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Development and Implementation of an E-Voting Mobile Application

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ABSTRACT: The fundamental right to vote or simply voting in elections forms the basis of democracy. The conduct of periodic, competitive, participatory, credible and non-violent elections is one of the main yardsticks used to determine the democratic condition of a state. In Nigeria, elections have been conducted using the manual system of voting ever since we started practicing democracy in 1999, but these elections using the manual means, have been marred with a lot of electoral malpractices and hitches. These include; violent attacks on the voters, result manipulations, vote buying, remoteness of polling centers etc. These are enough reasons that necessitate the development and implementation of an electronic voting system that goes a long way in addressing most of these problems. Nigeria's first ever electronic voting election was in introduced on February 6, 2018 in Kaduna state independent electoral commission (KAD-SIECOM). (KAD-SSIECOM) has appointed EMPTECH to provide an integrated electronic voting solution for the purpose of conducting local government council elections in the 23 local government councils of Kaduna state in 2018. The e-voting system aims at eliminating the bottlenecks evident in the manual voting system such as; the lengthy registration process, unnecessary movement of votes units, election violence and ultimately, the incredibility of the votes. This was achieved by developing a time effective registration platform which registers a voter and assigns a voter their voter's card immediately. The voter also gets to vote from their nearest safe and convenient polling unit and their votes is counted where it belongs. The results obtained from subsequent tests were very impressive in terms of time, security and accuracy as compared to the manual system. Such system with all these capabilities will go a long in ameliorating the aforementioned problems of the existing manual system of voting in the Nigerian electoral process.

KEYWORDS: Android studio, Mobile application, Module implementation, Software model, Finger classification.

I. INTRODUCTION

In every democratic setting with persons of differing and inconsistent opinions, decisions must be made between several options. This happens in the business environment, educational environment, social organizations, and mostly, in governance. One of the ways of making such a decision is through voting. Voting is a formal process of expressing individual opinion for or against a motion. In the governance sector of much organization, this process is always used as a means of selecting or electing a leader. One of the key areas where voting is applied is in election. Election is the formal process of selecting a person for public office or of accepting or rejecting a political proposition by voting. Due to enhancement of technology many countries are using the E-voting system for their elections known as electronic voting system.

Implementing new technology in an entire election process is very challenging because it requires many years of careful planning, detailed, structured and lots of trust on the whole entire system. E-voting provides an opportunity for solving the problems of traditional election process such as vote counting, missing stamp, fake voters etc. One common point for introducing this technology is to show the world, the level of internal technological development by a country.

E-voting is a tool for making the whole election process more efficient. Many countries are using this technology for fair elections, time saving and for impartial and better results. Unlike the rest of the world, Nigeria is still using a traditional paper based voting where each person`s are credentials checked manually and after verification, the voter is allowed to vote through ballot paper. E-voting does not only provided solutions but there are also, some challenges and concerns that are surrounding this technology and they should be figured out and considered when implementing the E-voting system in a country.

Electronic voting systems are rapidly overlapping the traditional paper-based voting. In traditional voting, there are a number of factors that make rigging easy in whole electoral process, factors such as, miscounting of votes, fake voters and involvement of outside sources and also other problems like time consumption, cost budget problems etc. So, the purpose of this proposal is to investigate how to model an authentic reliable and upright E-voting system so that a voter is submitted a vote in secure manner while

maintaining the time, verification, budget and also the security of the entire system.

The expectations, objectives and aims achieved through the E-voting system are:

- The aim is to develop an efficient and easy prototype of android based E-voting system that provide secure election process and build trust in people regarding this technology and also to improve voter confidence or experience.
- Prevention of rigging in polling stations during the calculation of results by reducing human interference.
- Reduce the whole budget of election process, such as the amount consumed in production and distribution of election accessories e.g. ballot papers, ballot boxes, voter cards etc.
- Another goal is to help the election management regarding calculation and verification such as fast counting of votes and verification of voters.

