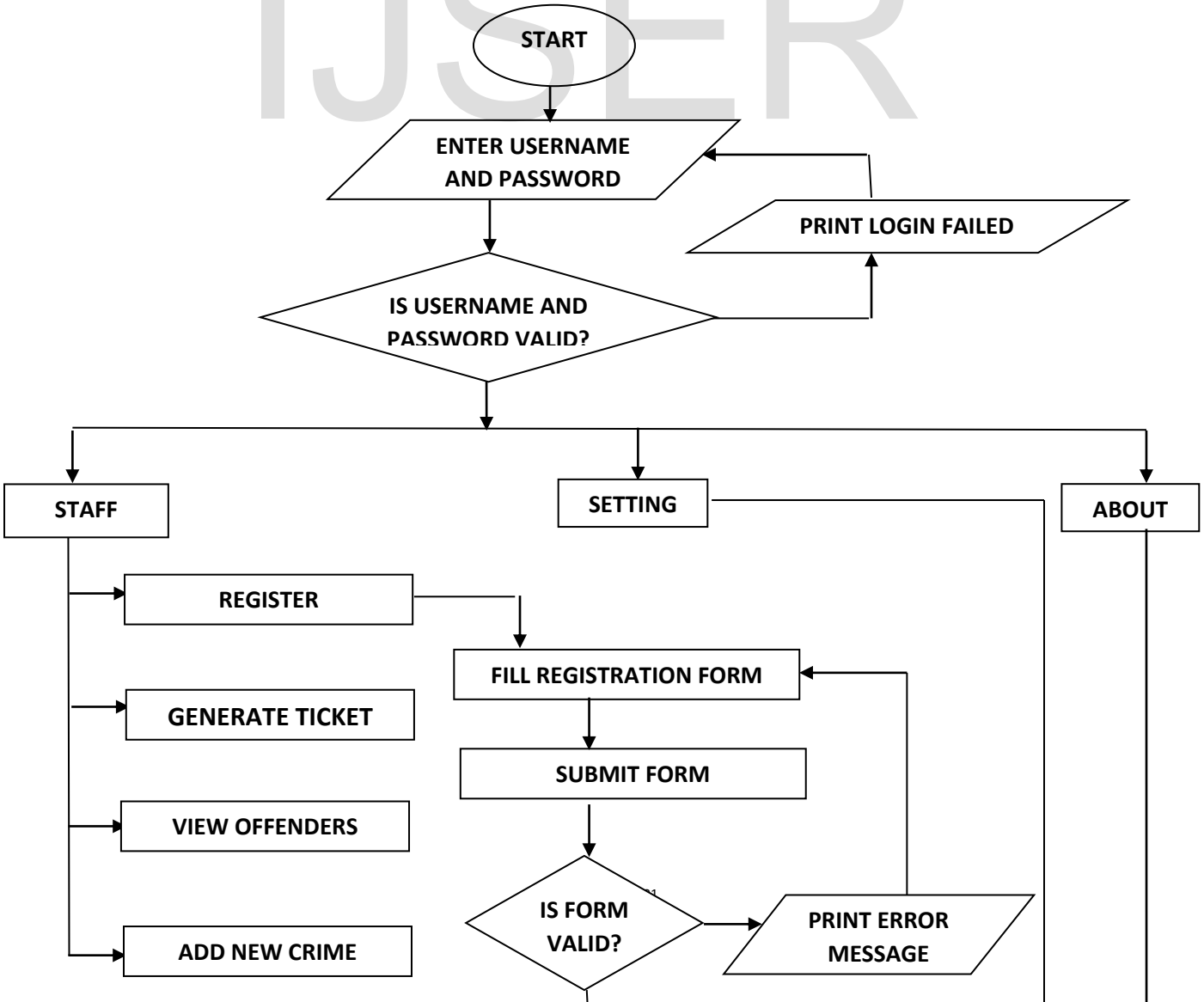

Figure 7: System Flowchart of Road Traffic Offence System

3.0 Summary

The existing approach of decentralized 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 the agency's decision-making. Manual means of identifying offender with only information about an offender is not enough; 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.

3.1 Conclusion

The main challenge of implementing road traffic offence system 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.

3.2 Suggestion for Further Work

1. A research to develop system that relies on thousands of sensors embedded in street signs and hidden in traffic lights and others posted at major streets and key intersections to capture data on traffic flows and density should be encourages. The system will be capable of capturing snapshots of road traffic

offences and then deliver it, wirelessly to computer servers. Computers then combine this information with FRSC field staff dispatches on road traffic offence, accidents or emergencies and deliver it to users who can access it on their PDA or Mobile phones and the internet.

