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Development of a GIS Mapping Application for Crime Analysis for Law Enforcement Agencies in Owerri Metropolis

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ABSTRACT: The aim of this work is to develop a crime analysis information system with the help of GIS, so that law enforcement agencies can adopt the use of crime maps in its operation and reap the benefit. The motivation to carry out this work came because the police find it difficult to manage and control these crimes largely due to the obsolete method and resources employed in doing so and also they face challenges of handling large number of information and huge volume of records pertaining to crime and criminals. The system will help law enforcement agencies in analysis of crime which leads to crime hot spot identification, improving outcome in crime investigation, criminal detection and also sharing of information. The methodology employed is, structured system development methodology because it is a proven one. The structured system development methodology takes an objective view of reality; provide elaborate planning guidelines, techniques and case tools. The system will be built on dotNet platform using C#/ADO.Net for the front end and application logic. MS-SQL will be used as data back end. Geomap tool, a third party API also provides some additional functionality for better visualization of maps for more accurate visual analysis. The expected system will be able to detect crime location, provide information to formulate strategies for crime prevention and reduce the further occurrence of similar incidence by analysing crime pattern.

KEYWORDS: Crime, Geographical Information System (GIS), Hotspots.

I. INTRODUCTION

The formal organized management of crime can be traced back to the mid 19th century in Britain advocated by Sir Robert (Musonda, 2000). From then crime management has evolved. In the early 20th century; a professional model for crime management was developed in the USA and diffused to other areas of the world. The main operational goal of professional policing model was reactive crime control. Law enforcement officers sat in their office waiting for complaints from the public and react to them. The police system was closed to the public and communication was in one direction only, that is from the top to the bottom. (O'shea, 2003). However, in the mid 1980s community policing developed and started to attract serious attention. One critical change associated with community policing being addressed by this research is the importance that information processing and crime analysis have assumed in crime management. Community policing model is more proactive than the professional model. It focuses on intervening before the crime is committed and constantly looking ahead (vision). In today's modern age where computers have become a way of life, it is therefore imperative for Nigeria Police to migrate from the manual system to a digital system in order to reap the associated benefits like crime mapping, crime hotspots identification and GIS analysis of crime. Case files going missing in manual systems yet this can be eliminated by computerizing the data storage. Storing crime information in a database would lead to more efficient data sharing within the force. This would mean that investigating officers have access to up to date information from any location where there is a computer. This can only be achieved through the use of crime mapping information systems and Geographic Information System (GIS). A GIS is a system of hardware and software used for the storage, retrieval, mapping and analysis of geographical data. It is a tool for revealing what is otherwise invisible in geographical information. GIS assisted crime mapping is often employed to understand the geographical distribution of crime, identify crime concentrated areas, or hot spots, and facilitate deployment decisions



