DEVICE REGISTER FOR THEFT DETERENT &

DEVICE RECOVERY

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APPLIED PROJECT

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DEVICE REGISTER FOR THEFT DETERENT

& DEVICE RECOVERY

BY

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Declaration

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:…………………………………………………………………

Candidate's Name:………………………………………………

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I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by Ashesi University College.

Supervisor's Signature:………………………………………………………………… …

Supervisor's Name:……………………………………………… …

Date:……………………………… …

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Abstract

Many people make use of electronic devices such as personal computers, laptops, cameras, mobile phones, gaming consoles, and a whole range of electronic devices to make their lives much more productive, entertaining and also to bring about significant change in the world. Just as the population of people who do so is increasing at a geometrical rate, so also is the rate of theft or loss of those devices, and more times than often, there is always a slim chance of recovering those lost or stolen electronic devices.

The aim of this project is to provide an online platform whereby people in Ghana can register their electronic devices with ease, alert the necessary authorities in the event of theft or loss, and check via an online or mobile service if the reported device has been found. This application is not a guarantee of recovering all missing or stolen electronic devices reported in the country, however if most gadgets are registered, it will discourage the theft of electronic devices, reduce and eventually put a stop to the second hand sale of those devices in the black market, and aid in recovery of missing or stolen devices.

Chapter 1:   Introduction

1.1 Background

Technological innovation has a major role to play in Ghana, considering Ghana's Millennium Development Goals. In the past, majority of work that people engaged in required a lot of physical input both at work and at home. In the past, family memories were preserved by going to a photo studio to take pictures and then print them. People also relied on record players to play their favorite music and they could not carry the record player every where they pleased, due to its size. There was also the issue of using big personal computers to do necessary work and then transfer documents with the aid of floppy disks.

The emergence of technological innovation such as modern electronic devices has simplified these day-to-day processes people engage themselves in, and there is the need to make sure that people always have those devices to help them out. There have been many cases of electronic device theft and more times than often, the stolen devices are resold on the black market to innocent people who do not have knowledge about how the reseller came into possession of the device(s). Buying or selling of stolen goods is a crime, and as such measures need to be put in place to check and prevent it.

Popular electronic devices are mobile phones, laptops, cameras, music players, and gaming consoles: As such, they will be the main focus in this project. Among these select electronic devices, devices that have a highest rate of use by people are mobile phones and laptops. Mobile phones

subscribers as at the end of 2008 reached a total of 4 billion people [1] which accounts for approximately 60 percent of the global population. It is evident that there is a steady growth of mobile subscribers and this in turn brings about benefits for the countries around the world.

It would be useful towards Ghana's Millennium Development Goals through the intervention of technological innovation if the population of people resident in Ghana can continue to make use of these technological innovations. The National Communications authority made an announcement on January 28, 2010 concerning the registration of Subscriber Identity Module (SIM) cards in Ghana as an initiative towards the identification of mobile phone SIM card owners and reducing the theft of mobile phones. This approach is limited as it only aims to curb mobile phone theft, without consideration for other electronic devices. However, it is necessary to implement services that will aid in the discouragement and reduction of theft and resale of stolen electronic devices.

A system that is accessible from computers and mobile phones via the internet and that allows users document the ownership of their electronic devices for the purpose of discouraging the theft of devices will be viable, because if every electronic device is registered, then a stolen device would prove useless to its new false owner knowing that the device status would be checked before it is purchased. If a thief decides not to sell the device, in the event that he/she is confronted, he/she would not be able to provide necessary documentation to backup the ownership claim, and this would aid in apprehending thieves.

1.2 The Problem

The security of electronic devices is essential to people; there seems to be a lot of cases involving the theft, loss and sale of electronic devices. Currently in Ghana, there is no measure in place to ensure the search and recovery of electronic devices in the event of loss or theft. The GSM operators have the resources to enable tracking of mobile phones to determine a good approximate location of a thief, but they are not doing so.

There exists a technology called Internet Protocol Version 6 (IPv6) that would aid in tracking every electronic device, but this technology is still very new and still undergoing testing. IPv6 could easily solve many problems involved with tracking, because every electronic device would have its own IP address and that would aid in tracking devices. However, because the awareness of this technology is not high, other means of combating theft and illegal sale of electronic devices need to be employed.

Electronic devices such as laptops, cameras, music players and gaming consoles only have unique identifiers such as serial numbers. These devices cannot be easily tracked, so effective means of monitoring, tracking, or recovery needs to be adapted.

In the law enforcement sector, when a police officer or a group of police officers apprehend a thief or a group of thieves and recover stolen items that were in possession of the apprehended thieves, it is almost impossible for the police to identify the true owners of the valuables recovered: there is not efficient infrastructure in place to allow the police

force inform the owners that their valuables have been found or for the general public to be notified of the recovery of valuables to the parties concerned.