2. The development of a system that can what road traffic condition will be like in several hour and allows documentations of road traffic offence be done via mobile applications.

3.3 APPENDIX B

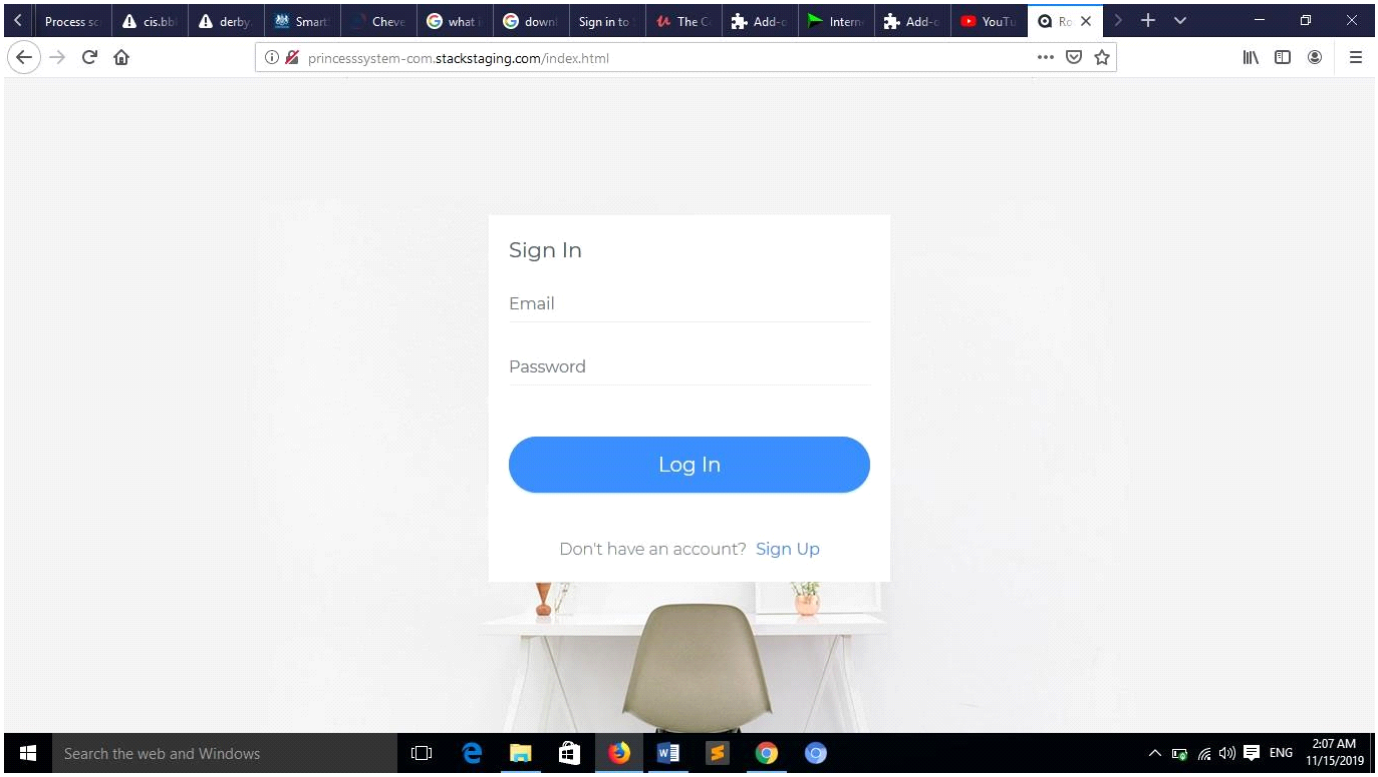

Figure 8: Login Form

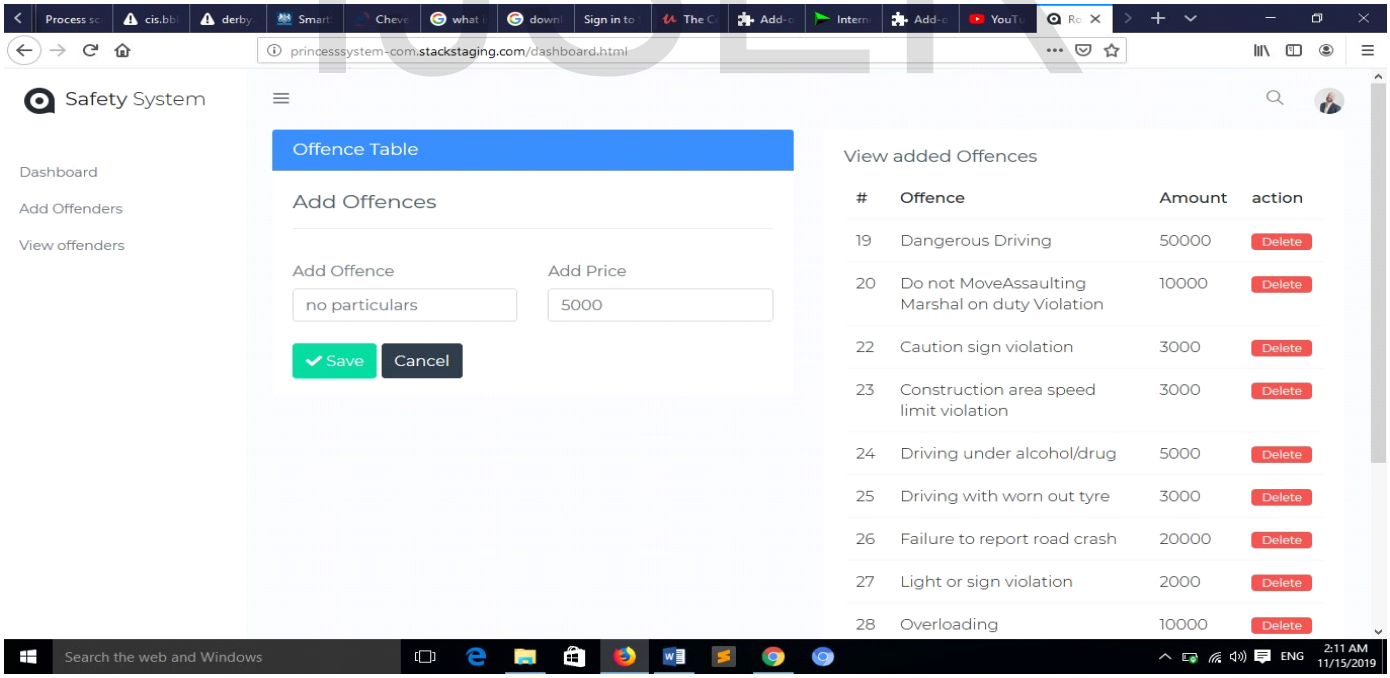

