UNIVERSITY OF BUEA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

DESIGN AND IMPLEMENTATION OF AN ANDROID APPLICATION:

CASE OF AN OCR BASED ID CARD FINDER

End of Course Project

Submitted by

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ABSTRACT

In Cameroon, it is mandatory for a person of age to have a National Identity Card, and present it upon request by authorized personnel. Failure to do so can result in a punishment of one year imprisonment or a fine of 50,000 Francs CFA to 100,000 Francs CFA. It is not uncommon though to find people without ID cards, because these were stolen, forgotten at counters of financial institutions and travel agencies, making them potential candidates for punishment. Hence the observance of thousands NICs on poles on the street and at counters, police stations is normal, with usually no way for the concerned to know their NICs are held at those places, except for the media, which have programs one could follow though very limited in solving the problem.

The will to help those who have lost their ID cards can be seen in people but a proper means of helping them is lacking. Noticing this therefore, and the increasing rate of penetration of smartphone and internet usage in Cameroon, we propose a solution which involves designing and implementing an android application to serve as first place where people who have lost their NICs can search. This application can be used by individuals, travel agencies, radio and television stations, to post or publish ID cards in they have found, and currently have in their holding. The application thus acts as a central database where people could search for their ID cards and know exactly who has it, and where to get it.

The solution thus proposed happens to be more efficient in helping people find their missing NICs without having to walk from place to place, or listen to the radio or watch the television at particular times, with no assurance of finding their ID cards. Nonetheless, being the first version of the system, it could be very much improved, with the help of ideas from other technology experts and the local population after having used it.

Declaration

This report has been compiled and presented to the Faculty of Engineering and Technology of the University of Buea by ***NAOUSSI KUITCHE Iselin Martial (FE12A114)*** *and has not received any previous academic credit at this or any other institution.*

Signature	**Signature**
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Supervisor Mr. AWUNGABEH Flavis	**NAOUSSI KUITCHE Iselin M.**

List of Figures

List of Tables

List of Abbreviations

ID – Identity.

FET – Faculty of Engineering and Technology

MTS – Mobile Telephone Service

MVC – Model View Controller

NIC – National Identity Card

NGO - Non Governmental Organisation

OCR – Optical Character Recognition

USSD - Unstructured Supplementary Service Data

Contents

Chapter 1 INTRODUCTION

1.0 GENERAL INTRODUCTION

As the world becomes increasingly interconnected, both economically and socially, technology adoption remains one of the defining factors in human progress. Two of the most penetrating and necessary technologies are cell phone technology and the internet. With the introduction of the game changing app-enabled smart phone technology, in which era we are, and with faster internet even in developing countries, innovation and entrepreneurship, have taken a whole new turn. As of June 2016, the Android play store was the largest app store with 2.2million applications. The Apple's app store was the second highest with 2 million available applications [1]. Across the world, mobile applications are solving problems local in form but global in nature, adding value to people's everyday life.

1.1 PROBLEM STATEMENT

In close to a hundred countries, it is compulsory for one to have an identity card is. In these countries, the card must be shown in demand by authorize personnel under specified circumstances [2]. Cameroon is one of those countries in which every citizen aged at least 18 should posses one, without which there is a punishment of one-year imprisonment or a fine of 50 to 100,000 francs CFA according to the regulations in force [3]. Though there is such great punishment for not possessing an identity card, it is not uncommon to meet citizens of without, for one reason or the other. One of the most common reasons is that their cards are missing. In booths of companies, on electrical poles and other public places, thousands of missing National ID cards are spotted. The lack of a proper means of helping those who have lost their NICs and

other documents find them in time poses a great problem, increasing the risk of insecurity as there are people with more than one NIC or in the form or identity theft, and also costs time and money to the said group of people.

Current methods of dealing with the problem include hanging the lost NICs at the counters of travel agencies, money transfer agencies, banks and even on utility poles. It has become common nowadays to find missing ID cards in public places such as streets, schools, hospitals and even in markets. They are piled up in large numbers at radio stations which has a service and a program for missing articles. Though these solutions help, they are not very efficient as they sometimes require much work on the part of the person who has lost the NIC, like requiring him or her to follow numerous radio programs by different stations at different times, or to move from police station to police station, with no assurance that his NIC is currently being held there. For these reasons and more, most people, except they have a glimpse of where they could have lost their NICs, go for the option of making a new one.

Figure 1:Missing NIC's on counter and pole

1.2 AIM OF PROJECT

This project focuses on the design and implementation of an android application for the purpose of helping users find missing documents, with emphasis NICs for now, using OCR technology, in an attempt to solve the afore mentioned problem, and support the existing methods for solving the problem. Given the inefficiencies of the current methods, it is imperative to use advantages in the evolution of technology to provide a "place" or a system where people who have lost documents can start their search.

1.3 SCOPE OF WORK

This project gives a detailed description of the design, implementation and development a system which helps users find missing Cameroonian NICs. The project was estimated to be completed in 3 months. The main deliverable of the project is an android application (Kmer ID Finder) which will act as a proof of concept and as a proposed solution to the above mentioned problem. The application should be able to

- Extract text from an image
- Allow users to post picked or missing NICs
- Display a list of missing NICs
- Allow the user to search for an NIC
- Allow user to contact the person who posted the NIC by message and/or call.

1.4 REPORT ORGANISATION

Our work is presented as follows:

- **Chapter 1 Introduction:** this chapter gives a general introduction to the project, formulates the problem statement, states the main aim and deliverables of the project, as well as the scope of work and the project organization.
- **Chapter 2 Literature Review:** covers the literature review which describes the evolution of cell phones, the state of the situation and necessity of the solution, key concepts on Optical Character Recognition (OCR) and the android platform in general.
- **Chapter 3: Methodology,** presents the methodology adopted in view of solving the problem and in coming out with the new system. It briefly describes requirements of the system as well as design patterns, tools and programming languages used.
- **Chapter 4 Results:** presents our results upon applying the said methodology in building the proposed system.
- **Chapter 5 Conclusions and future:** In this last chapter, general conclusions about the Kmer ID finder android application development exercise are drawn. Recommendations are made concerning this application and how it can be improved upon for the enhancement of the finding of valuable documents

Chapter 2 LITERATURE REVIEW

In Cameroon as well as other countries, it is mandatory for citizen of age to own an official identification document. As mentioned before, failure to present an NIC to appropriate authorities can result in up to one year imprisonment. Many people are found without NICs, not because they didn't make one, but because they lost it in one way or the other, may be for got their purses or wallets, or these were stolen, or even at counters of financial institutions, but do suffer same punishment. As with other problems, one could use the advantage given us by technology to find their NICs, which was difficult to do at first, and find it fast. In this chapter, we talk about the cell phone technology and how it has evolved, smart phone and internet penetration in Cameroon, existing solutions to the said problem as well as OCR technology.

2.1 EVOLUTION OF MOBILE PHONES

While the transmission of speech by radio has a long history, devices that are wireless, mobile, and also capable of connecting to the standard telephone network are much more recent. The first of such devices were barely portable compared to today's compact hand-held devices, and their use was clumsy. Along with the process of developing more portable technology, and better interconnection systems, drastic changes have taken place in both the networking of wireless communication and the prevalence of its use, with smartphones becoming common globally and a growing proportion of Internet access now being done via mobile broadband [4]. The advances in mobile telephony can be traced in successive generations from the early "0G" services like MTS and its successor Improved Mobile Telephone Service, to first generation (1G) analog cellular network, second generation (2G) digital cellular networks, third generation (3G) broadband data services to the current state of the art, fourth generation (4G) native-IP networks.

2.1.1 The First Generation Phones (1G)

The first Generation phones (Basic phones) existed from 1980s to 2000. They had the following characteristics:

- Heavy and Bulky
- Use analog mobile network
- Very expensive
- Had only SMS for data communication

The Motorola DynaTAC 8000X was the first commercially available cell phone. First marketed in 1983, it was 13 x 1.75 x 3.5 inches in dimension, weighed about 1.2kg, and allowed you to talk for a little more than half an hour. It was retailed for $3,995, plus hefty monthly service fees and per minute charges. It made calls, and there was a simple contacts application included in the operating system.

2.1.2 Second Generation Phones (2G)

The second generation phones (feature phones) existed from 2000 to 2007. It is in this generation that various handset vendors had the most power. The following characterize a typical phone in this category:

- It was smaller, thinner and lighter than first generation
- Multimedia capabilities
- Features such as camera and touch display
- Relatively slow data connection and Internet usage

- It used the digital network

2.1.3 Third Generation (3G) phones

Third generation phones (Smartphones) are phones from 2007 to present. Apple company made the first smartphone. These phones have the following characteristics

- Increased network speed.
- More PC like functions
- Open development environment
- High device intelligence

2.1.4 Fourth Generation (4G) phones

More recently, 4G phones were introduced. 4G requires a mobile device to be able to exchange data at 100Mbits per second. 4G phones are currently the state of the art. Core features of 4G include:

- IP based mobility
- Very high data speed.

Figure 2: Generations of mobile phones.
Source:http://www.slideshare.net/rahulmanojkumar/technology-life-cycle-30065489

2.2 SMARTPHONE AND INTERNET PENETRATION IN CAMEROON

In recent years, there has been a boom in the quality of smart phone in Cameroon and on the African continent in general. This was not the case decades ago, and we have the rapid evolution of technology to thank for that. Also, just months ago, the main internet providers in Cameroon, MTN, Orange and Nexttel switched rapidly from 2G to 3G (March 2015) to 4G (December 2015). Android being the cheaper of the smartphones has the higher number of users. The South African telecom group MTN International announced in its financial statements as at end June 2016 that the number of smartphones on its network in Cameroon reached 2.6 million

of devices, an increase of 34.1% [5]. In 2016, 18% of the Cameroonian population, representing more than 4 million people, uses the internet actively as compared to 3.7 million in 2015. These numbers are only expected to increase as technology develops and Cameroon becomes more and more immerged, hence, the need to develop solutions making use of latest technological advancements and with ability to reach a maximum number of people.