Reporting the loss of electronic devices to the police or necessary authorities is quite effortless in this part of the world. A police officer could ask the person reporting a loss or theft to produce specific details of a device, and the person might find it hard to remember specific details and would not be able to verify the device since he no longer possesses it. The police could then make it hard for the person to make a proper report or make a claim to a stolen device that has now been found by the police.

When the police in turn recover items that are perceived to have been stolen by the apprehended thieves, there is no way for them to contact the original owners since the latter do not have proper records pertaining to their electronic property, hence recovered stolen electronic devices remain unrecovered by their original owners. There is the ever growing need to implement solutions that will tackle the problems associated with the loss or theft of electronic devices.

1.3 Potential Applications for solutions

There are several technologies that could be implemented for the purpose of registering and tracking electronic devices. Such technologies would need to provide a 24 hours a day, 7 days a week fully functional

access to the service for customers who wish to make use of the application from anywhere at any given time.

The options include:

- A Web Application

- A Mobile Web Application

- A Mobile Application

- An Interactive Voice Response Application

- An SMS service

A web application is very suitable to provide such a service, because it can easily be accessed via a web browser using the internet as its network. However, due to the improvements in technology, and high usage of mobile phones to access the web, a mobile web version of the application in addition to the normal web application will be very effective. It would extend the reach of the application to a wider web audience.

Poor internet connectivity or lack of tech savvy should not prevent people from accessing the service. The Interactive Voice Response (IVR) technology can provide audio access to the application via a telephone. IVR automates interactions with telephone callers, and can serve as a backup or alternative route to the application. Another viable technological option is the implementation of a mobile application which can be installed on a select range of phones. This mobile application could be developed using programming languages such as Python or Java 2 Micro Edition (J2ME). Such an application would provide only a few features of the main web application

to the mobile user, and as such would simplify the use of the application to the user.

The use of Short Message Service (SMS) could also improve the functionality of the application. There are some phones that are not web enabled and that should not limit or prevent people from accessing the application. Using the SMS service which is available on every mobile phone, will enable people have access to certain functionality the web application has to offer. It can be used by simply sending some form of query to a telephone number assigned to the application, and relay information back to the user.

1.4 The Objective

The objective of this applied project is to reduce electronic device theft and sale of stolen electronic devices, as well as improve the chances of recovering a missing or stolen electronic device through the development of an application that will be accessible via the web, the mobile web, Short Message Service (SMS) and a telephone (both land line and mobile phones). The combination of the diverse forms of technology will give the main application a solid infrastructure that will deliver a top class service over various platforms. All types of users will have access to the necessary tools to combat electronic device theft, the sale of stolen merchandise and tools to aid in recovery of stolen or missing electronic devices.

1.5 Brief Overview

This paper seeks to outline the objectives of this applied project which is geared towards reducing the rate of theft of electronic devices and the re-sale of stolen electronic devices in Ghana as well as increasing the rate of recovery of stolen goods with the use of internet and telephony technologies.

Chapter 2:   Previous Work

2.1 Introduction

The issue of electronic device security is becoming more pressing. The number of reported cases of electronic device theft is increasing and ideas have been raised on possible solutions to the stated problem. Electronic

device theft occurs around the world, but measures to stop, prevent or reduce its occurrence are mostly present in the United Kingdom. The electronic device theft campaign is very effective due to the availability of technological infrastructure in the United Kingdom. One major company that is responsible for the development of infrastructure to combat the theft of electronic devices as well as the criminal re-sale of those devices is Recipero limited.

2.2 Case Study: Recipero Limited

Recipero limited is a company in the United Kingdom that uses data and analytics related to personal property ownership to reduce risk. Recipero provides access to information to "a range of organizations and individuals allowing them to reduce their risk when making decisions as broad as purchasing used goods to fulfilling insurance claim, or pursuing a criminal investigation" [2]. Recipero has an in-house development team that develops and integrates solutions that help solve property ownership risks.

2.2.1 Approach

Recipero limited has developed a range of products to tackle the theft of devices. Their products range from radio frequency identifier tags, hologram security stickers, and a series of web applications that provide services to one another: Recipero's web applications include www.immobilise.com, www.nmpr.com, and www.checkmend.com. Recipero

limited is geared towards collecting information about electronic devices from customers and providing them with a possible recovery option. Immobilize.com helps the customers alert the police force whenever a personal electronic device gets missing or stolen. Immobilise also provides certificates of ownership to simplify insurance claims, for those who insured their properties in the first place.

Among the features of Immobilise.com is the ability to allow customers to create a portfolio of their devices, and report at a later time if the device gets missing or lost. Immobilise.com corresponds with the National Mobile Property Register (NMPR) which is the "national police database of registered property ownership and stolen property records" [3]. The details of every property registered on Immobilise.com and also reported stolen or missing can be viewed on the NMPR by the police. The police can do random checks based on found devices to find out if the device was pre-registered. NMPR provides the police with an avenue to contact original owners of recovered devices in the case of recovered stolen devices.