Figure 9: Add Offences

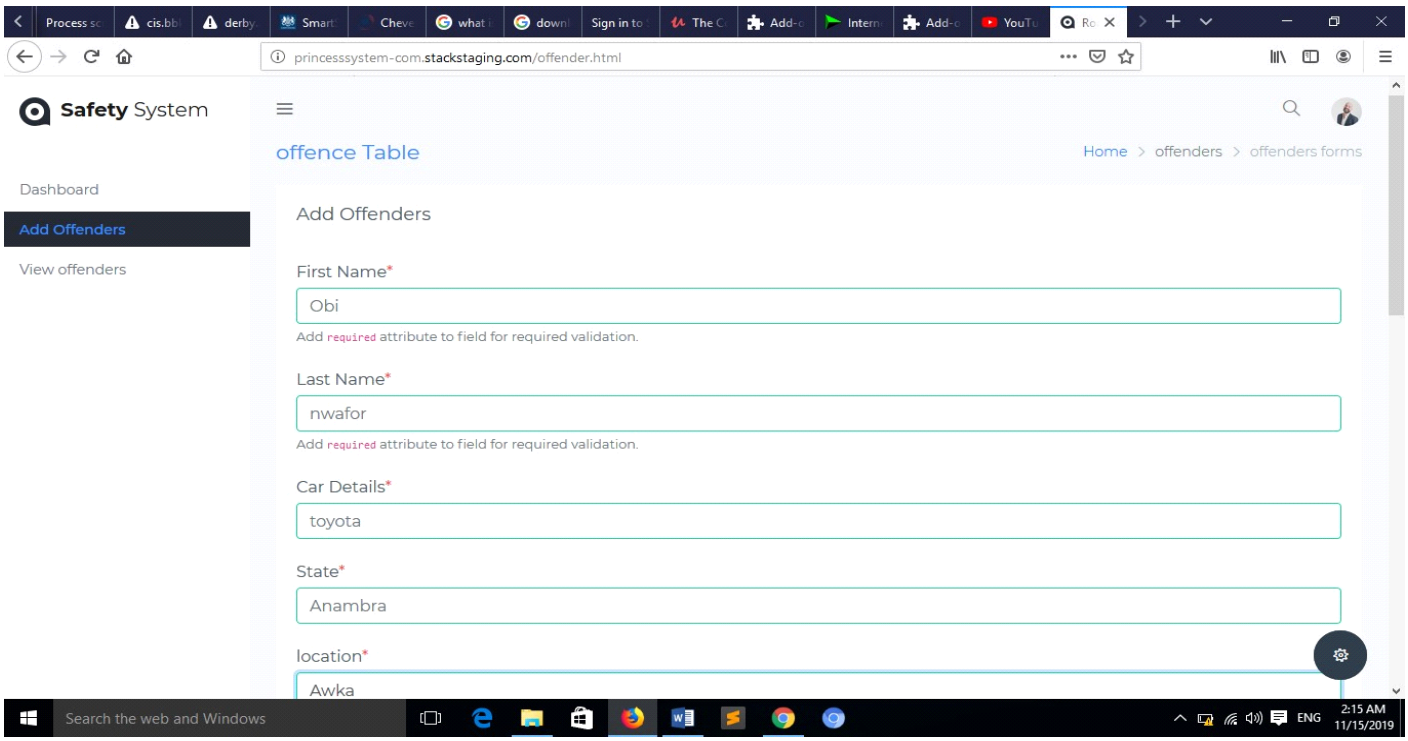

Figure 10: Add Offenders

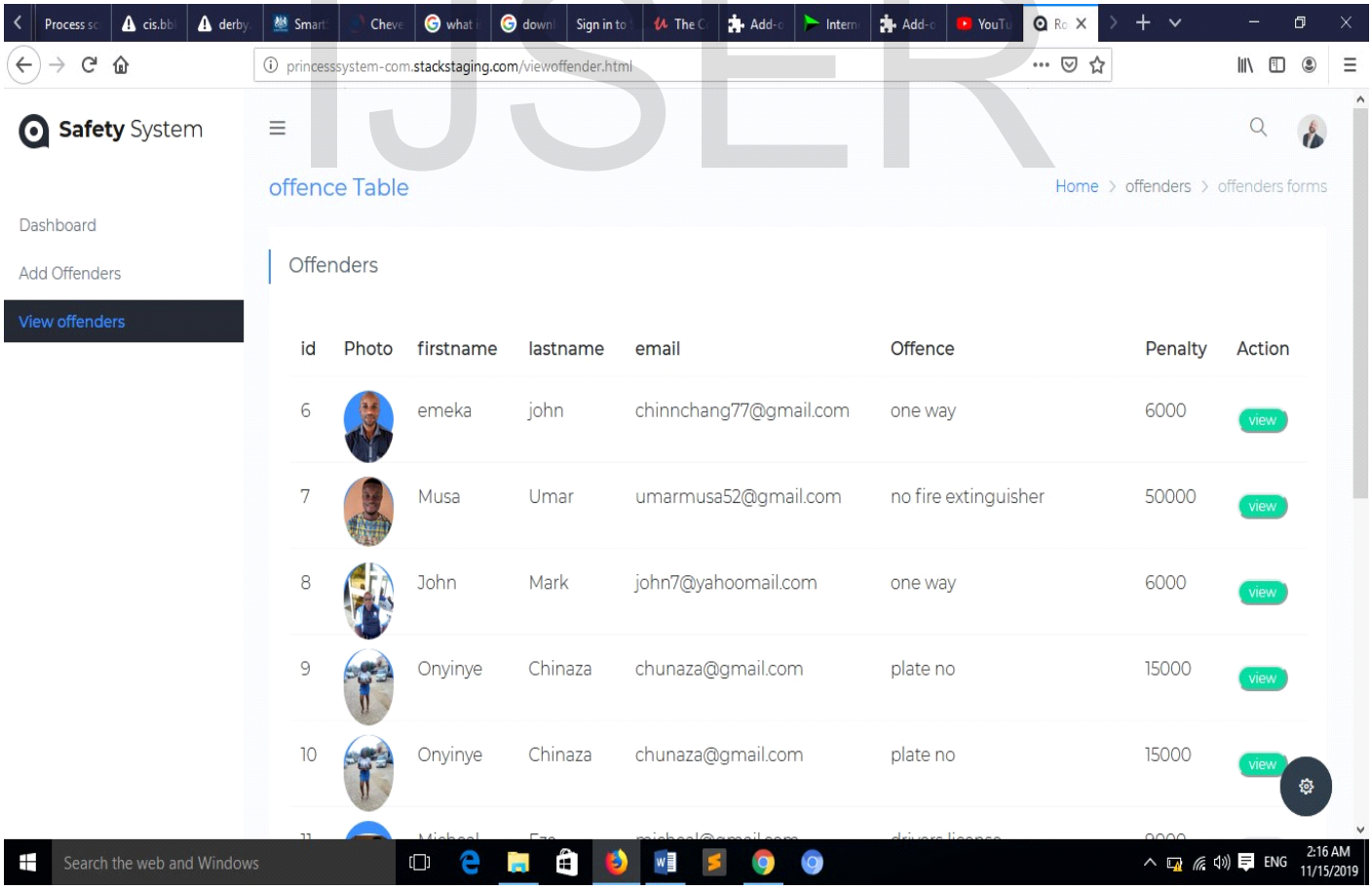