Table 1: Cameroon internet statistics. Source http://www.internetlivestats.com/internet-users/cameroon/

Year	Internet Users**	Penetration (% of Pop)	Total Population	Non-Users (Internetless)	1Y User Change	1Y User Change	Population Change
2016*	4,311,178	18 %	23,924,407	19,613,229	16.5 %	609,593	2.49 %
2015*	3,701,585	15.9 %	23,344,179	19,642,594	47.8 %	1,196,553	2.51 %
2014	2,505,032	11 %	22,773,014	20,267,982	76.2 %	1,083,517	2.53 %
2013	1,421,515	6.4 %	22,211,166	20,789,651	15.2 %	187,143	2.55 %
2012	1,234,371	5.7 %	21,659,488	20,425,117	16.9 %	178,418	2.56 %

2.2.1 What is A smart Phone?

In a nutshell, a smartphone is a device with which one can make telephone calls, but also adds in features that, in the past, you would have found only on a personal digital assistant or a computer-such as the ability to send and receive e-mail and edit Office documents, for example. It integrates the features of the cellphone which was used almost only for making calls, and the personal digital assistant, used for storing contact information, to-do list and syncing with the computer.

2.2.1.1 Key Smartphone features [6]

- **Operating System**: In general, a smart phone will have an operating system allowing it to run applications. Apple's iPhone runs the iOS, and BlackBerry smartphones run

the BlackBerry OS. Other devices run Google's Android OS, HP's webOS, and Microsoft's Windows Phone.

- **Web Access**: Most offer some sort internet access and can access the web at higher speeds
- **QWERTY Keyboard**: a smartphone includes a QWERTY keyboard. This means that the keys are laid out in the same manner they would be on your computer keyboard, not in alphabetical order on top of a numeric keypad, where you have to tap the number 1 to enter an A, B, or C. The keyboard can be hardware (physical keys that you type on) or software (on a touch screen, like you'll find on the iPhone).
- **Messaging:** Most cellphones can send and receive messages. The smartphone stands out by having the ability to handle emails.

2.2.2 The Android Operating System

Android is a mobile operating system owned by the American company Google based on the Linux kernel. It usually comes installed by default on a variety of mobile devices from phone manufacturers offering access to Google's services like YouTube, Gmail and more. Android is developed by Google in private until latest changes and updates are ready to be released. Google provides major incremental upgrades to Android every six to nine months [7]. The latest release at the time of this writing is Android N.

2.2.2.1 The Android Software Stack

2.2.2.1.1 The Linux Kernel

The android architecture is based on the Linux 2.6 kernel as hardware abstraction layer because it provides a proven driver model in a lot of cases existing drivers. It also provides memory management, process management, a security model, networking, a lot of core operating system infrastructures.

2.2.2.1.2 Native Libraries

Native libraries written in C and C++ are where a lot of the core power of the Android platform comes from. It has components like the surface manager responsible for composing different drawings surfaces onto the screen, and an implementation of SQLite used for data storage.

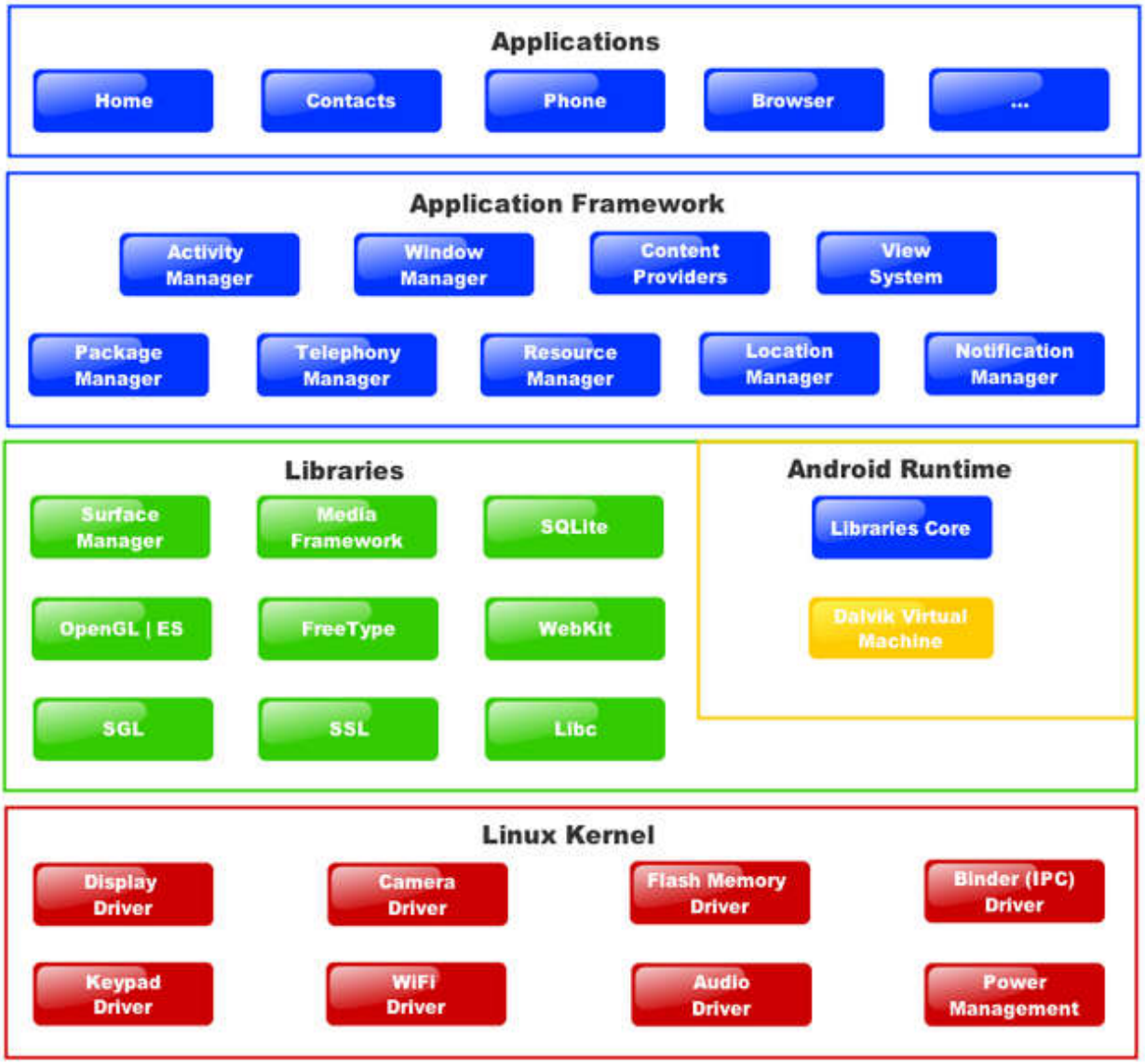

Figure 3: The android software stack.
Source:http://4.bp.blogspot.com/5KiCKsc9NjQ/UCXugyn4TCI/AAAAAAAAAEE/nzxBy6-kxFk/s1600/646px-Diagram_android.png

2.2.2.1.3 The Android Runtime

The main component the Android Runtime is the ***Dalvik Virtual Machine***. The Android Runtime was designed specifically for Android to meet the needs of running in an embedded environment where there is limited battery, limited memory, limited CPU. This is where .Class and .Jar files are converted to more efficient .dex.

2.2.2.1.4 Core Libraries

Core Libraries, written in the Java programming language contain all of the collection classes, utilities, IO, all the utilities and tools used in the building of Android applications.

2.2.2.1.5 The Application Framework

The Application Framework, written in a Java programming language is the toolkit that all applications use. These applications include the ones that come with a phone like the home application, or the phone application. It includes applications written by Google, and every other developer.

2.3 EXISTING SOLUTIONS

As mentioned before in solving the afore mentioned problem include:

- hanging the lost NICs at the counters of travel agencies, money transfer agencies, banks and even on utility poles.
- Keeping the ID cards in public places such as streets, schools, hospitals and even in markets, in the custody of some person, say a security guard.
- Dropping the lost NICs at radio and television stations which have a service and a program for missing articles.
- Displaying the missing items on the news bar of television channels.

These methods are not efficient as they require the user to either search public places such schools, hospitals, police stations, one after the other in search of their documents, with no assurance of finding it there, or to listen to particular radio and watch particular television channels and programs at specific times, which is much work and almost not feasible.

Some more innovative solutions were also developed like the MTC lost and found service, an NGO offering to reunite people and their lost items [8]. They display the lost item information to the public, and charge a fee of at least 5francs CFA for consultation and 20% of the price of the item for retrieval. They had a site *www.lostandfounddocuments.blogspot.com*, not accessible at the moment.

There also is a Facebook page, *Ma carte nationale d'identité perdue au Cameroun* which posts pictures of missing ID cards and places where they were found. The page claims a police station in Yaoundé alone makes more than one thousand certificates of loss a day. Its main disadvantage is some people take pictures of the ID Cards on poles or at those places, but neither keep them, nor give their numbers so they can be contacted. Also, from the looks of it and judging from the number of "Likes", many people don't know about the Facebook page

Not forgetting the use of USSD applications like the one implemented by further market which displays the names on missing NICs per region.

It is clear from the above mentioned points that people want to help others, but there is no platform enabling them do so efficiently, hence the proposed system.

2.4 SIMILAR PLATFORMS

There just are a few android applications in the business of helping their communities find lost items. Most of the ones at the Android play store do not work, or stay at the login page indefinitely. Some include:

1. ***LostRFound*** which is an Indian database of lost/found items and missing people, with details, helping people find their lost or stolen items and missing children. If an item is lost or found, its details are registered on the platform with the contacts of

the poster to ease contact. The application is much more general, but has a poor user interface, and does not guarantee the person contacting one for a found item is the actual owner of that item. It is left to the users.