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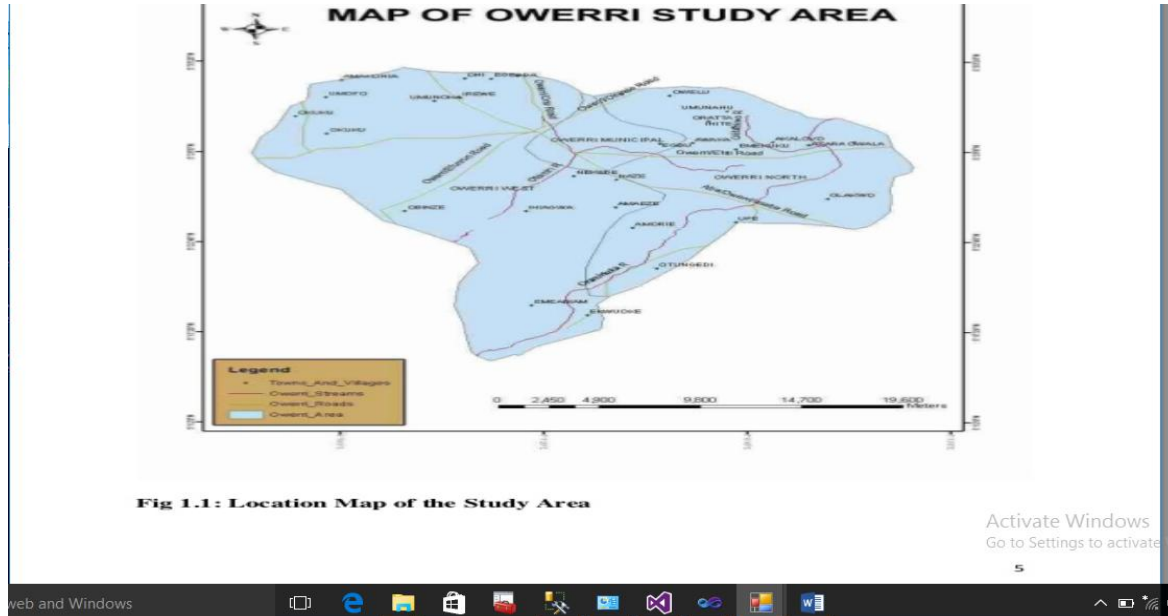
regarding the duration and dosage of intervention programs. The early applications of GIS in policing can be traced back to the 1960s, when it was constrained by the limitation of older computer systems lacking memory and speed. The migration of GIS from mainframe to desktop computers provides the law enforcement agencies with a cost effective option for crime control since hardware and software prices have reduced drastically. Methods of data collection available to law enforcement agents include street investigations, informers and undercover operations. GIS would enhance the analysis of the collected data due to its ability to handle spatial data. Irrespective of Government's huge investment in the Nigerian police force by way of personnel training and crime fighting equipment, crime has remained the bane of social and economic wellbeing of the people of Nigeria making the once peaceful nation now a heaven for criminals. The means of getting offenders is very much limited and the police force as it appears is yet not fully exposed to modern technologies that will help them combat crime properly. It is therefore with this in mind that this research works is carried out. This research attempts to explore the analytical approach to crime using the GIS technology in Nigeria. It is hoped that by adopting this innovative approach in combating crime the spate of crime will be drastically reduced. In today's modern age where computers have become a way of life, it is therefore imperative for Nigeria Police to migrate from the manual system to a digital system in order to reap the associated benefits like crime mapping, crime hotspots identification and GIS analysis of crime. Case files go missing in manual systems yet this can be eliminated by computerizing the data storage. Storing crime information in a database would lead to more efficient data sharing within the force. This would mean that investigating officers have access to up to date information from any location where there is a computer. This can only be achieved through the use of crime mapping information systems and geographic information system (GIS).

II. SIGNIFICANCE OF STUDY

Nigerian Police Force can hardly ascertain the areas under the jurisdiction of their stations or define the shortest route from their station to specific crime. Police stations in Nigeria are far from being distributed according to geographical spread, population characteristics or crime incidence. Crime mapping and analysis will help in decision making because the information gotten will reveal areas that are in need of more police formation in the metropolis. One major advantage of crime mapping is that it helps citizens to understand crime and how it affects the places we live.

III. STUDY AREA

Owerri is the capital of Imo State in Nigeria, set in the heart of Igboland. It is also the state's largest city, followed by Orlu and Okigwe as second and third respectively. Owerri consists of three Local Government Areas including Owerri Municipal, Owerri North and Owerri West, it has an estimated population of about 1,401,873 as of 2016 and is approximately 100 square kilometres (40 sq mi) in area. Owerri is bordered by the Otamiri River to the east and the Nworie River to the south. The Owerri Slogan is *Heartland*. It is currently referred to as the entertainment capital of Nigeria because of its high density of spacious hotels, high street casinos, production studios and high quality centres of relaxation. It is the home to annual beauty pageants, "Miss Heartland" and "Miss Adanma". Owerri was the last of three capitals of the Republic of Biafra in 1969. The capital of the secessionist state was continuously being moved as Nigerian troops captured the older capitals There are five higher institution of learning in the city namely Federal University of Technology, Federal Polytechnic Nekede, Imo state Polytechnic Irrespective of government's huge investment in the Nigerian police force by way of personnel training and crime fighting equipment, crime has remained the bane of social and economic wellbeing of the people of Owerri-city making the once peaceful city now a heaven for criminals. The means of getting offenders is very much limited and the police force as it appears is yet not fully exposed to modern technologies that will help them combat crime properly. It is therefore with this in mind that this research work is carried out. This research attempts to explore the analytical approach to crime using the GIS technology in Owerri-City. It is hoped that by adopting this innovative approach in combating crime the spate of crime will be drastically reduced.