Figure 11: View Offenders

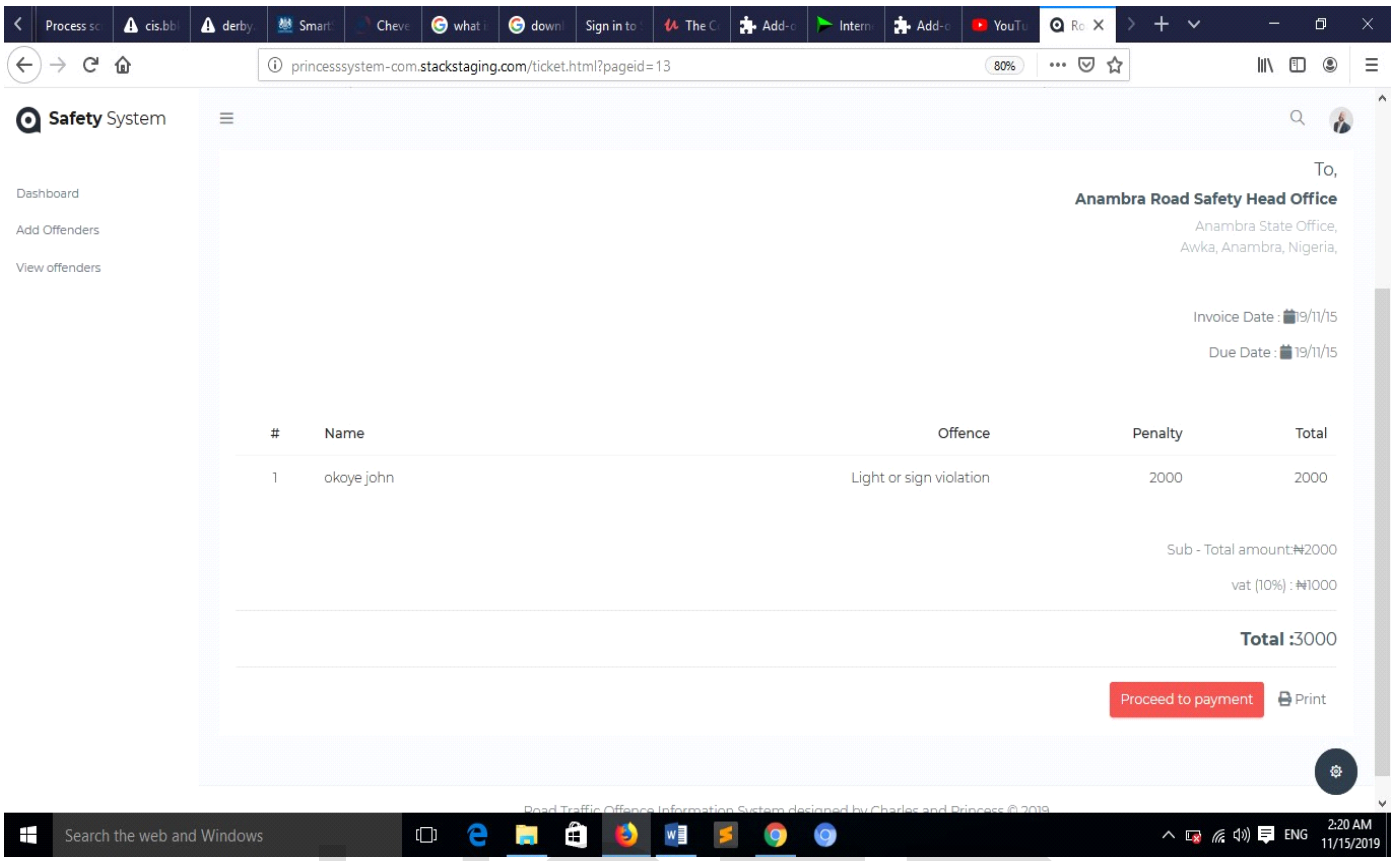

Figure 12: Generate Ticket

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