This work is mainly designed to enable the Independent National Electoral Commission to use electronic device to capture voter's information, and to allow voters to cast their votes easily and comfortably so as to promote a more credible election which is efficient and less costly. The dynamic nature of the elections application interface and database structure allows for different organizations to set up and conduct basic elections too. Its online interface enables real-time election monitoring and ease in result collation. Some of its major limitations are:

- It requires network access: Since the collection and sending of votes to the database requires an internet access which may not be readily available in some urban areas. This would seem a limiting factor, though the local database and the printed votes can be used for counting until the network is restored.
- The cost of setting up an e-voting system is high: Due to the delicate nature of such a system and the fact that its' major components are presently not locally sourced, it would be quite costly to setup, but its usage and maintenance cost is far better than the present ballot paper system.
- It depends on electricity to a point: In as much as it has an in built battery that can last for the required election duration on daily basis, a case of low battery would require it to charge, which may not be possible if there is no electric power at the moment

The significance of an e-voting system to the society and mostly to Nigeria is itemized as follows:

1. It will provide INEC (Independent National Electoral Commission) with a means to conduct less costly and fair elections.
2. The secure and flexible database management system safeguards data and information to account for credible elections.
3. It will serve to reduce the workload in the process of conducting election.
4. As it incorporates remote voting, individuals can vote from their convenience.
5. It will enable INEC reduce the time wasted in collating and announcing election result.
6. It will greatly reduce and eliminate disenfranchising electorates.
7. It will serve to eliminate invalid votes, curb election violence, as votes are counted immediately as they are cast.

II. LITERATURE REVIEW

E-voting is a proactive area of research which is updated yearly by new methodologies, functionalities and new approaches. E-voting can be done through different voting machines like electronic ballot printers, VVPAT machines and internet applications etc. It was first implemented in 1960's when punch card systems were introduced. Advance E-voting is implemented in many countries like (Belgium, Brazil, America, India etc.). Many countries, even Pakistan, is also considering and soon introducing Electronic Voting with the intention of improving many aspects of election process.

In Pakistan, the Electronic Voting was first implemented by KPK government along with NADRA in some districts and councils of Peshawar during last year in local bodies election. The KPK government implements an E-voting system based on Biometric (fingerprint) verification, and conducted a successful trial run of the system but this system can only verify the voter through fingerprint and still, voting is done through ballot papers. So according to a current situation, we are going to develop a Fingerprint E-voting system based on android application with new features and enhancements such as; the voting can be done electronically through Tablet devices instead of ballot papers, enhance security and also the other features like voters registration, Graphical interface for voters etc. will be included in our E-voting application. Many theories and researches have been proposed to explain the effective working of different E-voting systems, though the literature review covers the wide variety of such theories and researches. These reviews will focus on major themes which emerged repeatedly throughout the period of implementing the counting and electronic voting projects. These themes are: Making a decision, build system and implementing a system. Although this section presents these themes in a variety of context, background, related study and comparison, this section will primarily focus on working,

problems and enhancement of current technologies in E-voting system.

E-voting system is a proactive area of research and is updated year to year by new methodologies, functionalities and new approaches. The engineers and researchers who have done their work in the area of Electronic Voting posit that these voting systems do not fulfill the requirements of public elections, there are still some security problems in it and second, the current advanced technologies of this system still needs to be improved.

MOBILE APP DEVELOPMENT

Mobile app development involves building mobile applications that can work on mobile devices

Mobile application development is the process of creating software applications that run on mobile devices, such as tablets, mobile phones, wearable's, car dashboards, television etc.

Each computer on the network has access to the files and peripheral devices (such as printers or modems) of all the other computers on the network. There are many programming languages used for mobile app development such as; Java, flutter, C/C++,Python, Swift but I made used of Kotlin

What is Kotlin?

Kotlin is a modern, trending programming language that was released in 2016 by Jet Brains.It has become very popular since it is compatible with Java (one of the most popular programming languages are out there), which means that Java code and libraries can be use in Kotlin programs.

Kotlin is used for:

- Mobile applications (specially Android apps)
- Web development
- Server side applications
- Data science
- And much, much more!

Why Use Kotlin?