2.2.2 Feasibility of Previous Work

The key insight into Recipero limited's applications towards the reduction of electronic device theft and sale of stolen goods, is that the company developed applications for a society that already had the necessary technological infrastructure. The UK police are fully equipped with computers and laptops with constant access to the internet thus allowing easy access to the web applications which in turn has simplified their work and produced more positive results. The UK police also support Recipero's efforts to the

society, and as such they conduct registration events and seminars to convince people why they should patronize the service. Retailers also offer to register electronic devices for people at point of sale terminals. All these efforts contribute to the success of Recipero's products.

2.3 The Gap to Fill

United Kingdom residents/users have constant access to the web. Ghana residents/users do not have constant access. To provide people in Ghana access, there are a lot of opportunities or technologies that could have been explored concerning the development of electronic device recovery applications, such as accessing the features of the application through other ways apart from accessing the application through the internet from a personal computer. The reach of the application could have been extended, however it has been limited to the traditional web. This project will fill some of the gaps through the further development of the web application as well as support from other technologies.

Chapter 3:   Methodology

3.1 Introduction

The objective of this application is to provide a service to the Ghanaian public that would allow people to register a range of electronic devices in their possession, make a report concerning the theft or loss of any of the registered devices, and also allow people to report random electronic devices

that are found. These measures have been put in place as an initiative towards discouraging the theft of electronic devices, the re-sale of stolen goods and also to improve chances of recovering a missing or stolen electronic device.

3.2 The Approach

Software engineering principles were considered for the effective development of this interactive web application. After careful consideration of the principles and the application to be developed, the spiral model of software development was chosen due to its risk-driven approach to software development process.

Spiral development is a family of software development processes characterized by repeatedly iterating a set of elemental developmental processes and managing risk so it is actively being reduced. [4] This method of software development has aided in identifying the areas of uncertainty concerning the application and has contributed to finding alternative ways to solve the problem. The spiral model involves processes such as planning, risk analysis, engineering, testing and Iteration. These processes are evident in the four stages of spiral development model.

In the first stage of the spiral model, the objective, alternatives, and limitations of the application were identified. The functional and non-functional requirements were established, and upon careful analysis of the requirements, a schedule was developed for the testing of the application

and the risk analysis was performed, after which development proceeded to the second stage.

In the second stage, the system requirements were established, and the development of the application commenced. At this stage, when some functionality had been developed, it was tested with a few people for the purpose of getting results from potential users and implementing necessary changes to the application based upon results derived from testing.

In the third stage, the product was developed further, iterations were made and another round of testing was conducted. At this stage, after getting a few users to test the application, it became necessary to add more functionality to the application, as well as add alternative features that would support the core features of the application in the event that the main means of connecting to the application became unavailable.

In the final stage of the spiral model, all results derived from testing the system were incorporated into system requirements and further incorporated into the application. At that point, the application was tested at all levels to determine if the features of the application met the needs of all the system requirements. The implementation of the spiral model was used for the feasible development of the application and also helped identify aspects of the project that would be feasible in Ghana. Different technologies that could be used to deliver the service to the Ghanaian public were explored and implemented into the application.

3.2   Differentiation from Previous Work

Key features that differentiate this application from previous work are features such as development of the mobile friendly web application, development of a mobile application which is to enable the stakeholders who are the administrator, manager, the general public and police officers to perform certain functionalities of the web application which are feasible for the mobile. There is also the inclusion of Interactive Voice Response technology that allows users to call a certain number, and check credibility status of a mobile device.

An additional feature that is called SMS text bombing is used to intentionally send text messages over and over again to a phone reported stolen with the aim of frustrating the thief and making it difficult to sell the phone. These features are very useful on-the-go because they can be easily accessed through a mobile phone which most people in Ghana have access to as compared to personal computers or laptops. This feature needs the cooperation of mobile operators because when a SIM card from a stolen phone is changed, this application will lose track of the phone, and it is only the mobile operators that can track the IMEI.

3.3   System Development

From the list of functionality listed for the development of this application, there are certain modules that need to be developed to

contribute to the functionality and success of the application. Such modules include the development of a web application, a mobile web version of the web application, a mobile application to be installed on a select range of mobile devices, an Interactive Voice Response (IVR) application to be accessed by a telephone, and an SMS application to enable people perform queries to the application. The web application serves as the core of the application. All other aspects of the application depend on the web application.

3.4 Requirements Specification

In order for the development of the application to commence, the requirements of the proposed system were set and divided into functional and non-functional requirements.

3.4.1 Functional Requirements

- The system shall be easy and efficient to use
- The system shall allow new users to register to get login credentials
- The system shall be able to tell humans and computers apart
- The system shall require users to login in order to gain access to the core part of the application
- The system shall be able to track which category of user is logged on
- The system shall provide the user with a simple, clear and consistent navigation bar
- The system shall always keep users informed through appropriate feedback.