IV. 4.0 CONCEPTUAL FRAMEWORK

The occurrence of crime is not random. It is spatially distributed in pattern some patterns are discovered while others are not. Factors such as social class, income level, and environment play parts in the type of crimes that are committed. Resources and/or a lack of resources can influences the probability of crimes committed in any given area. Because of the complexity of crime, crime has to be managed. Crime has various definitions depending on which angle one is looking at it from, for this research crime is defined as “Violation of law, or an instance of

this, punishable by the state”. Management on the other hand is the process of directing and controlling the resources of an organization, such as its personnel, materials, and equipment to achieve the goals of the organization. Crime management is therefore, defined as controlling, directing, and coordinating police resources (money, equipment, and personnel) to prevent the violation of law and where it has been violated, to apprehend the criminals and take them to court and recovers the stolen property.

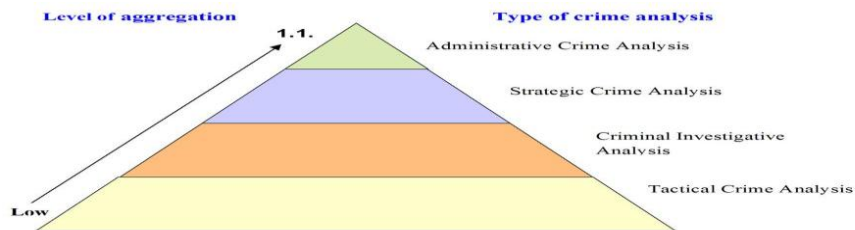
A) WHAT IS CRIME ANALYSIS?

As already mentioned, crime analysis can be described as the systematic study of crime and disorder problems (Boba 2009). Alternatively, Gottlieb, Sheldon, and Raj (1994) described crime analysis as a set of systematic analytical processes directed at providing timely and pertinent information relative to crime patterns and trend correlations to assist the operational and administrative personnel in planning the deployment of resources for the prevention and suppression of criminal activities, aiding the investigative process, and increasing apprehensions and the clearance of cases." In an attempt to clarify what crime analysis is and to provide a common definition for practitioners, the International Association of Crime Analysts (IACA) has recently proposed the following formulation (International Association of Crime Analysts: Crime analysis is a profession and process in which a set of quantitative and qualitative techniques are used to analyze data valuable to police agencies and their communities. It includes the analysis of crime and criminals, crime victims, disorder, quality of life issues, traffic issues, and internal police operations, and its results support criminal investigation and prosecution, patrol activities, crime prevention and reduction strategies, problem solving, and the evaluation of police efforts."

Four major categories of crime analysis are:

- a) Crime intelligence analysis;
- b) Tactical crime analysis;
- c) Strategic crime analysis; and

d) Administrative crime analysis.



Source Boba, 2009

Figure 1: The types of crime analysis in four dimensions

B) MAPPING AS A SPECIAL CASE OF DATA VISUALIZATION.

Desktop computing has put graphic tools within the reach of virtually everyone. Preparing a publication-quality graphic, statistical or otherwise was an arduous process a generation ago. Today it is much easier, although the process still demands considerable care and effort. This new ease and flexibility have broadened our perspective on graphics as tools for the visualization of information. This has happened because people no longer have to devote themselves to one specialized, time-consuming methodology, such as cartography. Now, maps can be produced more easily, and the computer has in effect freed people to produce *other* kinds of graphics as needed, such as bar charts, scatter diagrams, and pie charts.