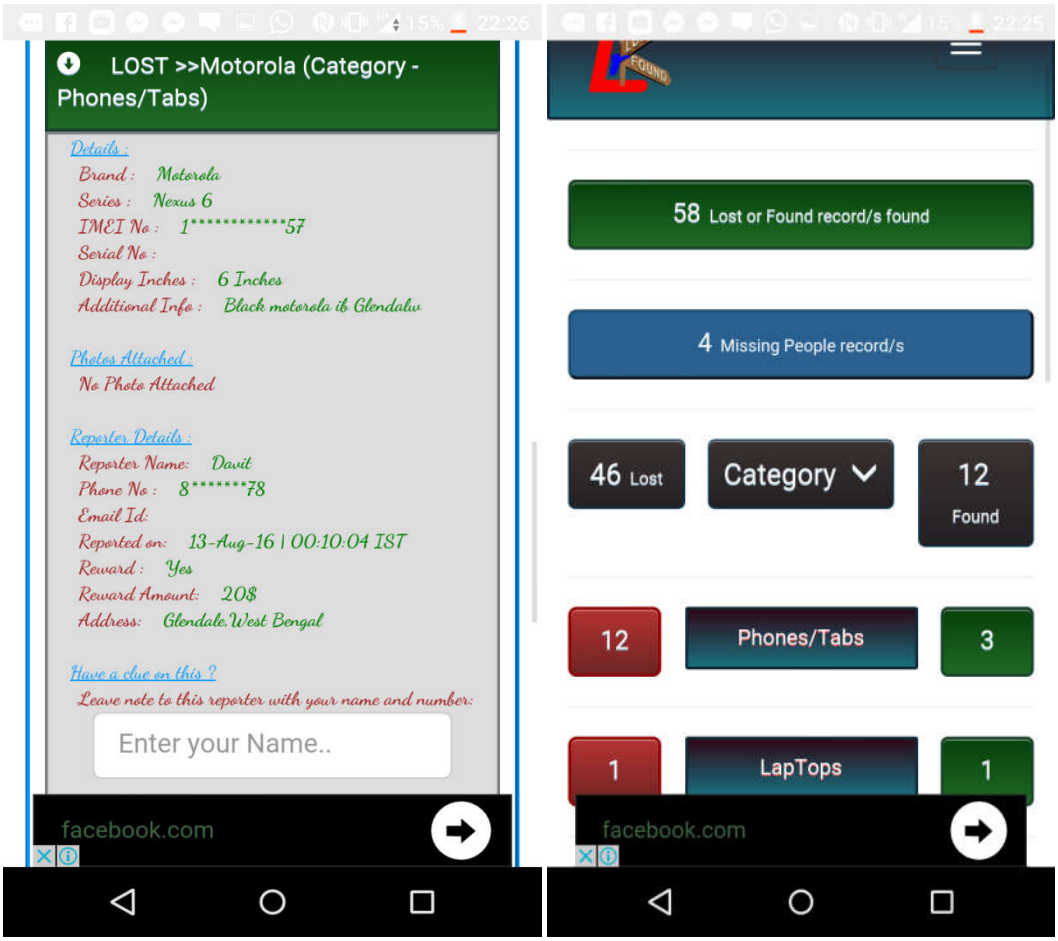

Figure 4: Screenshots of lost R found application

2. ***Lost it Found it***, still and Indian based application makes it possible for people all over India to post an advert if they have lost or found and item. The application has a much better interface than the first, but has no posted item. It could not be tested further because it failed at every attempt to create a new account as seen on figure above.

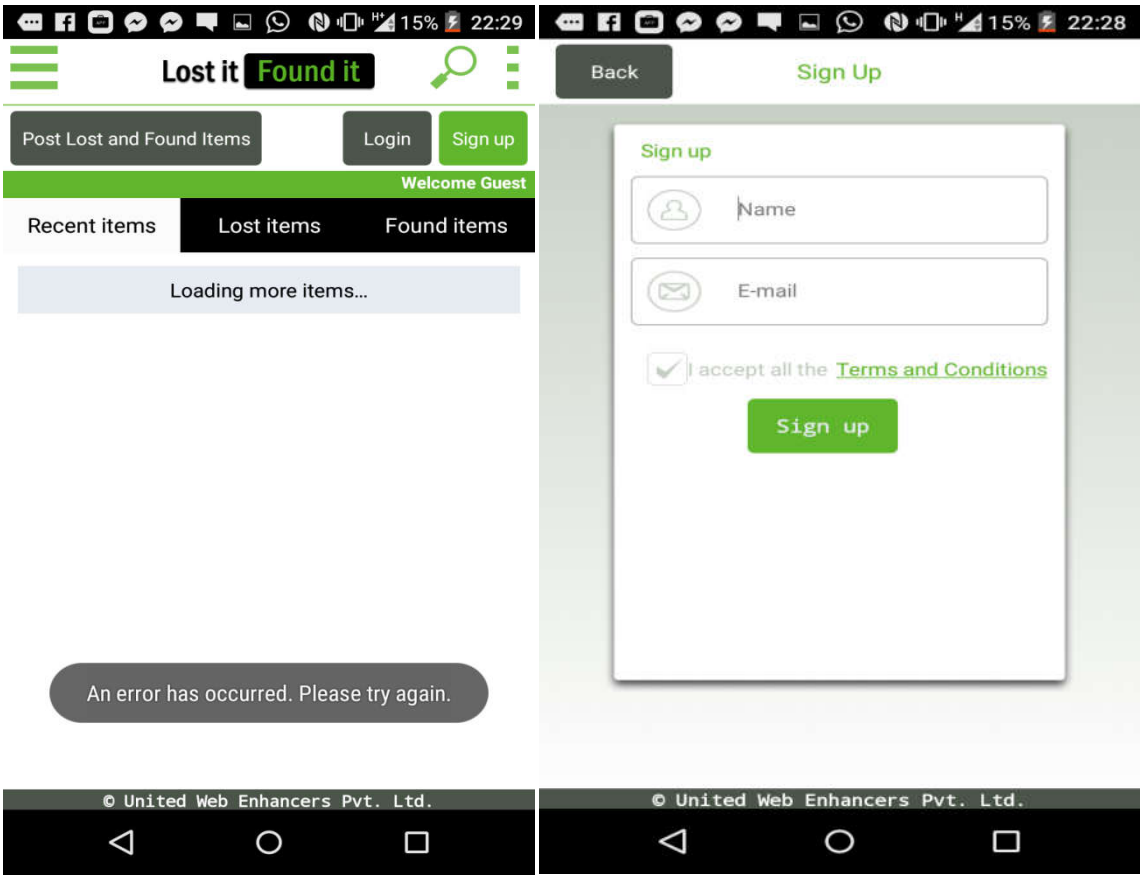

Figure 5: Screenshots of the LostIt FoundIt android application

2.5 OPTICAL CHARACTER RECOGNITION

Optical Character Recognition, or OCR, is a technology that enables you to convert different types of documents, such as scanned paper documents, PDF files or images captured by a digital camera into editable and searchable data [9]. It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation.

2.5.1 Uses of OCR Engines

OCR engines have been developed into many kinds of object-oriented OCR applications, such as receipt OCR, invoice OCR, cheque OCR, legal billing document OCR. They can be used for

- Data entry for business documents. e.g. check bank statement, passports, receipt etc
- Automatic number plate recognition
- Extracting business card information into contact list
- Make textual versions of printed documents
- Assistive technology to help impaired blind users.

2.5.2 OCR Stages[10]

The OCR process consists of 3 stages, pre-processing, character recognition and post-processing.

2.5.2.1 Preprocessing

In this stage, the OCR software preprocesses the image to improve chances of successful recognition. Some techniques used in this stage amongst others include:

- **Binarisation:** Converting an image from colour or grey scale to black and white.
- **Deskew:** tilt the image clockwise or anti clockwise to make the lines of text perfectly horizontal or vertical
- **Layout analysis or Zoning:** identifies columns, paragraphs, captions as distinct blocks.

2.5.2.2 Character Recognition

There are two basic types of core OCR algorithm, which may produce a ranked list of candidate characters [11].

- ***Matrix matching*** involves comparing an image to a stored glyph on a pixel-by-pixel basis; it is also known as "pattern matching", "pattern recognition", or "image correlation". This relies on the input glyph being correctly isolated from the rest of the image, and on the stored glyph being in a similar font and at the same scale. This technique works best with typewritten text and does not work well when new fonts are encountered. This is the technique the early physical photocell-based OCR implemented, rather directly.
- ***Feature extraction*** decomposes glyphs into "features" like lines, closed loops, line direction, and line intersections. These are compared with an abstract vector-like representation of a character, which might reduce to one or more glyph prototypes. General techniques of feature detection in computer vision are applicable to this type of OCR, which is commonly seen in "intelligent" handwriting recognition and indeed most modern OCR software

2.5.2.3 Post Processing

This aims at improving the accuracy of character recognition. OCR accuracy can be increased if the output is constrained by a lexicon – a list of words that are allowed to occur in a document. This might be, for example, all the words in the English language, or a more technical lexicon for a specific field.

2.5.3 OCR Tools and Engines:

Examples of OCR tools are provided by Google, ABBYY, Adobe Acrobat, and ScanSnap. These softwares can scan an image and extract words from the document. This citation [12] gives a good comparison of OCR tools by name, operating systems, languages etc.

2.6 PROPOSED SOLUTION

The proposed solution in solving the problems stated previously is an Android application permitting users to register, post missing NICs, searching the missing NICs, and contacting the person who posted the card. It uses ABBYY OCR engine to get information from the NICs. The system takes advantage of the increase in penetration of smartphones, especially android smart phones, and the fact that internet is getting cheaper, to provide a solution to this problem faced in our local community.