- The system shall give the user the option of logging off the system at any given point.
- The system shall provide the user instructions for use of the system where necessary.
- The system shall provide help and documentation to the user at all times

3.4.2 Non-Functional Requirements

- The system shall be user friendly
- The mobile application part of the system shall be deployed only on some Symbian Series 60 mobile phones.
- The server shall use a MYSQL database for the storage and retrieval of data.
- The mobile application part of the system shall be developed using Python programming language
- The web and mobile web application modules shall be developed using HTML, PHP, JavaScript.
- The Interactive Voice Response module shall be developed using XML.

3.5   Implementation

Based on the requirements of the application, the following are the modules built to ensure the effective and complete development of the application.

3.5.1 The Web Application

A web application is an application that can be accessed on the internet with the aid of a web browser. Web applications are platform

independent, not expensive to develop and does not need to be installed. The web application will enable people in Ghana register with the online service, create a simple portfolio of their electronic devices as well as provide users with the option of reporting the loss or theft of one or more devices, and report a found device with ease.

The user will be notified by an SMS text message in the event of the recovery of the item(s) reported stolen or missing by the user (see figure 3.1). The customer will be required to provide relevant details pertaining to the device(s) so as to simplify the identification of an electronic device by the system. At the customer's request, a certificate can be issued containing information about the user and the corresponding electronic devices. Any authorized police officer will also be able to check an electronic device status, as well as post information regarding recovered devices.
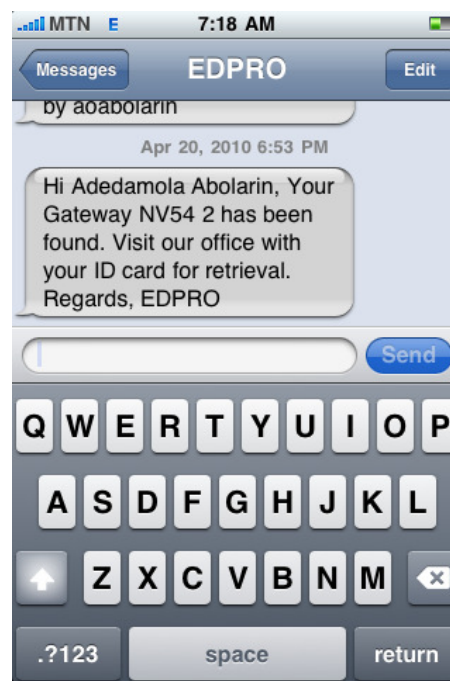

Figure 3.1 – Screen shot of Lost & Found Notification Text Message

In the course of developing the web application, programming languages such as Hyper Text Markup Language (HTML), Hypertext Processor (PHP), JavaScript, Structured Query Language (SQL) were used. Other languages that could have been used for the development of the web application include, Active Server Pages (ASP), Java Server Pages (JSP), Ruby, Perl, Cold Fusion etc. The programming languages HTML, PHP, SQL, and JavaScript used to develop the web application were chosen as a result of the developer's preference.

HTML provides the application with a framework for organizing the content of the application. Cascading Style Sheets (CSS) is intertwined with HTML to provide the application with a unique style. PHP scripting language is used to code the main functionality of the web application and works with SQL which connects the web application to the database where all the information is stored. JavaScript is used to validate all the forms in the web application.

3.5.2 The Mobile Web Application

Mobile web applications are versions of original web applications but developed to suit and conform to the mobile web. The mobile web provides access to information, anytime, and anywhere there is cell phone coverage [5].

For a long time, the web has been accessed from desktop devices. Today, a lot of people can access the internet not only from their computers but from their mobile devices. "Web-enabled mobile phones now extend the

reach of the Web to three times that of today" [5]. This means a wide audience will be able to access the application in Ghana via the Mobile Web.

Some developers have realized this and have taken this into consideration during their development stages, while others continue to develop for the traditional web with disregard to the mobile web. A lot of websites that are aesthetically pleasing on the web are not so on the mobile web. This is because a lot of mobile phones have much smaller screens and resolutions than desktops or laptops. There is the need to develop web applications that are suitable for both the traditional web and the mobile web, so as to extend the reach of the application to users through both platforms. The W3C initiative has a Mobile Web Initiative which is geared towards making browsing the Web from mobile devices a reality [6].

This application shall have a mobile web version that conforms to the standards of the Mobile Web Initiative, and shall provide the basic and important functionalities of the main application. The reason for developing the mobile web version of this application is because the target market for this application is Ghana, and a lot of people access the internet from their mobile devices seeing that there are more mobile devices than personal computers in Ghana. The mobile web version of the application will make the application interoperable between various mobile devices.

The components used to develop for the traditional web are used to develop for the mobile web. However, there are certain exceptions to be considered when developing for the mobile web. The use of tables and large images where avoided in the development of the mobile web application aspect of the application.