- Kotlin is fully compatible with Java
- Kotlin works on different platforms including Windows, Mac, Linux, Raspberry Pi, etc.
- Kotlin is concise and safe
- Kotlin is easy to learn, especially if you already know Java
- Kotlin is free to use
- Big community/support
- Kotlin IDE
- The easiest way to get started with Kotlin, is to use an IDE.
- An IDE (Integrated Development Environment) is used to edit and compile code.

III. REVIEWS OF RELATED WORK

This article describes the design, construction and operation of an E-voting machine using a microcontroller. This machine is based on two units: voting unit and control unit. A microcontroller requires a code which is written in assembly language. A voting unit is also connected with the control unit. Voting can be done through the Voting unit placed in the polling booth, a voter presses the button beside the candidate's symbol to cast the vote and this vote is saved in the EEPROM of the control unit. The security of data is enforced by producing digital signatures for data files. The election credentials and results which are stored in the EEPROM of the control unit can easily be checked on the screen of the control unit and can also be downloading into a central count system for result tabulation and for other verification purpose. This article also discusses security analysis and proposes different methodologies, solutions and tools. This concept was good but for a practical application, it requires more efficiency, usability and feasibility to be further improved.

This research article proposes the multifaceted E-voting system, where voters can cast their votes using a Computer network, web browsers and mobile phones. The system was based on the three tier architecture: client, and database Server. The problem in this system is that the voter's identities are linked with the votes which are against the election laws so, this system requires improvement on the voter's privacy.

This research paper proposes two voting environments one is offline E-voting system using different biometrics with embedded security and the second is online E-voting system. This paper also discussed the polling data security and voter authentication process. In offline E-voting system, verification can be done by different ways such as using Face Recognition, Fingerprint sensing and RFID, which enables the voting machine and allows voters to cast their votes. In online E-voting system, a voter requests for a password through web application by providing his mobile number, and a password is randomly generated and will be automatically sent to the voter's mobile GSM through SMS. The verification is done by entering that password and the voter will be then enter the voting window and cast the vote through web application. The voting data and voter details will be sent to the database using GSM system with cryptographic technique and RC4 algorithm. The problem in these systems is that the vote counting is very hard because the online votes are saved on servers and offline votes are saved on a voting machine and these votes cannot be merged for calculation at a time.

This proposal describes the enhancement of security for remote electronic voting system based on android application, without compromising the feasibility and usability of the system.

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This work describes an automated E-voting system. In this system, voter credentials will be stored against their fingerprints in the database. In this system, voter's credentials are being verified via OTP code and then, they can vote their desired candidate using fingerprint. All the casted votes are encrypted using DES algorithm. The system is designed using object oriented language; KOTLIN. Three layered network system is used to send the votes from client to the main database server. This system makes use of one server and one database, using firebase database; its inbuilt server sends an OTP to verify user information and then sent to the firebase database. This work focuses on secure transmission of election data and votes through different network system, this system makes use of one server and one database, using firebase database

This work proposes a decentralized electronic voting system application for android devices such as Smart phones and tablets. Both candidates and voters must be verified via OTP so as to be sure that they are Nigerian citizens before they can be logged into the application. Their information are then saved in the database, in order to verify accuracy to ensure and privacy, The application is developed with the help of KOTLIN language, an online E-voting system with security enhancement to minimize attacks with the help of hash function and time stamping algorithm. The system is based on six phases which are: registration, authentication, saving, managing, counting and auditing.

This paper deals with the development and design of an offline Fingerprint based E-voting system. The voter credentials are pre-stored in database with their fingerprints template. Firebase is used as database server for the submission and verification of the OTP sent, the system allows voters casting a vote using fingerprint biometric. The vote counting will be done on database server; this makes the process fast, efficient and secure. This paper also proposes the problems and solutions of different fingerprint verification method. It also helps out in the brief study of mathematical equations used during fingerprint authentication process. This paper focuses on the methodology and security by various methods and techniques. This report proposes an optical voting system. This system includes the special software and hardware. The hardware part captures a picture of the ballot card and the software part handles the conversion of that picture into binary data. A ballot card is given to the voter; this ballot card contains the candidate's name and symbols which are printed in front of each candidate, the symbols can be a triangle, stars or uncompleted arrows. The voters make their choice of a candidate by filling in the symbol next to the candidate. After completion of that action, the voter puts the card inside the vote tabulating machine (like printer). This tabulating device is connected to the computer and has the capability to identify the filling symbols done by voters and according to those filling symbols, the computer will saved or record the vote. All the votes are saved and inserted in the system database and finally, processed to produce the overall results. The problem in this system is that sometimes, the machine can not accurately read the ballot card and thus, can reject the vote.