Chapter 3 METHODOLOGY

The effectiveness of any solution to a given problem can only be guaranteed by the effectiveness of the methods used to obtain this solution. As such in this chapter we will present the methodology used in the design and development of the proposed solution.

3.1 APPROACH

In order to guarantee the successful development of the project, its implementation was largely guided by standard methods used in the development and implementation of software. The agile development methodology was used in the development. A software development methodology is the framework that is used to structure, plan, and control the process of developing a system.

3.1.1 Agile Development Methodology

The agile methodology is an iterative approach to software delivery that builds software incrementally from the start of the project, instead of trying to deliver it all at once near the end. It works by breaking projects down into little bits of user functionality called user stories, prioritizing them, and then continuously delivering them in short two week cycles called iterations. Planning, analysis, design, implementation and testing are done many times over as each user story is implemented.

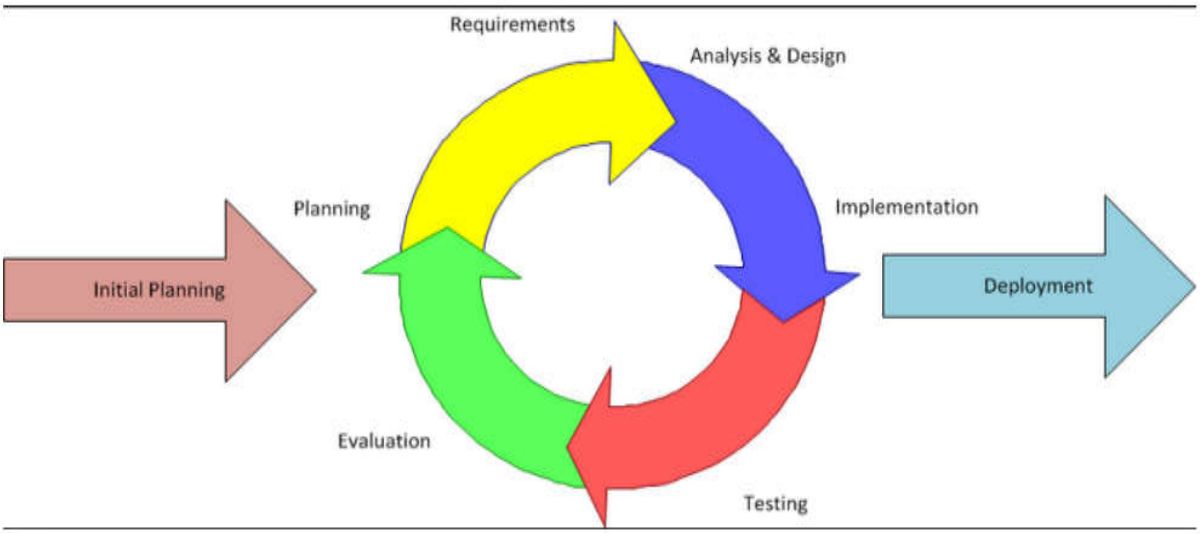

Figure 6: Nature of Agile software development methodology

Advantages of the agile methodologies that contributed to me using it include:

- A working product is redelivered in a short time.
- It is less costly.
- Favours frequent change of requirements.
- Progress of development is measurable.

Some disadvantages are:

- Though it is incremental, whole system should be understood before hand, hence good planning and design is necessary.
- Since some modules are completed much earlier, well defined interfaces will be required

3.2 DESIGN PATTERNS

A design pattern describes a proven solution to recurring design problem. Design patterns are good to use because they are proven, reusable and expressive (that is they provide a common

vocabulary). Main patterns used in development were the Model View Controller architecture, and the Object Oriented Design patterns.

3.2.1 Object Oriented Design

Object oriented programming sees the world as data modeled in code by objects. Objects represent real life objects like cars, oranges, teachers etc. Each object has a state or a set of states, called attributes, and a ways or a set of ways it behaves, called behaviours or methods. In OOP, the programmer focuses on each object, its states and behaviours, and how it interacts with its environment. Object Oriented Programming has great advantages over other programming styles which include [14]:

- ***Code Reuse and Recycling***: Objects created for Object Oriented Programs can easily be reused in other programs.
- ***Encapsulation (part 1)***: Once an Object is created, knowledge of its implementation is not necessary for its use. In older programs, coders needed understand the details of a piece of code before using it (in this or another program).
- ***Encapsulation (part 2)***: Objects have the ability to hide certain parts of themselves from programmers. This prevents programmers from tampering with values they shouldn't. Additionally, the object controls how one interacts with it, preventing other kinds of errors. For example, a programmer (or another program) cannot set the width of a window to -400.
- ***Design Benefits***: Large programs are very difficult to write. Object Oriented Programs force designers to go through an extensive planning phase, which makes for better designs with fewer flaws. In addition, once a program reaches a certain size, Object Oriented Programs are actually *easier* to program than non-Object Oriented ones.

- ***Software Maintenance:*** Programs are not disposable. Legacy code must be dealt with on a daily basis, either to be improved upon (for a new version of an exist piece of software) or made to work with newer computers and software. An Object Oriented Program is much easier to modify and maintain than a non-Object Oriented Program. So although a lot of work is spent before the program is written, less work is needed to maintain it over time.

Some disadvantages of OOP include:

- ***Size***: Object Oriented programs are much larger than other programs. In the early days of computing, space on hard drives, floppy drives and in memory was at a premium. Today we do not have these restrictions.
- ***Effort***: Object Oriented programs require a lot of work to create. Specifically, a great deal of planning goes into an object oriented program well before a single piece of code is ever written. Initially, this early effort was felt by many to be a waste of time. In addition, because the programs were larger (see above) coders spent more time actually writing the program.
- ***Speed***: Object Oriented programs are slower than other programs, partially because of their size. Other aspects of Object Oriented Programs also demand more system resources, thus slowing the program down.

3.2.2 Model View Controller (MVC)

Model View Controller is a methodology or design pattern for successfully and efficiently relating the user interface to the underlying data models. MVC is widely used with programming languages such as C++ and Java. Android is based on the MVC models with

layouts representing the views, and Activities which handle logic and user interaction with the views. MVC accomplishes its goal by proposing three main components to be used in software development:

- A Model, which represents the underlying logical structure of data in a software application and the high-level class associated with it. It contains no information about the user interface.
- A view, which is a collection of classes, or xml files representing the elements in the user interface (everything with which the user can view and respond to on the screen such as buttons, dialog boxes, and so on.)
- A controller, which represents the classes connecting the model and the view, and is used to communicate between classes in the model and the view.

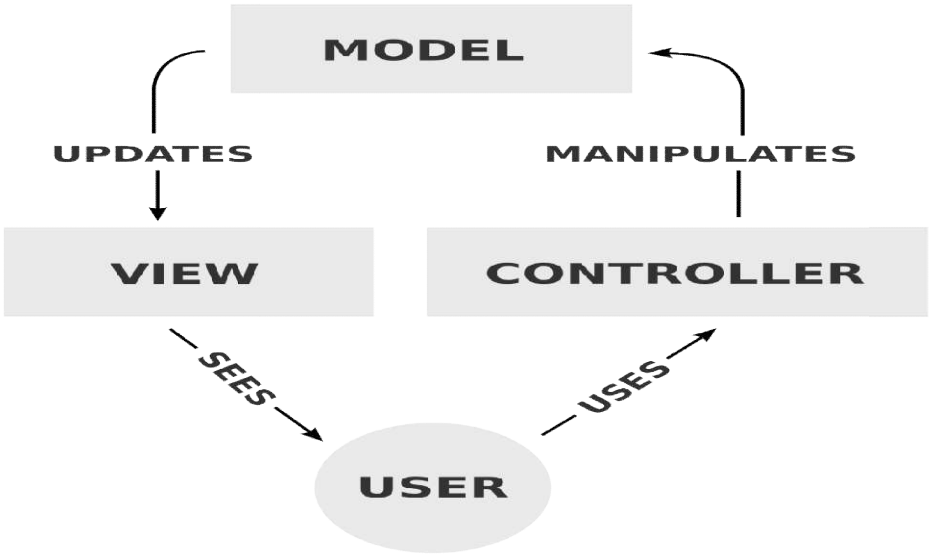

Figure 7: How MVC works

MVC has the advantages of separation of concerns which allows the reuse of business logic across applications, many views can be built from same underlying model, and it brings about simplicity as it removes unnecessary ambiguity.

One disadvantage of MVC is that it is not easy, and one has to spend a lot of time to think of how to structure his application. Android is by default MVC with activities and layouts which made the thinking process a little easier.

3.3 REQUIREMENT AND SPECIFICATIONS OF THE SYSTEM

Requirement analysis is the process of determining user expectations for a new or modified product. With the requirement analysis, we can easily understand the system and how it fulfills its user's needs.

The system is designed to meet some functional and Non-Functional Requirements. Functional requirements answer the"what" questions about the system while Nonfunctional requirements answer "how" questions. The nonfunctional requirements include system security, availability, maintainability, quick response to user's request and reliability while functional requirements are captured in some of the modeling diagrams that follow.

3.3.1 System Models: Unified Modeling Language

The Unified Modeling Language (UML) is a general purpose graphic language used by software professionals for specifying, visualizing, constructing, and documenting the artifacts of a software intensive system. It is the standard language for writing software blueprints [15].

The UML has 3 main models:

- User Model

- Object Model
- Dynamic Mode

3.3.1.1 The User Model

The user model consists of Use Case Diagrams which are used to graphically describe the interaction of the user with the system. They represent actors, activities and their relations. They are primarily used to gather the requirements of the system to be built. These include both internal and external requirements and mostly design related. So when we analyze a system we identify functionalities and actors.

The Kmer ID finder app shall permit a user to register, sign in, post a missing ID card, browse ID cards, view details about an ID card, search for a particular ID card, and contact the user who posted a particular ID card.