3.5.3   The Mobile Application

The mobile application was developed using Python, a multi-paradigm programming language (a programming language supporting more than one programming paradigm) that is simple to learn and possesses a clear syntax which is very easy to understand, reduces cost of maintenance and above all, can run on major operating systems. The Python language is "an interpreted, object-oriented, high-level programming language with dynamic semantics. It is very suitable for developing applications because it supports modules and packages, which encourages program modularity and code reuse" [7]. It is on this basis that Python was used to develop certain functionalities that are present in the web application. The mobile application will also interact with the web application.

3.5.4   The Interactive Voice Response Application

Interactive Voice Response (IVR) is a "computerized phone system that enables a person, typically a telephone caller, to make a selection from a voice menu. The selection is made using touchphone keypad entries or voice responses. The phone system plays pre-recorded voice prompts and the person typically presses a number on a telephone keypad to select the option associated with the voice prompt. This interaction allows the individual to communicate with the phone system and thus the computer system to either obtain information or to process a transaction." [8] This technology would connect a customer to the web application simply by the user calling a

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phone number assigned to the IVR application, following instructions and making keypad inputs.

IVR solutions use pre-recorded voice prompts and menus to present information and options to callers, and touch-tone telephone keypad entry to gather responses. [9] The IVR aspect of the application was developed using xml language. The Voxeo Designer application for developing telephony applications [10] was used in the development of the IVR application. The IVR application was then uploaded to an external server, mapped to the Voxeo application manager and then called from a mobile device.

The benefit of the IVR application to the user is that the users who choose to use it would only require a telephone with talk time on it to use the service. The IVR application has pre-recorded voice prompts on it that will serve as a guide to users who are not familiar with it.

3.5.5   SMS Checking & Text Bombing

Short Message Service (SMS) also known as text messaging is generally used to send text messages of up to 160 characters to mobile phones. It does not require that the receiving device is within range; what it does is to transmit the messages within a cell to anyone on any network. SMS has the capability of sending messages to mobile devices from web applications with the aid of an SMS gateway.

The SMS aspect of the application will perform two functions. The first is to enable users perform device credibility checks by sending a text message to a number and receiving a result based on the query in the text

sent, while the second is to enable SMS text bombing which is used to bombard a certain phone with a lot of text messages within a period of time. This feature would only be used if a mobile phone is stolen, and the owner approves the use of SMS text bombing to frustrate the thief, make it difficult for the stolen mobile phone to be sold and possibly make the thief return the mobile device. SMS bombing targets the IMEI number of the mobile phone and as such will also require the cooperation of mobile operators.

3.6 The Database

A Relational database was used for the entire application. The database was chosen for the application because the tables in the database communicate and share information with each other. Structures Query Language (SQL) is the language used for the database, because it is easy to integrate the web application written in PHP and HTML with the database. See the database table and structure in figure 3.2 and 3.3 respectively.

Table Name	Description
login_module	This table stores information regarding every user's login credentials, which include, the username, password, type of user, user ID, and first name. This table also holds information about the administrator and manager

customers	This table stores information regarding every user excluding the administrator and manager. It is the customer id that is used to identify how many devices a particular user has from the device properties table.
Device_properties	This table holds the primary information about every device that is registered.
Device_manufacturer	This table contains a list of various electronic device manufacturers.
Device_category	This table contains information concerning the device categories allowed for the application. There are only five categories namely, "Laptop", "Mobile Phone", "Cameras", "Music Players", and "Gaming Consoles".
Device_status	This table holds information concerning the device status of every device. The status values are "In Possession", "Missing", "Stolen".
Lost_n_found	This table holds information containing lost and found devices posted on the application.

Figure 3.2 Database Tables

Database Structure

login_module

PK	**username**
	password
	user_id
	type
	firstname

Customers

PK	**customer_id**
FK1	username
	email
	first_name
	last_name
	other_names

device_category

PK	**device_category_id**
	device_category_name
	device_category_description

device_manufactureer

PK	**manufacturer_id**
	manufacturer_name

device_status

FK1	**device_id**
	device_ststus

device_properties

PK	**device_id**
FK3	username
	model_make
	model_code
	serial_number
	imei_number
	description
	distinct_markings
FK1	**device_category_id**
FK2	**manufacturer_id**
	manufacturer_code
FK4	customer_id

Lost_n_found

PK	**if_id**
	category
	imei_number
	serial_number
	make
	model
	description
	recovered_date
FK1	device_id

Figure 3.3 – Database Structure

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3.7 Use Cases

There are four types of users in this application. They are the administrator, manager, police officers and Ghanaian residents that possess the range of electronic devices specified for this project, which are laptops, mobile phones, cameras, music players and gaming consoles.