This report proposes an E-voting system that merges two technologies; the internet and the GSM technology in order to advance E-mobile voting system where the internet will manage the database and the server of a voting system, while the GSM system provide voter authentication and allow voters to cast votes through mobile app. The voting application is pre-defined by the network operators and exists in mobile SIM tool kit option. First, the voter have to give some information to verify his eligibility and then it is allowed for a casting a votes through small graphical interface. Then, the vote is submitted to the database through internet, in a secure manner. This research will ensure the security of voter's and grant the information flexibility to the voters. The privacy of the voter is secured by cryptographic technique using a blind signature protocol so that the voter's identity is not linked with the votes. The paper also describes the basic prototype of the GSM electronic voting machine. The problem with this system is that it does not allow voters to cast the vote through old mobile models.

This work describes an online E-voting system using fingerprint authentication. This system makes use of password and individual's name used as first security for login into the system. The data or information entered by the voters is verified by the pre-defined information in the database: after creating an account, OTP is then sent to the number used for regristration.

After successful verification of both security levels, the voter is allowed to cast a vote and vice-versa, for a candidate registered to be voted. The system is designed using KOTLIN language and firebase database. The backend server is used for vote counting

This paper proposes a new idea of E-voting using SMART cards known as SAILAU voting system. There are two terminals used for voting, first is the voting terminal and second is the poll book terminal. In this system, the administrator first scans the voter's national ID card with the bar code reader to check the eligibility of the voter. After verification, the ballot SMART card is issued, then the voter goes to the voting terminal and inserts the card to activate the machine, the machine displays a ballot screen where the voter selects the candidate through the touch screen. The vote is recorded in the SMART card memory. Then, the voter goes to the poll book terminal where the voter inserts the card into the SMART card reader. The machine reads the recorded vote and flashes the memory then the card is ready for the next voter. This paper introduces a unique idea of SMART card and it works like an ATM card and it is more secure even though still complicated for the voter.

This article describes the combination of two systems which are: direct optical scanning and paper-based voting. The system based on a touch e-voting machine, barcode printer, scanner, and a ballot box. The voting machine starts by using USB key booting equipment. First, the voter is verified by the polling officer and after the verification, the smart card is given to the voter for activating the voting machine. When the machine is activated, it displays a ballot screen. After confirming the vote on a touch screen, a printer prints out a ballot containing two parts, a machine-readable part (QR code) and a human-readable part. Then voter scan the QR code using the scanning unit. The scanning unit is interconnected with a laptop, which automatically stores the vote in a secure USB sticks and the voter also drops down the human-readable ballot paper in a ballot box that can be used later for recounting purpose. The laptop needs a special tool or software for operating the USB-sticks to check the results. The operating system used for the laptops is LINUX. The system includes a special security such that when a ballot paper is scanned a second time, the vote will not be registered or stored. This paper focuses on a new idea of E-voting system which is secure, effective and efficient in working.

IV. SUMMARY OF THE WORK REVIEWED

So, according to overall background study, analysis, experience and comparison, it is stated that Technology implementation and up-gradation in elections are always challenging and require careful consideration and planning. This study proposes that E-voting provides an opportunity for solving some traditional problems but also introduces new concerns. This study also discusses some typical features and technological solutions of E-voting and provides an overview of the weaknesses and strengths of this technology. At last, this technology still needs to be improved to enhance its efficiency and usability for the elections

IV. MATERIAL AND METHOD

This paper describes the details on this work that is used to achieve the progress of E-voting system. This section describes the framework, functionalities, challenges, requirements and specifications that are required to implement on this system. This also demonstrates the overall tools, development, planning, implementation, the whole process and its work flow. Generally, this work describes the core development of the whole E-voting application.