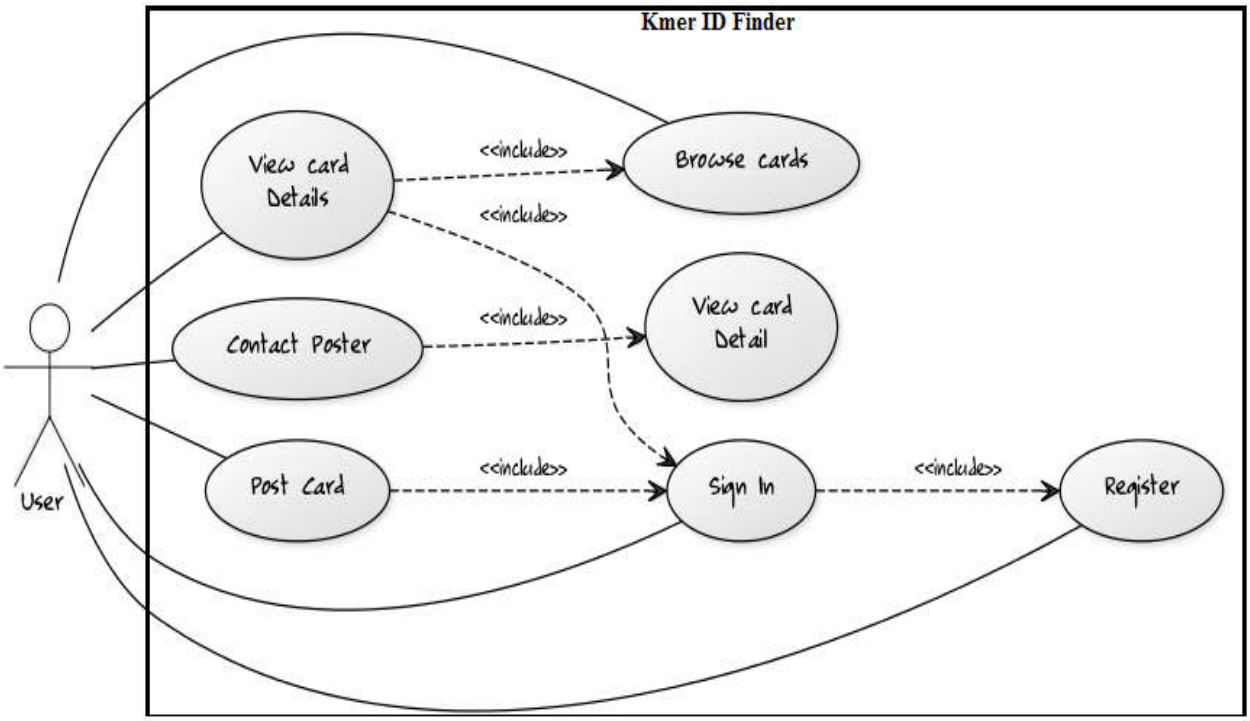

Figure 8: system usecase diagram

3.3.1.2 The Object Model

The object model in the unified modeling language is represented by the class diagrams. A class diagram is used to represents the static view of an application. In addition to visualizing, describing and documenting different aspects of a system they also used for constructing executable code of the software application. These diagrams describe attributes and operations of a class. They also describe the constraints imposed on the system. They are the only diagrams that map object orientation, so they are extensively used in objects oriented systems. A class diagram will show a collection of classes, interfaces, associations, collaborations and constraints.

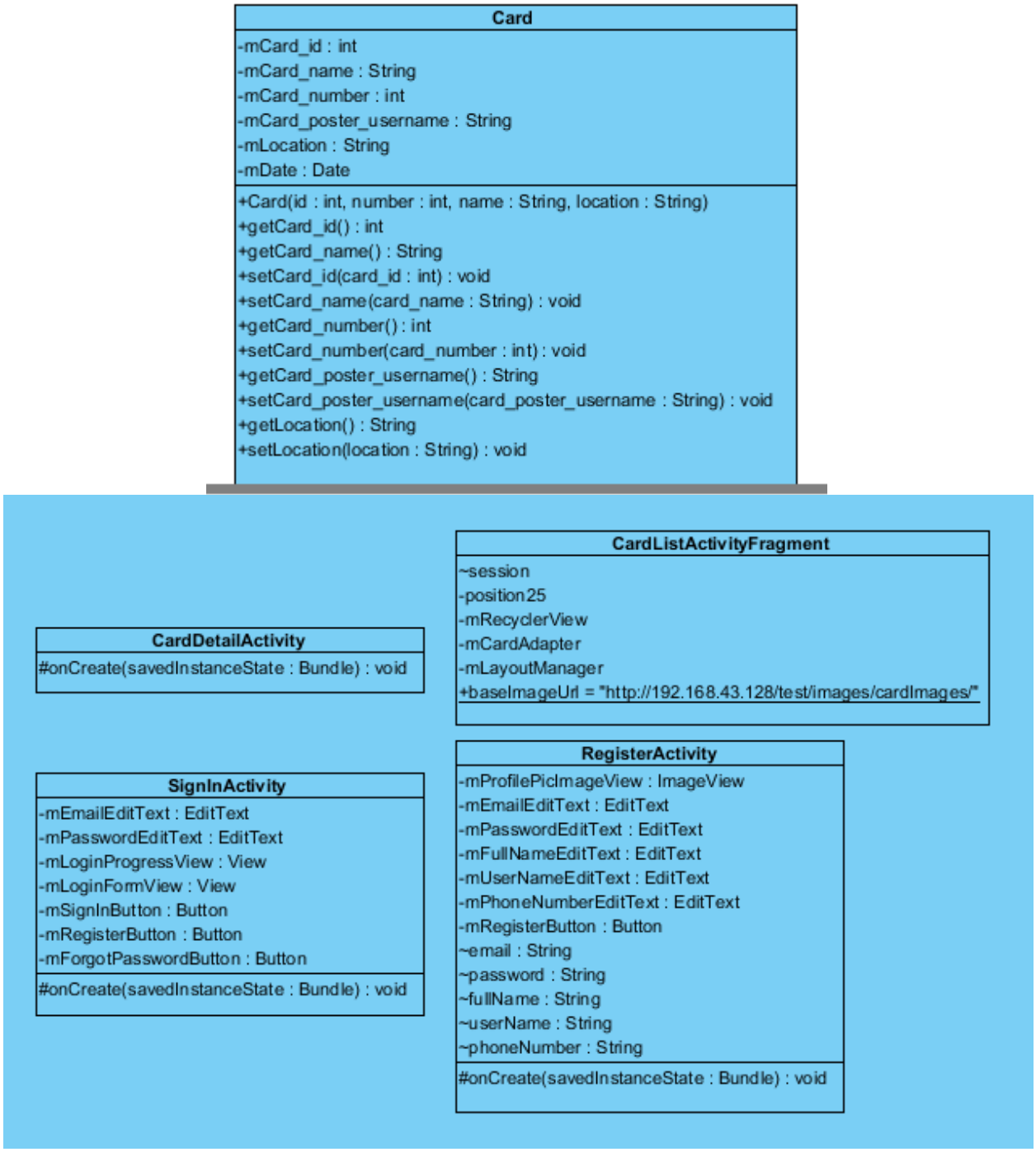

Figure 9: class diagram of some classes of the system

Figure 9 shows class diagrams of some classes in the application. The card class is seen to have parameters like mCard_id, mCard_name, and methods like getCard_id(). In order to have an even better static view of the system, figure 10 shows the database schema for the application.

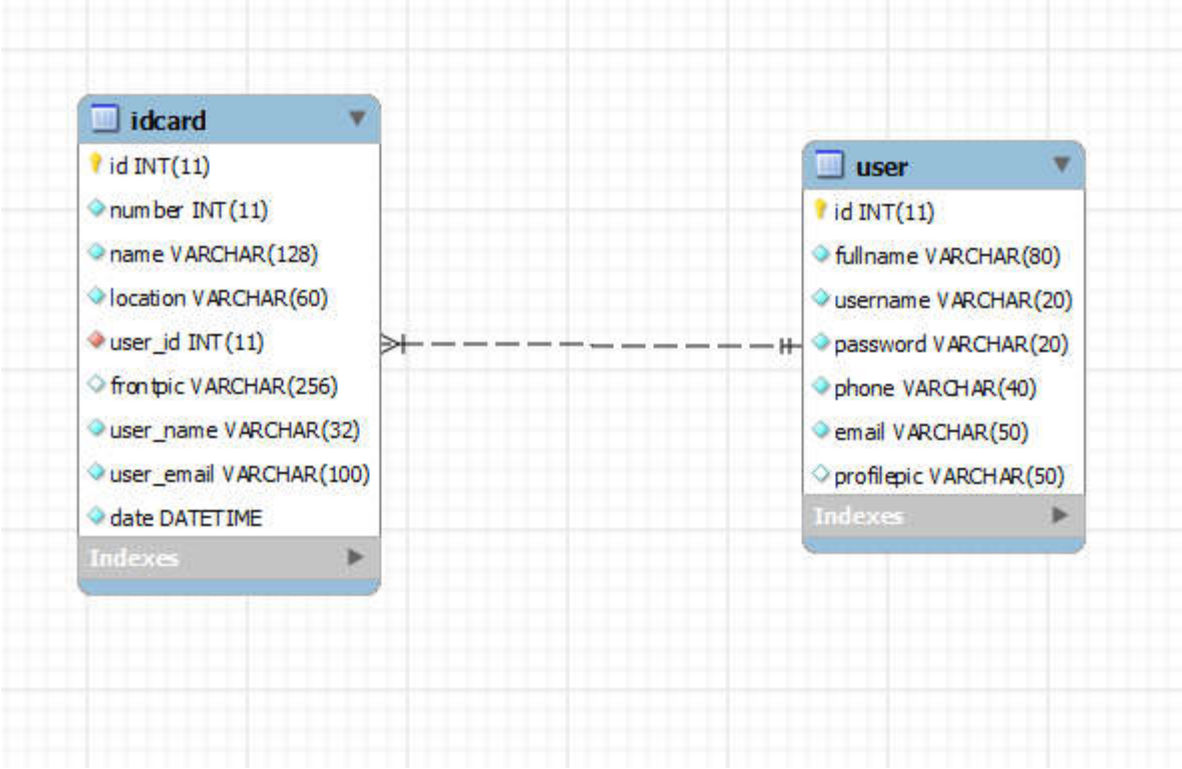

Figure 10: Database Schema for Kmer ID Finder

As shown by the schema, one user can post many ID cards to the system.