3.7.1   Administrator

The administrator can add new users, view users and manage all users with the exception of the manager. These are the only privileges the administrator has. See figure 3.4 for graphical representation.
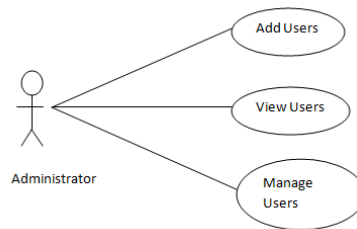
Figure 3.4 Administrator Functions

3.7.2   Manager

The manager can add, edit, update, and delete device categories and device manufacturers. See figure 3.5 for graphical representation.
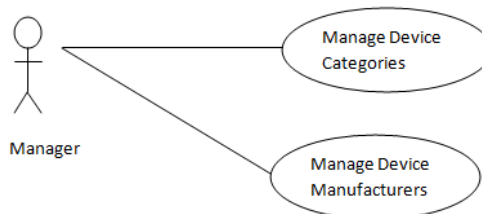
Figure 3.5 Manager Functions

3.7.3   Police

A police officer can report a device found with thieves or found lying around. The officer can also check the ownership status of a device. See figure 3.6 for graphical representation.
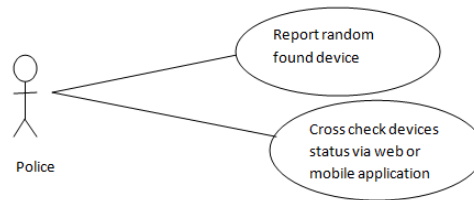
Figure 3.6 Police Functions

3.7.4   Client

The client can create, edit, and delete entries in the portfolio. The client can also report one or more of his/her electronic devices stolen or missing as well as generate a certificate of ownership. The client can check the status of a device reported stolen or missing by the user via the web application, mobile web application, and the IVR and the SMS application. The client also has the option of transferring ownership of a device provided the new owner is registered on the application. See figure 3.7 for graphical representation.
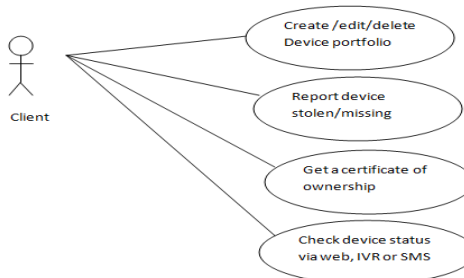
Figure 3.7 Normal User Functions

3.8   Development Tools

The following development tools were used in the development of the application.

- Voxeo Prophecy Version 10.0.39115.0

- Dreamweaver CS4

- Python Development Kit

- Mozilla Firefox 3.6 Browser

- Apache Server

Chapter 4:   Solution

The following five sections outline the solutions implemented for the entire application.

4.1 The Web Application

The goal of the web application is to provide people in Ghana with an option of registering their electronic devices, reporting the theft or loss of a device, generate certificate of ownership, report a random found device, check if a device reported by the user has been found or not. Any user apart from the administrator, manager and police officer needs to register with the service before the person can be granted login credentials and access to the application. The user would need the following credentials depicted in the screen shot in figure 4.1 to register with the service.

Figure 4.1 – Screenshot of the Registration Page

The application needs to ensure that it is a human being registering with the service and not a computer malfunction, which is why there is CAPTHCA [11], a user verification feature is implemented in the registration form. Upon successful verification and registration, the user is redirected to the login page, which is the home page of the application (see appendix 1). The user logs in and creates a device portfolio as shown in figure 4.2 below. The electronic devices that the application allows users to register are laptops, cameras, mobile phones, gaming consoles and music players. When the device portfolio is created and populated, the user can then view the devices in the entire portfolio section, as shown in figure 4.3 below.

Figure 4.2 – Screenshot of the Electronic Device Portfolio

Figure 4.3 – Screenshot of the Electronic Device Portfolio

4.1.1 Features

Once a user has items in the portfolio, it is very easy to report a device stolen or missing. In the event of recovering the device, the user can simply update the portfolio to indicate that the device is now back in possession. For the purpose of authorized sale by the owner of a device, the user can transfer ownership of a device to the new user. The user can get a certificate of ownership which will serve as proof of ownership in the event of claiming a recovered stolen device at a police station.

4.2 The Mobile Web Application

The mobile web application is simply a modified version of the web application. The difference here is that large images and tables are not used

in the mobile web application. The mobile web version conforms to the W3C initiative which recommends that the use of tables for styling and positioning should be avoided. Figure 4.4 is an example of the home page of the mobile web application.

Figure 4.4 Home Page of Mobile Web Application

4.3 The Mobile Application

The mobile application was built for select stakeholders of the application. The mobile application, built in Python allows the administrator add and manage users on the application. The manager can also add and manage device categories and manufacturers. A police officer may also check the device credibility of an electronic device, or report a recovered device. The advantage of the mobile application is that it can be used in the field and at Point of Sale (POS) terminals.

4.4 The Interactive Voice Response (IVR) Application

The IVR application was developed using the Voxeo Designer application which is meant for building telephony applications. Voxeo

designer uses text-to-speech to convert statements written into audio and then packages the voice application into XML language. The IVR aspect of the application has been developed and mapped to a number (0012067016818) in the United States for the purpose of testing because it will be very expensive to get a number for this service with a mobile operator in Ghana. The application plays voice prompts to a user and asks if the user is from Ghana. If the user selects '1', the user is directed to an aspect of the application that plays the options to the user.

