

Web-Based Location-Aware System Architecture for Combating Electoral Criminal Activities in Nigeria

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Abstract: The proliferation of computational capabilities of location aware technology has made them viable medium for carrying out a wide range of activities, involving information exchange. One area where location aware technology is gaining great usefulness in society is electoral crime detection, reporting and combating. Looking at the just concluded election in Nigeria, one major problem hindering electoral crime detection and reporting is lack of efficient communication platform between the Independent National Electoral Commission (INEC), police, various security personnel and the general public. The general public, Police and the INEC lack a common platform for exchanging real time information about criminal activities, electoral crime suspects and those under investigation for various crimes. Lack of readily accessible information of electoral crime trends in major towns and cities is also a key setback to electoral security needs. In this research paper, a location aware service infrastructure for detecting, reporting and tracking down electoral criminal perpetrators is proposed. This is based on the client-server architecture; allowing users (the general public) to exchange various categories of electoral crime/criminal related information with INEC in real time is designed. The system is recommended for the local, state and federal government authorities in Nigeria.

Keywords: Location-Based Services, Electoral Crime, INEC, GPS, LPS.

I. Introduction

Electoral crime is part and parcel of human nature and society in most democratic settings. That is why no society can claim to be completely electoral crime free. But the types of criminal behavior tend to follow the pattern of social and economic development of a given society. It is therefore not unexpected that a society at a low level of development and uneven distribution of income (and wealth), tends to experience an upsurge in the rate of violent crimes such as politically motivated killings, snatching of ballot boxes, rigging election, falsification of results, the use of illegal weapons, ethnic and religious clashes and the like.

What is worrisome, however, is that the Independent National Electoral Commission (INEC) and police which are meant to be the antidote to electoral criminality appear to be getting overwhelmed by the phenomenon. The electoral criminals appear to be ahead of the INEC / police such that the latter now only react to the commission of crimes and usually after the offenders might have left the scene making things appear as if the original emphasis on crime prevention has been completely lost. Aside other complaints, there are institutional constraints, which contribute to the uncomplimentary image of the police and thereby undermining their capacity to deliver efficient crime control via proper and prompt investigation and policing services. These include inadequate manpower, lack of expertise, lack of adequate equipment, low level of education, low morale, lack of training facilities, lack of technological knowhow, etc.

In developed countries; computers have been used in detecting and combating crime for some decades. Computer-Based Criminal Records Systems were the first of such systems deployed as an attempt to record a person's criminal history. Before the introduction and the application of computers in criminal records, crime investigation and detection; most criminal records or other criminal related activities were carried out using the manual or traditional approach in the process of data processing, which involves the use of paper files, manual skills and the human brain. Recent researchers have identified computer networks platforms and devices as possible tools for effective crime detection and reporting. Technological advancements have led to the invention of extremely powerful mobile handheld devices and have brought about large and high speed data transfer capabilities through mobile communication networks. Functions of data processing devices like computers have evolved from merely data storage to performing complex computations over the past three decades.^{[1],[2]}

The high computational power of some computer devices like smart phones, tablets and PDAs accounts for their high demand and usage by the general public. Smartphone shipments worldwide reached 485 million in 2011, increased to about 655million in 2012, and expected to rise over one billion smart phones by 2016^[3]. Another key factor making computer and network technology viable medium for fighting crime is the advancement of cellular networks technologies. The introduction of 3G / 4G cellular network technologies by the most mobile network operators has improved the communication demands for mobile users^[4]. With these

two factors in place, development of dedicated location awareness platforms for detecting and reporting criminal activities is of great importance.

This research paper proposes a client / server architecture solution for combating electoral crime. This proposed platform will be implemented as a software security assistant to the Nigeria police force for metropolitan crime control.

II. Literature Review

2.1 Location-Aware Service Platform

Location-aware is one of the drivers of the ubiquitous computing paradigm. With sales of hardware and software for Location Based Services (LBS) of about 175 million EUR in Western Europe in 2008, the market for LBS is rapidly growing and may exceed 560 million EUR by 2011. The major driver of LBS is the GPS technology in mobile phones, where 40% of the smart phones shipped in 2008 have GPS built-in. Besides GPS, LBS can also be achieved by mapping GSM cell ids or WiFi networks to geographic locations (e.g. Google or Skyhook Wireless). While most LBS are offering navigation and routing services, and come in the form of highly specialized hardware devices (e.g. from companies like Garmin or TomTom), a wide range of mobile phone software for LBS is rapidly entering the market. Popular examples include friends' tracking and tracing (e.g. Google Latitude1), tourist and city guides (e.g. wikitude2), and location-based safety advice (e.g. iSafe3). Although all these applications offer specific functions to mobile phone users, and need to be downloaded and installed on the mobile phone "one-by-one", all of them are actually implementing the exact same process of accessing the device's location, transferring it to a server application, and receiving and displaying the location-based information. The wide range of mobile platforms (e.g. different Symbian editions, Blackberry, iPhone, Windows Mobile, Google Android, etc.) and software development environments, as well as the fast life cycle of mobile phones and their operating systems make such distribution approach an expensive task.