3.3.1.3 The Dynamic Model

The Dynamic Model in the unified modeling language is represented by sequence and activity diagrams. Sequence diagram are meant for emphasizing the time sequence of interactions between classes. The main purpose is to visualize the interactions between the components of the system.

The following is a sequence diagram for the Kmer ID Finder application

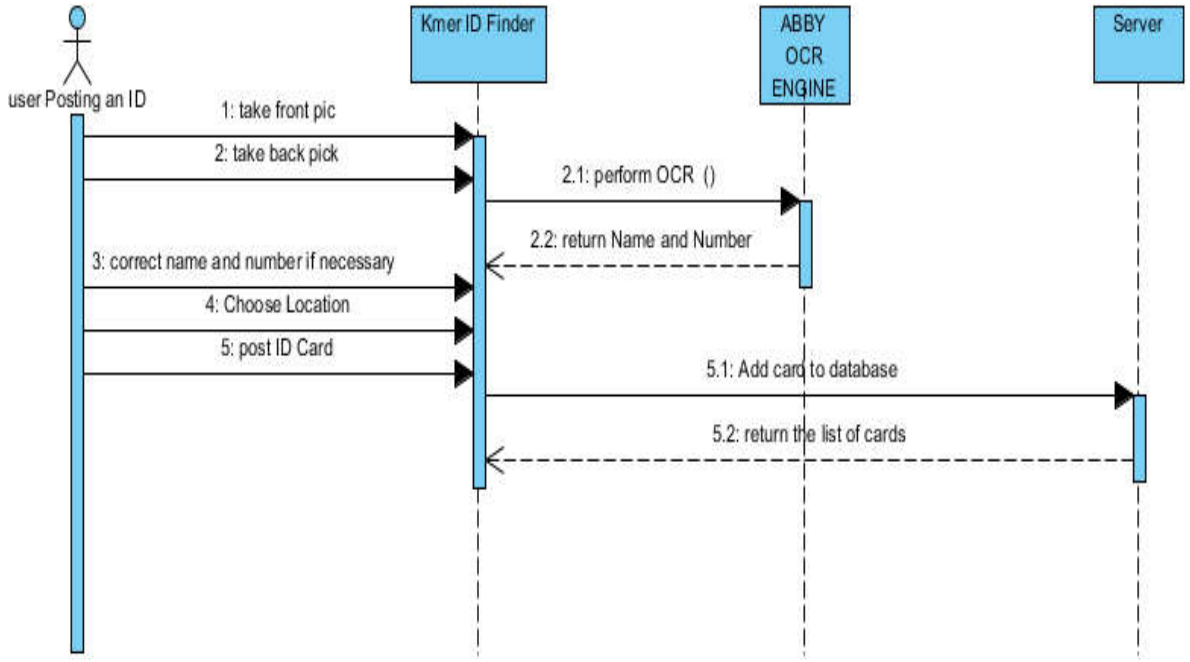

Figure 11: sequence diagram for posting a missing ID card

Activity diagrams are used to show the flow of data within the system. The following figures depict the activity diagrams showing how various use-cases are realized.

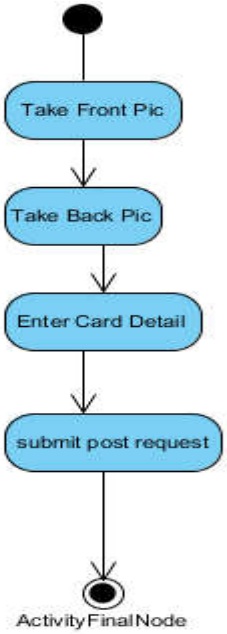

Figure 12: Activity diagram for posting an ID card

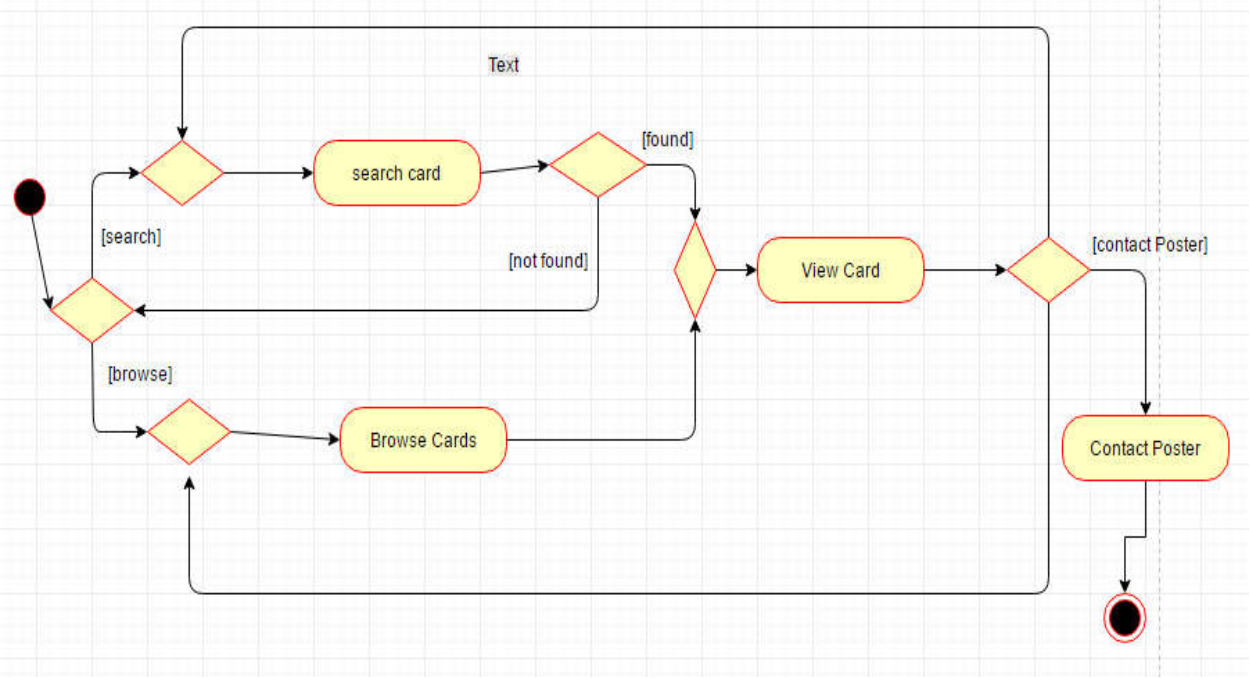

Figure 13: Activity diagram for finding an ID card

3.4 TECHNOLOGY AND TOOLS USED

Android Studio which is the official integrated development environment (IDE) for android platform development was the main IDE used in development, with **JAVA 8.0**

MySQL was chosen for the database, because it is not only an extensible, open storage database engine, offering multiple variations such as Berkeley DB, InnoDB, Heap and MyISAM, but also is open-source like Java.

PHP was used as the server-side scripting language because it is fast, and easily works well with MySql.

PHPmyadmin and **visual paradigm for UML 10.0** were used as design tools for the different parts system like the database, and classes with PHPmyadmin as server.

The **Genymotion emulator** as well as various physical devices was used for testing. Genymotion was used because it is fast. **Itel 1452** and **Alcatel OneTouch** were the physical devices used with android versions 4.4 (kitkat) and 5.0(Lollipop) respectively.

Chapter 4 RESULTS AND DISCUSSION

The result of requirements gathering, design and implementation is the fully functional Kmer ID finder android application capable of being run on all android phones with version later than version 17. The figures below show results obtained.

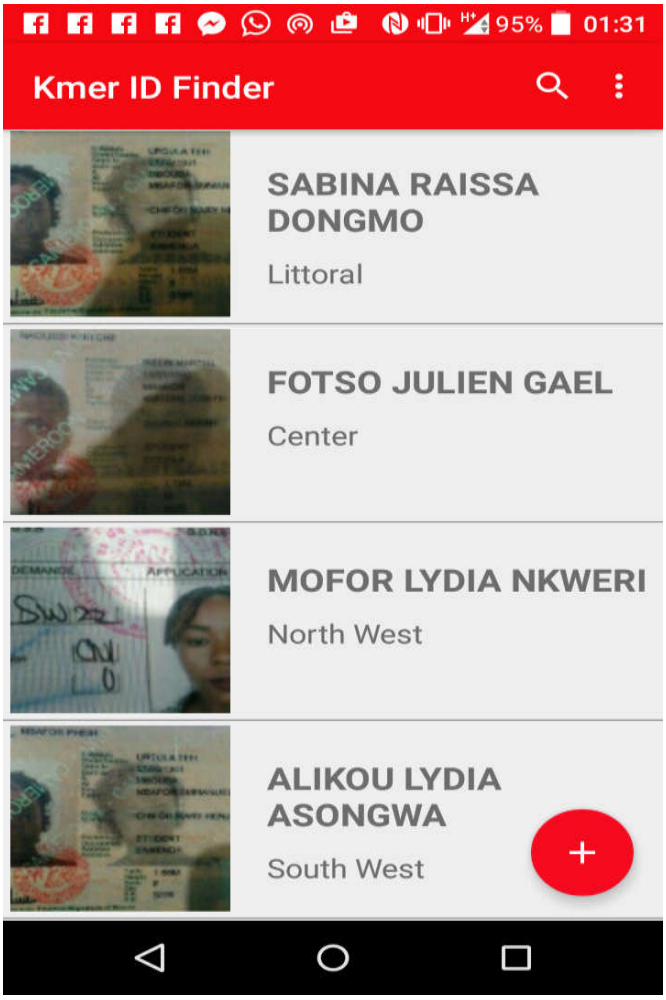

Figure 14: Initial landing screen

Upon installation and launching of the application, the user is presented with the screen above, where he/she can browse cards, but cannot see card detail, nor post a new missing ID card unless he/she is signed in. An attempt to do any of these actions will take him/her to the sign in page.