An International Mobile Equipment Identifier (IMEI) used to uniquely identify mobile phones will be the criteria for mobile phone identification in the application. The user may enter the IMEI number, which is then sent to the database for verification. If there is a record of the number in the database, the user is notified, which means that the device that was just checked has already been registered by another user, thus there is the assumption that the device is stolen. The user can choose to exit the application at any stage in the application. See figure 4.5 for IVR application schema.

4.4.1 Tracking Pre-registered (Stolen) devices

If a user attempts to register a pre-registered mobile phone, the user is allowed to register it, and personal information is collected from the person for the purpose of identifying the new false owner. A "promotional message" is played to the user that he/she is the 100th customer of the application and as such should contact the company for a reward. The person attempting to register the pre-registered device could either be the thief or a victim of sale

of stolen goods. The user would then be asked by office personnel about the processes that led to the device possession.
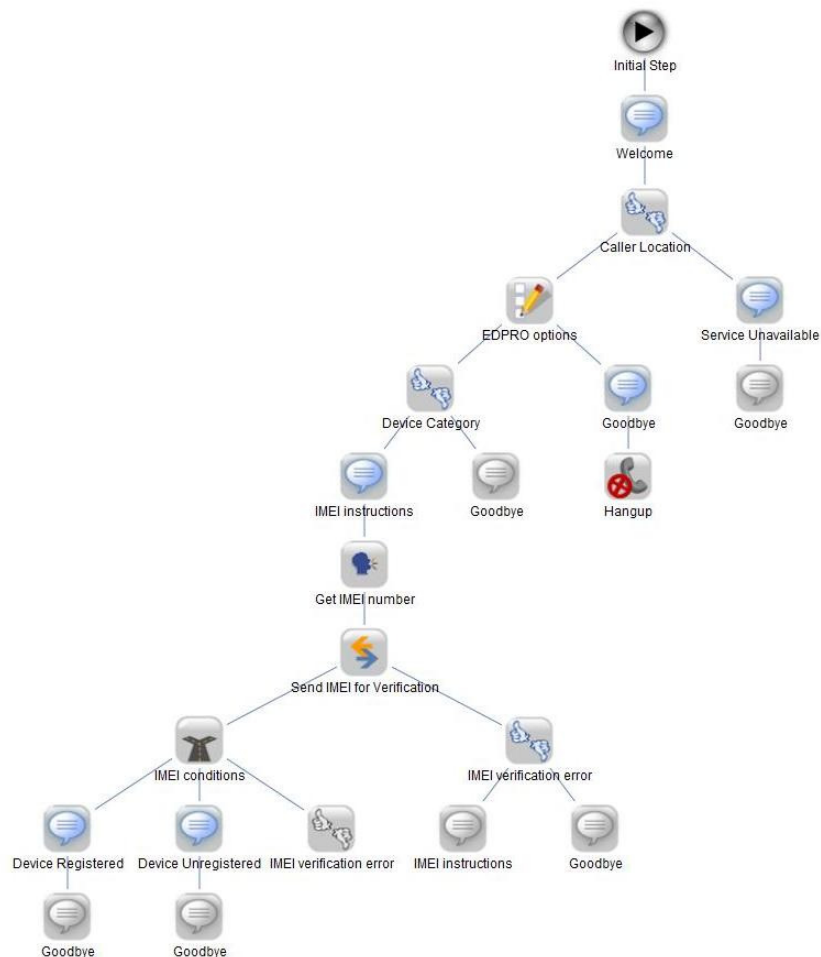

Figure 4.5 The IVR Application Structure

4.5 Usability Testing

Usability testing provides an opportunity to evaluate a product by testing it on users. In this case, a series of usability tests were performed with the purpose of receiving feedback from the stakeholders and the general

public in order to make necessary adjustments to the application. Areas of interest in usability testing include accuracy, performance, and recall.

For each testing session, five students at Ashesi University were selected to test the application and observations were made during the testing process. The reason for choosing five people each time was because experts assert that usability tests with more than five people is not necessary. [11] At most five people can be used for testing, and then a series of tests could be carried out in order to get results.

Before each test was conducted, each test subject was given an overview of the application and then asked about what he/she expected to see in the application. After this process, the test subject was allowed to use the application, without any guidance. The first page that is seen on the application contains some information about the application, and a login portal with an option of registering first time users. Every one of the test subjects clicked on the link that would allow for registration and all the test users had no problem with registration process.

As each user logged in with the newly acquired login credentials, each user easily made his/her way to the page for adding devices to a portfolio and then proceeded to view the items in the portfolio, as well as testing the device theft reporting system. After each user completed the test, recommendations were made by the user and the feasible recommendations were incorporated into the application. The feedback gotten from the test subjects was used in the process of iteration.