What does it mean to say that maps are a form of visualization? Simply that a map is data in a form that we can see all at once. Books or tabulations of data are also visualizations in the sense that we assimilate them visually, but they are labor intensive visualizations. Maps and other graphics are essentially pictures of information, those proverbial pictures “worth a thousand words.” If they are well done, they convey their message more or less at a glance.

V. METHODOLOGY

Data was collected by primary and secondary means. The primary data collection employed were interview which entailed talking directly to the people identified such as the police command. Owerri Municipal has 17 wards of which 8 wards were selected randomly and 15 questions were distributed to each. A list of Police stations in Owerri municipal was also collected from the Police State Criminal investigation department. Ten (10) Police stations were sampled and 2 questions were distributed to each giving us a total of 140 respondents. The second method is a step by step process (Figure 2) of how GIS can be employed in the creation and analysis of Crime maps.

A) SPATIAL DATA ACQUISITION

The spatial data was obtained by taking GPS observations of the coordinate of the police stations, and also GPS coordinates of crime hotspots in Owerri City and land use and road map of Owerri municipal gotten from Ministry of lands.

B) ATTRIBUTE OR NON SPATIAL DATA ACQUISITION

- Crime
- Accused
- Victim

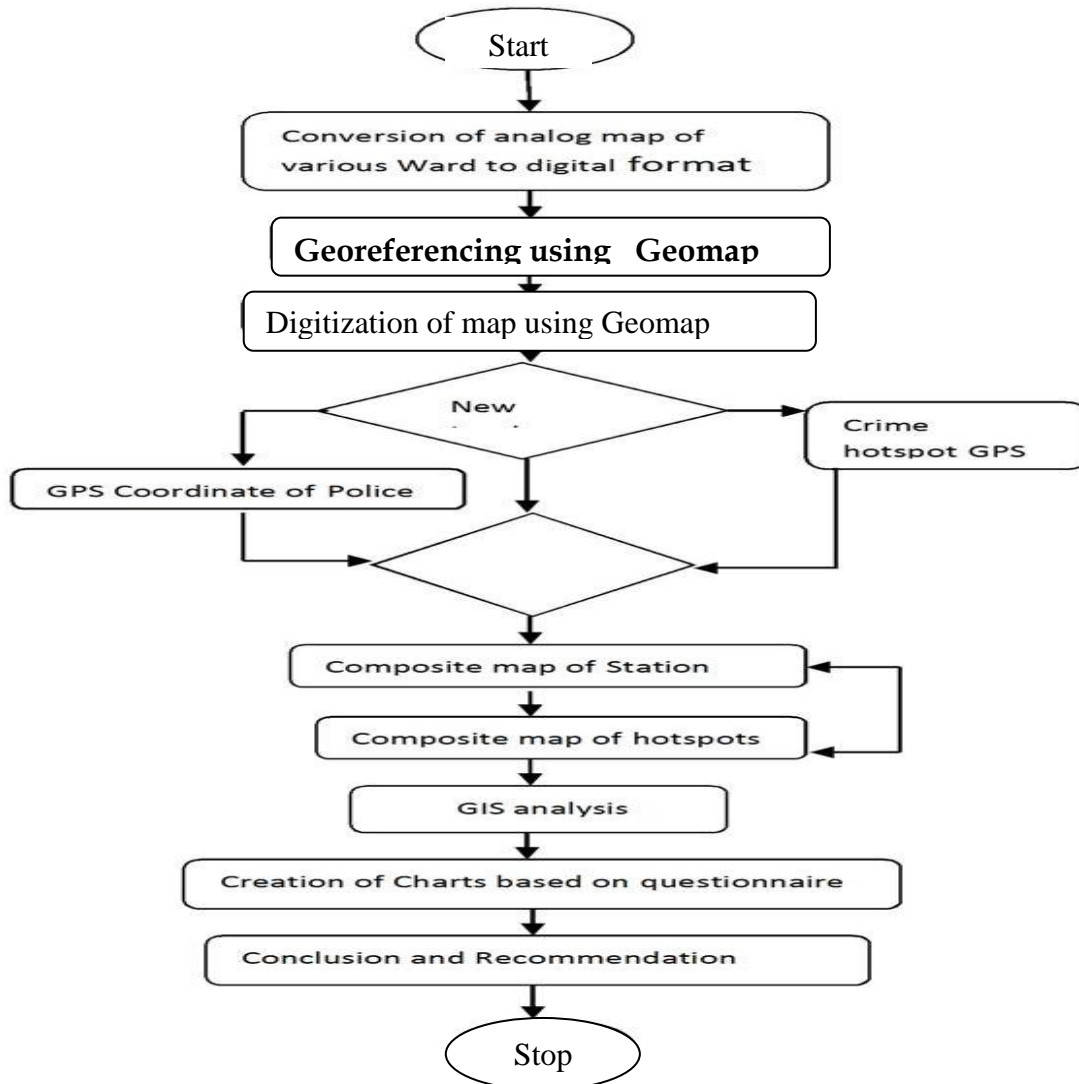


Figure 2 flow chart of GIS map preparation and analysis

VI. RESULT AND DISCUSSION

Figure3 shows that 67% of the respondents are above 25 years. 23% are married, 61% single and 16% others (separated/widow-widower). All the respondents have lived within the study area for more than 3 years, meaning that by virtue of their long stay they are acquainted with their immediate environment as far as crime is concerned. In terms of occupation, 49% of the respondents are students mostly from tertiary institutions and this group is a very volatile set, on the grounds that they constitute the bulk of the non-working population and are subject to all sorts of possible incriminating activities as a result of needs, peer activities and age. The other groups are employed in one form of occupation or the other.

A) CRIME RATE AND PATTERN

Result shows that 97% of respondents have knowledge of crime within the metropolis while **Figure 4** shows

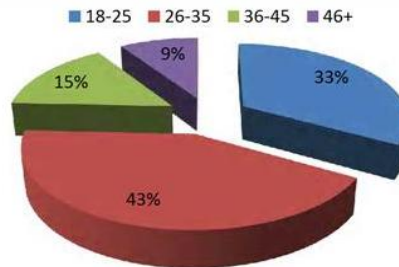


Figure 3 Age distribution Respondent

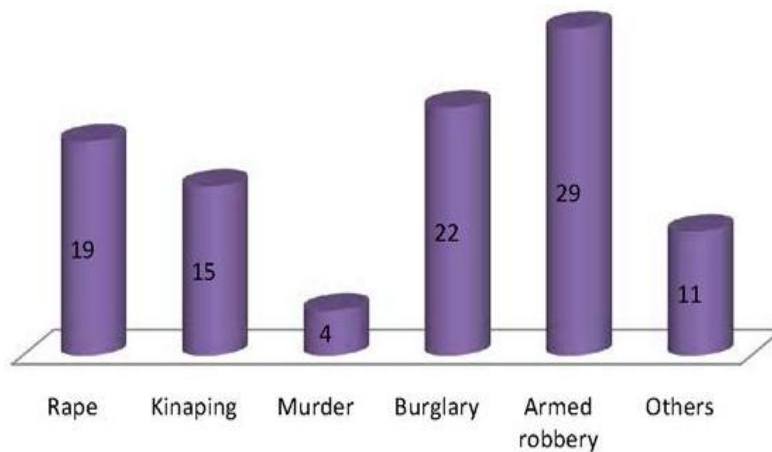
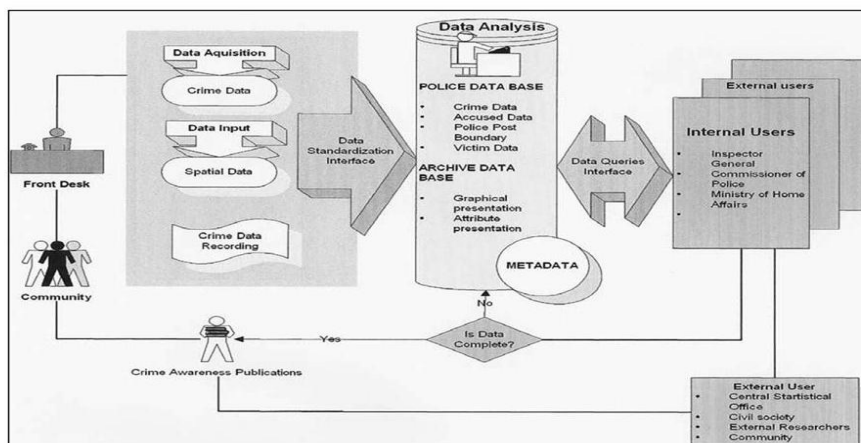