However, today's commercial applications in the context of location awareness are usually limited to a dedicated purpose and scenario. Examples are navigation systems, combining GPS position data with motion sensors of the vehicle, traced within an electronic map. Traffic jam warning systems with GSM-based information delivery already utilize location information from the GSM cellular structure. In-house localization technology provides knowledge about the vicinity where staff or equipment is located. As these examples show, the scenarios are spread over separate, sometimes dedicated, devices due to lack of general integration and a unifying platform.

2.2 Computerized Crime Detection and Criminal Tracking Systems

The advancement of computer technologies has led to more effective ways of detecting and fighting crime in a given society^[5]. Today, engineers and researchers have proposed and developed a number of computer based systems, especially for crime detection and reporting. This section presents an overview of some of the most powerful computer based crime fighting systems developed within the past few years. The overview pays attention to functionalities and principles of operations of these systems. Crime Stoppers, New Orleans has launched a new free mobile crime-fighting application for Android and iPhone platforms, called Tip Submit^[6].

The application was created by Tip Soft and Crime Reports and is known to be the first anonymous top submission mobile software. By design, Tip Submit allows citizens to submit crime tips to Crime stoppers securely and anonymously. The system identifies tipsters by their tip number only, which it assigns to the tip. The Mobile App allows tipsters to upload photos or video and is able to send the location of the video by a GPS locator. Other key feature of Tip Submit is that, it has no limits on the amount of text as with sending SMS text messages. Also, it maintains two-way dialogue and real-time chat between the tipster and Crime stoppers.

Engineers in the University of Virginia have development software which helps the Police easily access crime data online. The system, called Webcast allows establish trends on the data, showing the types of crimes that commonly occur, and the places with which they are associated. By typing in specific dates, types of crimes, locations, and selecting names of weapons used, Web-Cat produces graphs, reports, and maps of high crime areas. Another powerful computer based crime fighting tools is Mobile Vic PD^[6].

Mobile Vic PD is a recently released mobile application, by the Victoria Police in Canada for fighting crime. The mobile application can be used to report minor crimes. It offers anonymous tips to police, stay updated on crimes in progress, receive missing child reports or check on stolen property. Accurint is produced by LexisNexis for the iphone and ipad. This Mobile app connects government and law enforcement agencies to more than thirty billion public records and critical investigative tools needed to verify information in the field, and rapidly follow-up on new leads as they develop. The most widely used tactical led generation tool for law enforcement in the United States is Cop Link Mobile Plus app, developed by i2^[7]. The app runs on iphones, ipads and Android platforms. The app enables officers to achieve better situational awareness with automated

geospatial searches of recent events, as it allows the searching of state and local criminal records from multiple jurisdictions' databases.

Another great feature of the app is its ability to organize vast quantities of seemingly unrelated data to assist in making tactical, strategic and command-level decisions. IPOL-mobile is an iPhone application used for crime fighting by Police in Geneva, Switzerland [6]. It enables the police to have immediate access to various information such as the latest burglary or violence incident as well as the identities of culprits of such crimes. With the help of this application, officers can track ownership information of vehicles by simply entering its number plate into the Smartphone application. Officers can also get important real time information about their duties (patrol hours and location), police directories, lawyers and translators and their availability hours using the application.

III. Methodology

This research paper proposes a system architectural design of a web based location-aware system infrastructure for combating electoral crimes in Nigeria to assist Independent National Electoral Commission (INEC) officials and the general public fight electoral criminal activities like snatching of electoral ballot boxes, permanent voters card (PVC) readers, computers and so on within a given metropolis. The infrastructure also serves as a common platform for both the INEC and the general public to interact and exchange information about electoral criminal activities and to track crime perpetrators via global positioning system (GPS). The system must ensure ready and up to date information access of electoral crime suspects and criminal activities in all localities within the metropolis for facilitating the tracking down of electoral crime perpetrators.

3.1 The Proposed System Architectural Framework

The proposed system architecture is client / server based. The client side will be a web application running on the client devices of the users (INEC / general public). Information about electoral criminal activities and crime perpetrators are uploaded onto the server by the INEC and partly by the general public remotely. Application running on the users' handheld device like smart phones, PDA, etc will communicate directly to the server; retrieving and providing real time information about electoral crime and criminal activities of places within the metropolis. The basic concept of the system architecture is shown in figure 1.