Chapter 5:   Evaluation and Conclusion

5.1 Operating Conditions

The software worked well when deployed and tested on an apache server and accessed from Mozilla Firefox and Internet explorer browsers.

There a few factors that needs to be present for the application to fulfill its full potential. Such factors include the provision of appropriate information technology infrastructure to the Ghanaian police force, to enable the police conduct checks with the application while on-the-go. If people are encouraged to register their electronic devices with the service, then any thief who steals an electronic device with the intention of re-selling it for financial gain, would know that the potential buyer would check if the electronic device has already been registered; if the device turns out to be already registered, it may be a simple indication that the device has been stolen except when change of ownership has not been carried out correctly, but that can easily be resolved by the two parties.

5.2 The Challenge

One of the challenges here is that it is hard to convince people to take some time off to register their electronic devices online. A lot of people in West Africa, Ghana to be precise are well aware of the Internet. The issue is that they only use it for a few reasons, such as the checking of emails and visiting social networking sites. They have not been presented with the

various opportunities the internet has to offer. They would rather prefer the product be registered at the point of sale. There is also the fear of hackers getting into the system to know which people are in possession of certain electronic devices and then stealing it from them. The process of registering an electronic device with the service is also another challenge because of the necessary details needed in the registration process.

5.3 Evaluation

The application generates weekly reports only available to the manager and police officers. This is important and crucial to the success of the application because it helps track the number of users patronizing the application, the amount of electronic devices owned by people, the amount of electronic device that are being reported stolen or missing. The reports would aid the police force in monitoring the rate of electronic device theft, and the data may help police personnel track down thieves if a pattern is recognized in the theft occurrence.

5.4 Conclusion

This application has been able to satisfy all the system requirements established during the preliminary development stages. The technologies used have made the registration and possible device recovery of electronic device in Ghana possible. The application is ready to be deployed; however, it would require the co-operation of the Ghanaian government, people, and police force for it to work.

The application now allows for easy registration of electronic devices, easy device theft/loss reporting, certificate of ownership generation, easy notification of lost and found electronic devices by the Ghana police.

The features that make the application accessible from any internet or mobile access point is the implementation of interactive voice response application to check and report missing/stolen mobile phones, a mobile web application that can be used by police officers and users at the field of work and point of sale terminals. Also the lost and found notification by SMS when a device has been found, and the use of SMS text bombing to frustrate mobile phone thieves. All these features have contributed to the availability of the application through different media.

It is indeed possible to curb electronic device theft in Ghana, but this application will be a stepping stone towards that goal. The application will effectively reduce the occurrence of theft of electronic devices as well as recovery of such devices if most of the people in Ghana who possess electronic devices register them.

Bibliography

[1] iTWire Davey Winder. September 2008. [Online]. Available:

http://www.itwire.com/your-it-news/mobility/20824-61-percent-of-global-population-now-using-mobile-phones [Accessed: February 12, 2010]

[2] Recipero Limited, Recipero January 2010. [Online]. Available:

http://www.recipero.com/ [Accessed: January 29, 2010]

[3] National Mobile Property Register (NMPR). [Online]. Available:

http://www.thenmpr.com [Accessed March 2, 2010]

[4] Barry Boehm. February 2000. Software Engineering Institute. [Online]. Available:

http://www.sei.cmu.edu/library/abstracts/reports/00sr008.cfm [Accessed: February 9, 2010]

[5] R. Cremin, J. Rabin, B. Fling, D. K. Robinson. DotMobi Mobile Web Developer's Guide Part 1: Creating Simple Mobile Sites. e-book March 2007 [E-book].

[6] Tim Berners Lee. W3C Mobile Web Initiative. 2009 [Online].Available http://www.w3.org/Mobile/ [Accessed: February 27, 2010]

[7] Python.org. [Online]. Available:

http://www.python.org/doc/essays/blurb.html [Accessed: March 28,

2010]

[8] Custom-IVR.com. 2009. [Online]. Available: http://www.custom-ivr.com/ivr-definition.htm [Accessed: April 2, 2010]

[9] Voxeo. 2008 [Online]. Available: http://www.voxeo.com/library/ivr.jsp Accessed: December 29, 2010]

[10] Voxeo Corporation. The Voxeo Prophecy Platform. [Online]. Available: http://www.voxeo.com/prophecy [Accessed: January 3, 2010]

[11] Jakob Nielsen. Useit.com.March 2000. [Online]. Available: http://www.useit.com/alertbox/20000319.html [Accessed: April 7, 2010]

Appendix

Appendix 1 – Home page & Login Page

Appendix 2- Managing Electronic Device Portfolio

# Appendix 3 – Administrators view of all users using EDPRO

# Appendix 4 – Managing Users by Administrator

Appendix 5 – Police Home Page on EDPRO

Appendix 6 – Police Lost and Found Reporting system
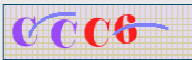
Appendix 7 – Device Credibility Checker for the Police

Appendix 8 – All lost and found electronic devices