Figure 4 Prevalent types of crime in owerri city

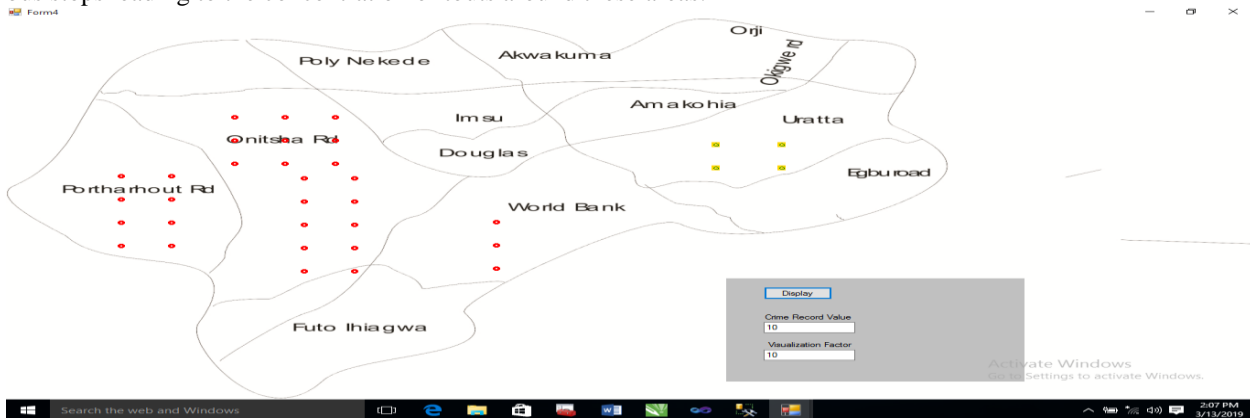
Different types of crimes experienced in Owerri metropolis. The analysis shows that robbery singly accounts for about one third (29%) of the total number of identified crimes. This was closely followed by burglary (22%), rape (19%) kidnapping (15%) murder (4%) and others, which include pick pocketing (11%). The implication of this result is that crime is endemic in the metropolis and as such, efforts should be directed at checkmating it