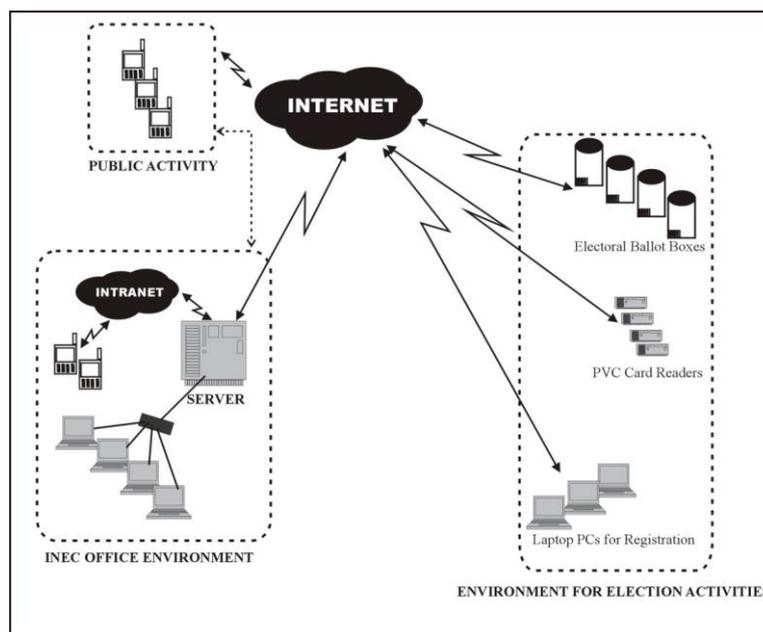


Figure 1 Propose system architectural framework

Figure 1 shows the client / server based architectural system for combating electoral criminal activities using location aware system. The system architectural framework has three (3) major environments namely: INEC Office environment, environment for election activities, and public domain or environment. In the election activities environment special GPS sensors are placed on physical equipment or devices like the laptop computers used for registration exercise, electoral ballot boxes, PVC card readers / machines and so on should in case they are snatched by hoodlums during election periods or stolen by thieves.

These sensors when fully deployed and activated on the electoral devices / components will ensure the real time transmission of signals between the devices or components they are installed on and the server within

the INEC office. The movement of these devices within the electoral environment or the metropolis can easily be tracked at real time as the case may be via GPS and the developed application on server side application.

In the INEC office / general public environment, users can perform the following activities using the system by upload:

1. Upload of Crime Related Information:

There are three categories of information which the INEC / general public can upload onto the server resident in their environment. The categories are as follows:

- (a) Descriptions of people on INEC wanted list and their related electoral criminal records / information can be uploaded through various INEC users' client devices to the SERVER.
- (b) Tip-offs of on-going electoral crimes: Information about criminal activities which are currently taking place during elections can also be uploaded by client devices by both the public and INEC officials via a web based interface on their client devices.
- (c) Descriptions of criminals on police wanted-list can also be uploaded onto the server by both the public and INEC officials.

3.2 How the Propose Architecture works

Personal details or at least descriptions of criminals on police wanted-list are uploaded onto the server. Common information about such criminals may include: Name, age group, facial looks, complexion, weapons in possession, crime involved, other crimes associated with in the past, etc. Missing items reports containing the description of items that are reported missing; such information is uploaded onto the server by the police / INEC administrator in the metropolis.

Information regarding such items may include name of item, description, the last time and the place where the item was last seen are also captured. Various categories of tip-offs are also uploaded to the server. Any member of the general public who has the app running on his mobile phone can conveniently and silently post suspicious activities of the vicinity to the server for action to be taken by INEC officials or police.

They can also report people whose descriptions match those on the police wanted list by uploading information quietly on the server using the mobile app, this will lead to the arrest of such criminals. On the other hand, items found matching the description of items in the Police list of missing items are also uploaded onto the server by the general public therefore the Police can retrieve such mission items (e.g. ballot boxes). Both the INEC, Police and general public use the same client information on their mobile devices to interact with the server, but only the INEC and the Police have the privilege of accessing of different sort of information from the server.

In the case of INEC device or component theft or snatching in election environment to any part of the metropolis, the INEC administrator can quickly and easily track such device(s) or component(s) by using the application navigation system via the GPS to trace the deployed sensor that must have been fully activated/embedded within the device(s) stolen or snatched as the case may be.

Coordinates will be plotted immediately within the metropolis and the location will be detected and reported accordingly. The location will be stored on the server and other permitted users can also access the information via their client devices by connecting to the server via the intranet WiFi Cloud or the Internet.

IV. Conclusion and Recommendations

This research paper presents a unique system architectural framework for merging web based application and location aware services (LAS) to combat electoral criminal activities in Nigeria. It also identifies the usefulness of location aware services technology in combating electoral criminal activities in a given metropolis using Global Positioning System (GPS) Technology and within a specified environment using Location Positioning System (LPS) via Radio Frequency Identification (RFID) WiFi technology. Its usefulness can effectively bridge the communication gap between the INEC, police and the general public in electoral crime fighting before, during and after election activities. A location aware service technology framework has been suggested based on the client / server model.

The architectural design based its viability largely on the presence of stable cellular network connectivity and assumes that, Smartphone usage is common among the general public which can also be used for accessing the location-aware service platform. The system is highly recommended for both the local / state and federal government of Nigeria to effectively and efficiently combat electoral crimes in a digital sense.

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