Figure 14 shows the sign in page where a user will have to enter his/her email and password, and if they are registered already, the result of tapping the sign in button will be the list of posted cards that they can browse, view details, and the floating action button which if touched starts the activity for posting a new NIC as shown in figure 13 above

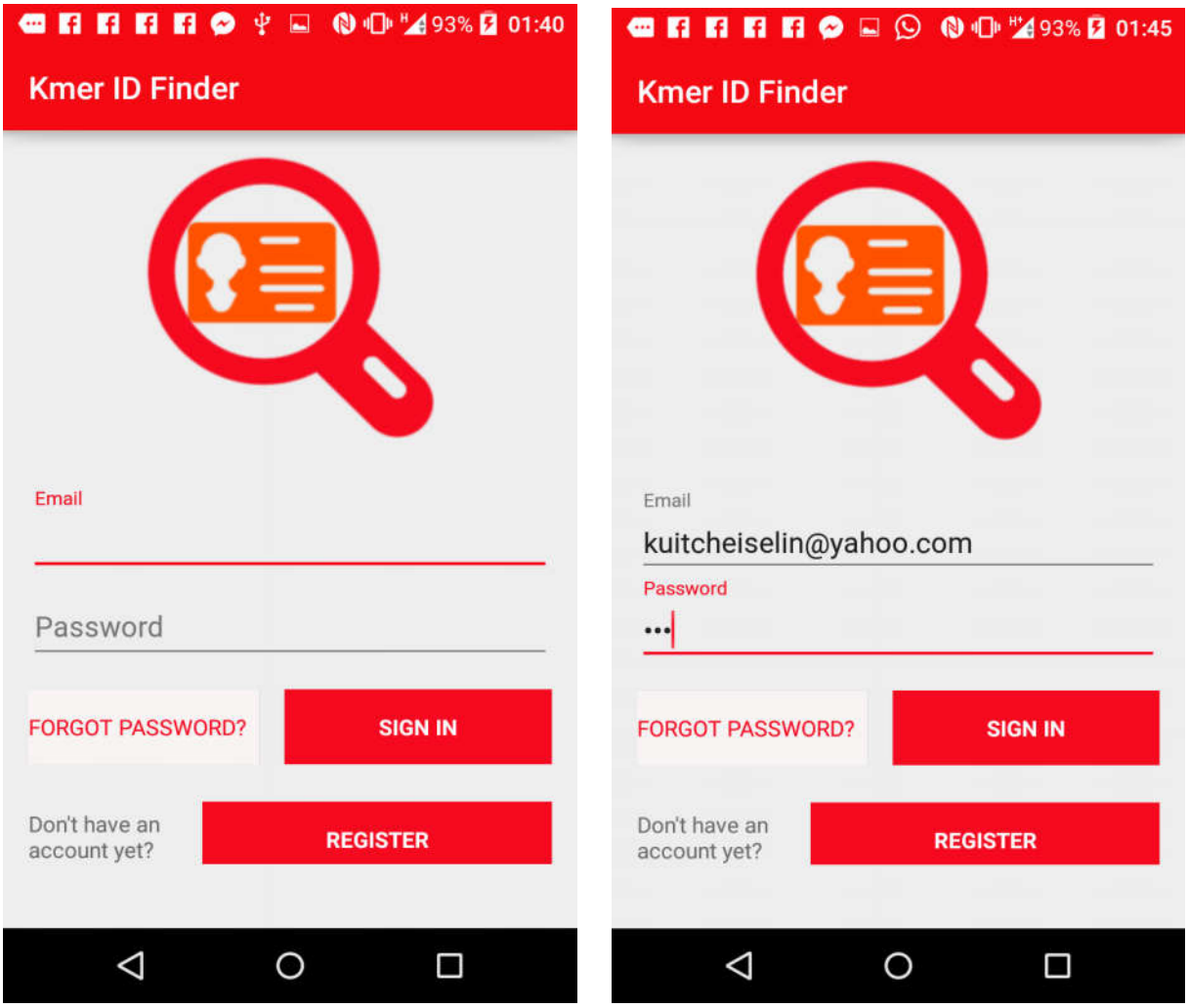

Figure 15: Sign In screen

If the user does not have an account yet, he or she will have to register. Figure 15 shows the screen that comes up as a result of pressing the “register button”.

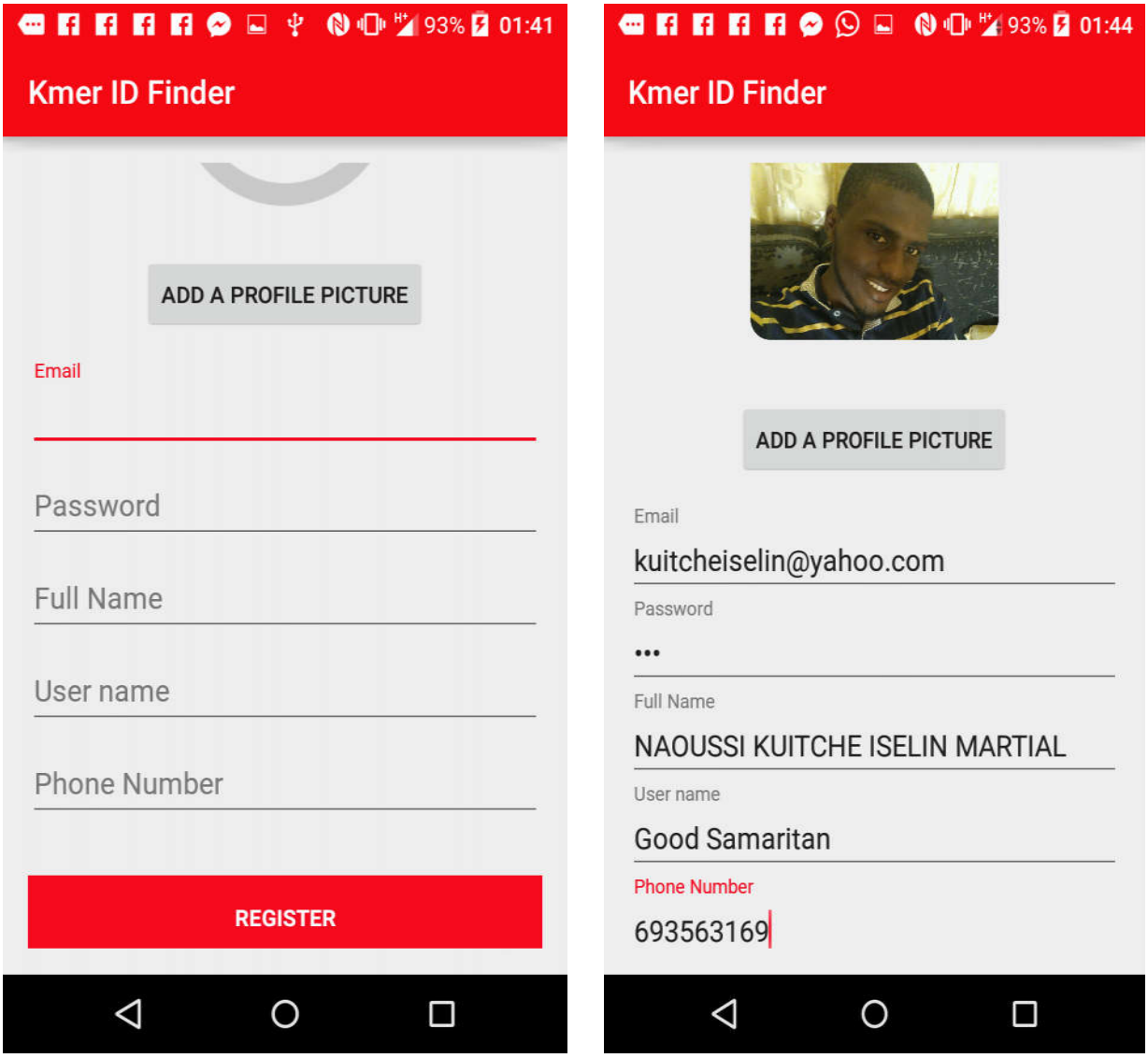

Figure 16: register screen

A registered user who is signed in can post an ID card. Figure 16 shows the view displayed as a result of tapping the floating action button to post a missing card.