B) SYSTEM DESIGN

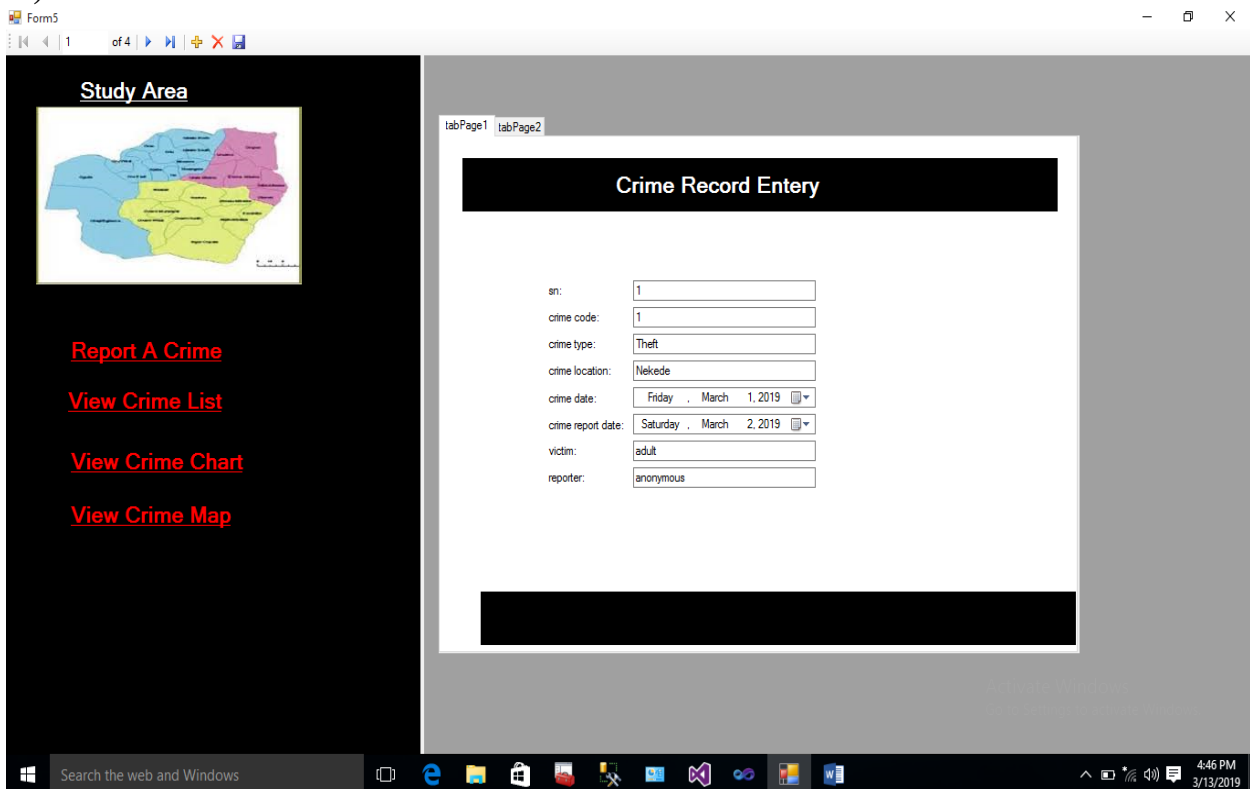


C) CRIME HOTSPOTS

GIS helps law enforcement agents plan for crime control. Police officers are able to know where crime is concentrated and focus resources in turn. With GIS it is not only possible to give statistical summaries of crime events per given area but also to visualize the location of crime on a map. Figure 5 shows crime hotspots location indicated with different colors of dots within the study area. These are the various places in which there are high rates of crime occurrences. Figure 5 shows the GIS analysis result of the crime hotspots. Onitsha road has a higher incidence of crime. This is indicated by the Red dots on the map. Crimes are higher in these places because of the location of Owerri market and bus stops leading to the concentration of touts around these areas.



D) CRIME ENTRY INTERFACE



The figure shows a screenshot of a web application interface titled 'Form5'. On the left is a sidebar with a 'Study Area' map and four menu items: 'Report A Crime', 'View Crime List', 'View Crime Chart', and 'View Crime Map'. The main content area is titled 'Crime Record Entry' and contains a form with the following fields:

- sn:
- crime code:
- crime type:
- crime location:
- crime date:
- crime report date:
- victim:
- reporter:

The Windows taskbar at the bottom shows the time as 4:46 PM on 3/13/2019.



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VII. CONCLUSIONS AND RECOMMENDATION

The use of GIS in crime mapping and management has been discussed. Given the right atmosphere and cooperation from all relevant authorities, GIS can be used to map and analyze crime occurrences with a view to determining factors leading to such crimes and how they can be effectively managed. With GIS, the police and other law enforcement agents could produce maps showing the scene of crimes and the route(s) leading to scene areas by performing simple queries.

The government should establish GIS/ICT sections in all the police quarters and procure all the needed tools, and annually train the police force on GIS usefulness in crime detection and how to use the various tools. Police stations should be cited in areas close to crime hotspot. A map of all the hotspots and photographs of suspects should be stored in GIS tools to increase the knowledge of the police in GIS and aid planners in decision making. More so the police force should have a website where citizens can easily alert them on crime scene, suspect and their photographs at will and an accurate GPS coordinates of all roads network should be stored in the GIS tools in order to provide routine instruction to direct patrol vans to crime scene.\

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