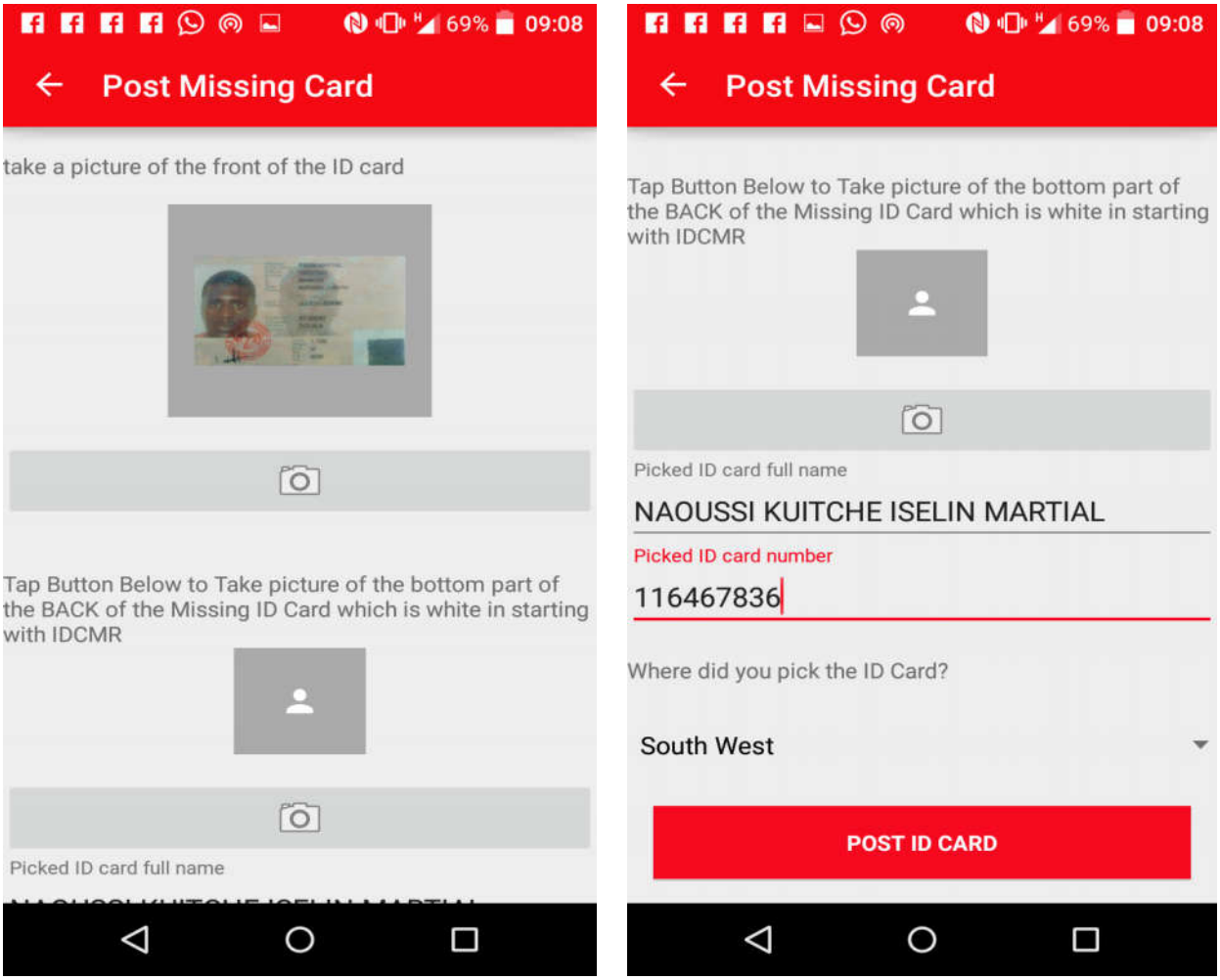

Figure 17: post ID card screen

Tapping on an ID card from the list of ID cards results in the card detail page, where the user can confirm the ID card, and contact the poster. This screen only comes up if a user is logged in.

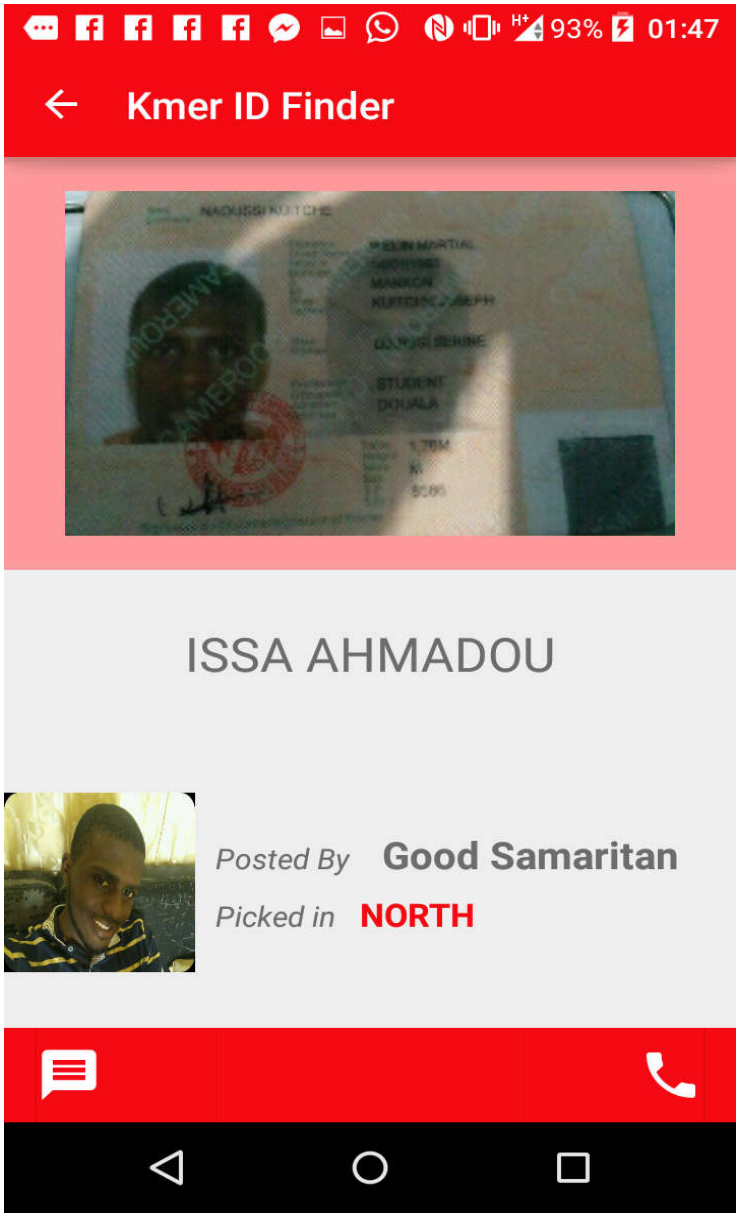

Figure 18: Card detail screen

Chapter 5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

The main objective of this project was to develop an android application that would help people in Cameroon find their ID cards should they be lost or missing. The proposed application comes to complement the other methods for solving the missing ID card problem where solutions exist, and is recommended as the standard where no solutions exist. It would really help more, if police stations, radio and television stations, financial institutions and other public places have accounts on the platform. This would make the victim's search easier and more targeted. This solution thus takes advantage of the increasing penetration rate of the internet, and smartphones in the community to solve a national problem.

For a start we had to study existing solutions of "lost but found" android applications, as well as applications making use of OCR technology. The aim of all these studies was to know how these systems function and see exactly which type of functionalities that are awaited from our system; to search for reusable fragments of existing systems so as to incorporate them in our system. After the phase of documentary researches, we continued with the detailed specification and analysis of all the desired functionalities of the entire platform together with all the components that are implied. What followed after was the Design of the platform in which we pointed out the classes involved; the work flows of the transactions on the system and the sequences they follow; and the coming up with the physical and

logical architectural layout of the platform. To start the implementation phase we had to install and configure different tools, to enable us develop the application.

The most time consuming part in the course of working with this project was looking for an efficient OCR tool, as it requires the extraction of sensitive information and no error is permitted. The ABBYY OCR engine was chosen for its renowned accuracy, leaving us the task of understanding how it works, and how to integrate it our solution.

5.2 RECOMMENDATION AND FUTURE WORKS

Though as of now Kmer Id Finder is a consumable product, the following could be added to improve on its functionalities:

- Search by location could be added such that a user can simply change the location in the preferences and thus view all posted ID cards from a particular region.
- Search by user could be added too such that one could click on a user, and view the profile, and all cards posted by that user.
- A way on checking on a user if he has found and collected his or her ID card, so as to get statistics about how the application is helping.
- Other sensitive documents like passports and drivers' licenses. Since the application uses OCR, it would be relatively easy to extract relevant information from these documents.

REFERENCES

1. Statista. *Number of apps available in leading app stores as of June 2016.* Retrieved August 17th, 2016, from http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/
2. Wikipedia. *List of national identity card policies by country.* Retrieved August 17, 2016 from https://en.wikipedia.org/
3. Cameroun tribune. (January 10th 2015). *Alarming number of missing ID cards floods public places*. Retrieved August 17th, 2016 from http://www.cameroonweb.com
4. Wikipedia. *History of mobile phones.* Retrieved August 17th, 2016 from https://en.wikipedia.org/
5. *The number of smartphones on the MTN Network in Cameroon reach 2.6million, increase by 64.1%.* Retrieved August 17, 2016 from http://www.businessincameroon.com/telecom/
6. (August 4th, 2016). *What makes a smartphone smart.* Retrieved August 17th, 2016 from http://cellphones.about.com/od/smartphonebasics/a/what_is_smart.htm
7. Wikipedia. *Android (Operating System).* Retrieved August 17th, 2016 from https://en.wikipedia.org/wiki/Android
8. *More than 10,000 missing National Identification Cards in Cameroon* .Retrieved August 17th, 2016 from http://www.bontehsblog.com/more-than-10000-missing-nationa/
9. ABBYY. *What is OCR and OCR Technology.* Retrieved August 17th, 2016 from https://www.abbyy.com/

10. Wikipedia. *Optical Character Recognition*. Retrieved August 17th, 2016 from https://en.wikipedia.org/
11. OCR Introduction". Dataid.com. Retrieved August 17th, 2016.
12. Wikipedia. *Comparison of optical character recognition software.* Retrieved on August 17th 2016 from https://en.wikipedia.org/
13. Centers for Medicare & Medicaid Services (CMS) Office of Information Service (2008). *Selecting a development approach*. Web article. United States Department of Health and Human Services (HHS). Retrieved 15 July 2015.
14. *CS 164: Fall 2015 - Introduction to Computer Science Object Oriented Programming Retrieved* August 17th, 2016 from https://www.cs.drexel.edu/~introcs/Fa15/
15. Booch, G., Rambaugh, J., & Jacobson, I. (2005). The Unified Modeling Language User Guide (2nd Ed.). Addison-Wesley Professional