The above work presents the variety of methods and technologies that are used to develop the different E-voting systems. These systems can be used in universities, organizations and also, in countries. Many researchers have been done to upgrade the efficiency and eliminate the errors that may occur during the election process. The developers and researchers have faced some challenges, shortages, limitations and troubles during this work and necessitate the creation of such a system that strives to overcome these problems.

V. RESEARCH APPROACH

Research purpose In the information age: it seems that the application of information technology is an in-dispensable tendency for the evolution of organizations in the 21st century, regardless of public or private organizations. The application of information technology in public affairs briefly includes the electronic democracy, which is governance-oriented, and e-government, which is service-oriented. E voting, being a vital part of the services being offered by e-Government, would lead to the application of information technology to improve the efficiency of public sector, obviously and the participation of the citizen through the electronic forum. The purpose of this research is to identify the factors affecting the election process in Nigeria and ways they can be eliminated. There are two main research approaches used in scientific work, they are quantitative and qualitative. The main difference between these two is that the aim of quantitative research is to find explanation to a phenomenon or a situation that can be generalized to other people and places while in qualitative research, the aim is to gain deeper understanding of a phenomena or a situation. Quantitative approach will be used to discover the issues that threaten the election process in Nigeria especially, as it relates to voters. We are making use of existing data already collected by previous literature on Nigerian elections to analyze the election process and derive a conclusion on how to eliminate the issues.

- Research conclusion Based on the reviewed data collected on previous conducted elections in Nigeria. The main issue with the Nigerian election was the issue of voter's apathy towards the electoral system which is as a result of many factors such as; inaccessible registration and voting venue, election violence; that could lead to loss of lives, result manipulation and so on. A system that serves to increase voter's participation in the electoral process is the remedy to these issues at hand. E-voting system serves to provide a remedy for the inaccessible registration and voting venue, as eligible citizens can be registered and vote from their places of residence and be certain that would their vote count. It also provides a means to eliminate ballot box snatching as votes are counted as they are cast. There is also less room for result manipulation because the result is updated and displayed for all as the votes are being counted. The research goes through different steps in order to complete the project (E-voting system). The

research approach will be divided into four steps which are shown in the figure below

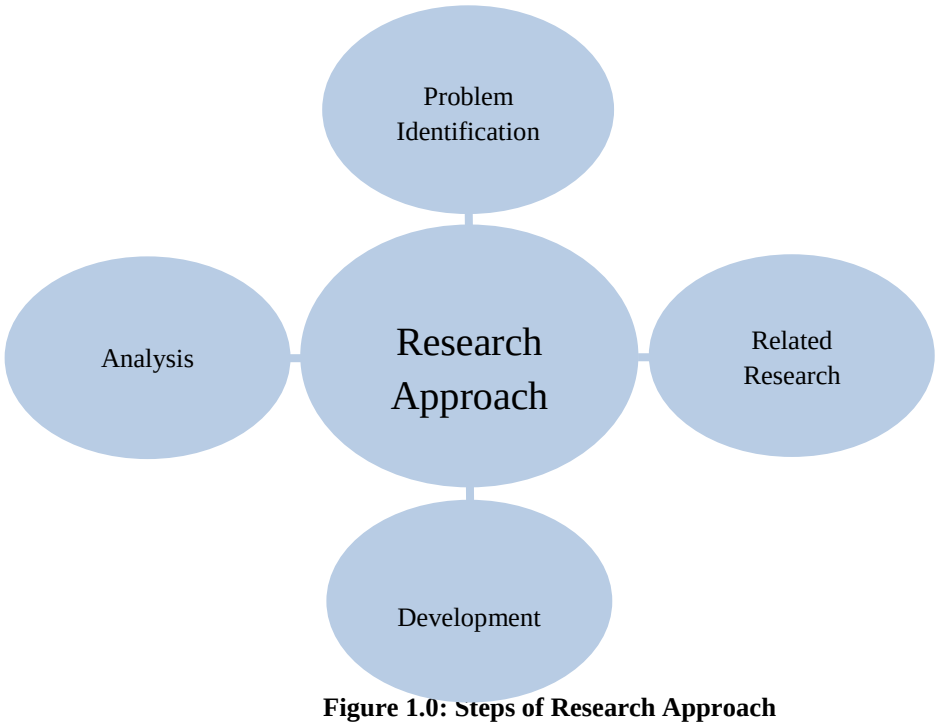


Figure 1.0: Steps of Research Approach

VI Problem Identification:

Different E-voting systems been introduced to enhance the election process. These systems are regularly analyzed and examined for correctness and security. A variety of researches have specified that all or most of the E-voting system used at the time were faulty and did not do their tasks properly. From this point of view, our most significant task is to develop an easy and efficient prototype of E-voting system based on android application with enhanced security and protection of the system. This can be attained by upgrading the different measures such as security actions and verification methods and also, by avoiding the mistakes done by others in their systems or machines.

VII **Technical Research:**

The technical research is a core process related to E-voting system components such as; the programming language, user interface, fingerprint algorithms and fingerprint classifications etc. Fingerprint is an emerging technology, many researchers and developers came up with different algorithms for the fingerprint matching and identification process. There are some important factors to consider for achieving the implementation and desired goal of the fingerprint based E-voting application. So, here are some technical research and classification they are as follows:

Fingerprint Recognition:

Biometrics is considered as a vital component used as a personal authentication and identification. Biometric identification can be done by the fingerprint recognition, eye recognition and face recognition and also, by speech characteristics. One of the most major biometric processes is the usage of fingerprint. Fingerprint recognition is known as the electronic method of verifying or identifying fingerprint images. It is a very complex issue, because of the difference and unique impressions on the same finger. Therefore, the fingerprint matching is a big problem. There are two approaches used in fingerprint recognition systems they are: verification mode and identification mode. There are some techniques used to make the identification and verification process faster. These techniques are called fingerprint indexing and classification technique.

Fingerprint Classification:

The fingerprints are categorized into three classes upon their visual patterns they are: arches, loops and whorls. Each class is split into smaller classes. The first type is known as loop fingerprint, it also has two types; ulnar loop and radial Loop. Arch is the second type of the fingerprint; it is subdivided into two types; tented arch and plain arch. The third type of fingerprint is known as whorl. This type is divided into; central pocket whorl and plain whorl. These figures below show the different types of fingerprints:

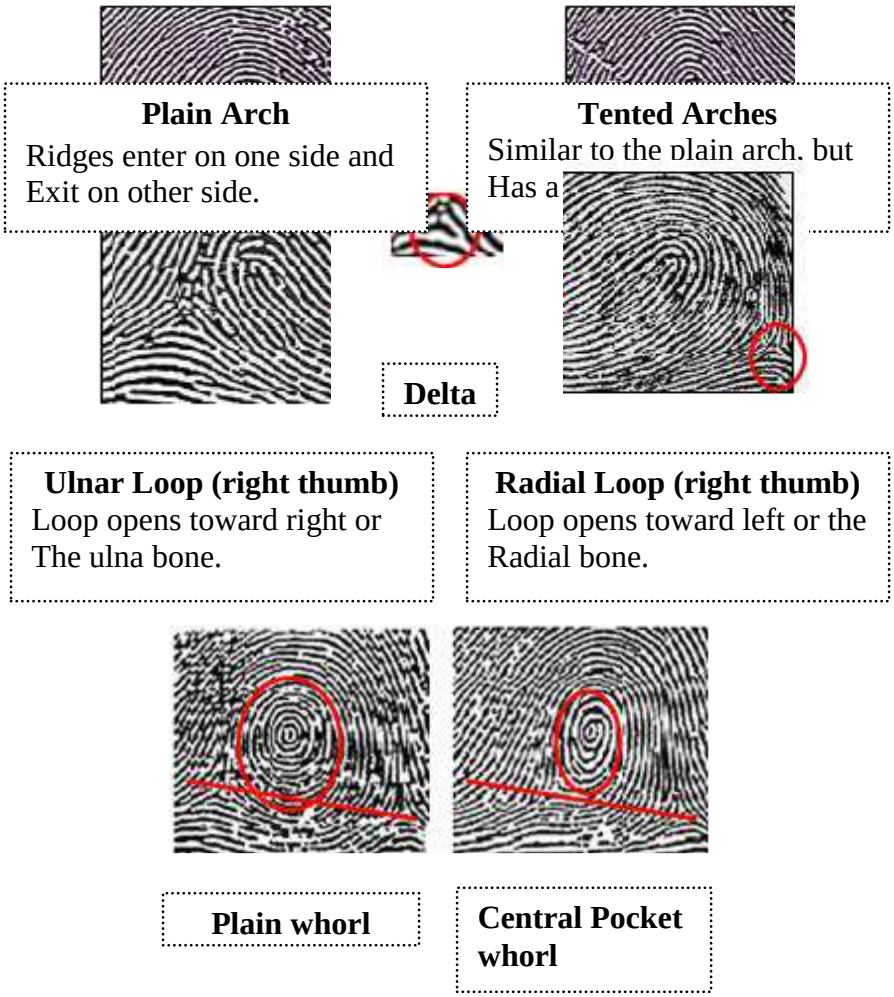


Figure 1.1:. Types of Fingerprints

The lines on a finger are known as ridges. The characteristic of ridges on a fingerprint are recognized as minutiae, the minutiae are basically; bifurcation, dot and ridge ending. Bifurcation is identified when a ridge splits into two different ridges. The ridge break point is called the ridge ending, while the small ridge is known as dot (or island). In identification process, these three types of features are very essential because the algorithms which are making comparisons are based on these features. These figures below show the different types of fingerprint features or minutiae.

FIGURE 1.2 Identification Character

Generally, the process by which the fingerprint is determined is known as minutiae matching technique. The extraction of minutiae method requires a multiple processes which are shown below:

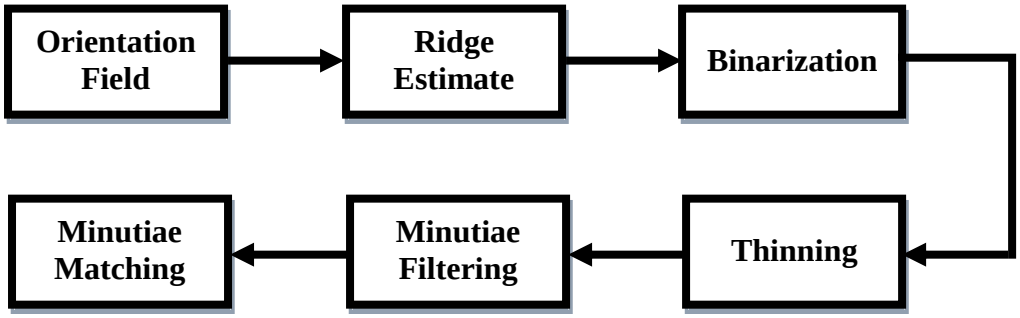


Figure 1.3: Block Diagram of Minutiae Method

The images below show the fingerprint at the initial process and after computation process.

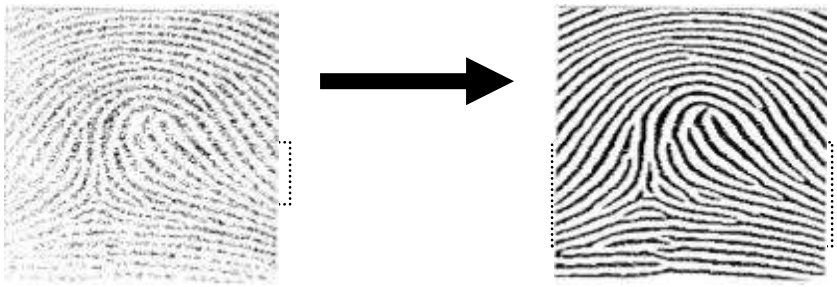


Figure 1.4: Image Enhancement through Computation

Work Process Chart:

The flow chart has been used to simplify the understanding. The flowchart, basically a diagram, consists of symbols to show the flow of the whole project process. All the steps should be executed in order to attain the final result of the work. The chart below shows the work process

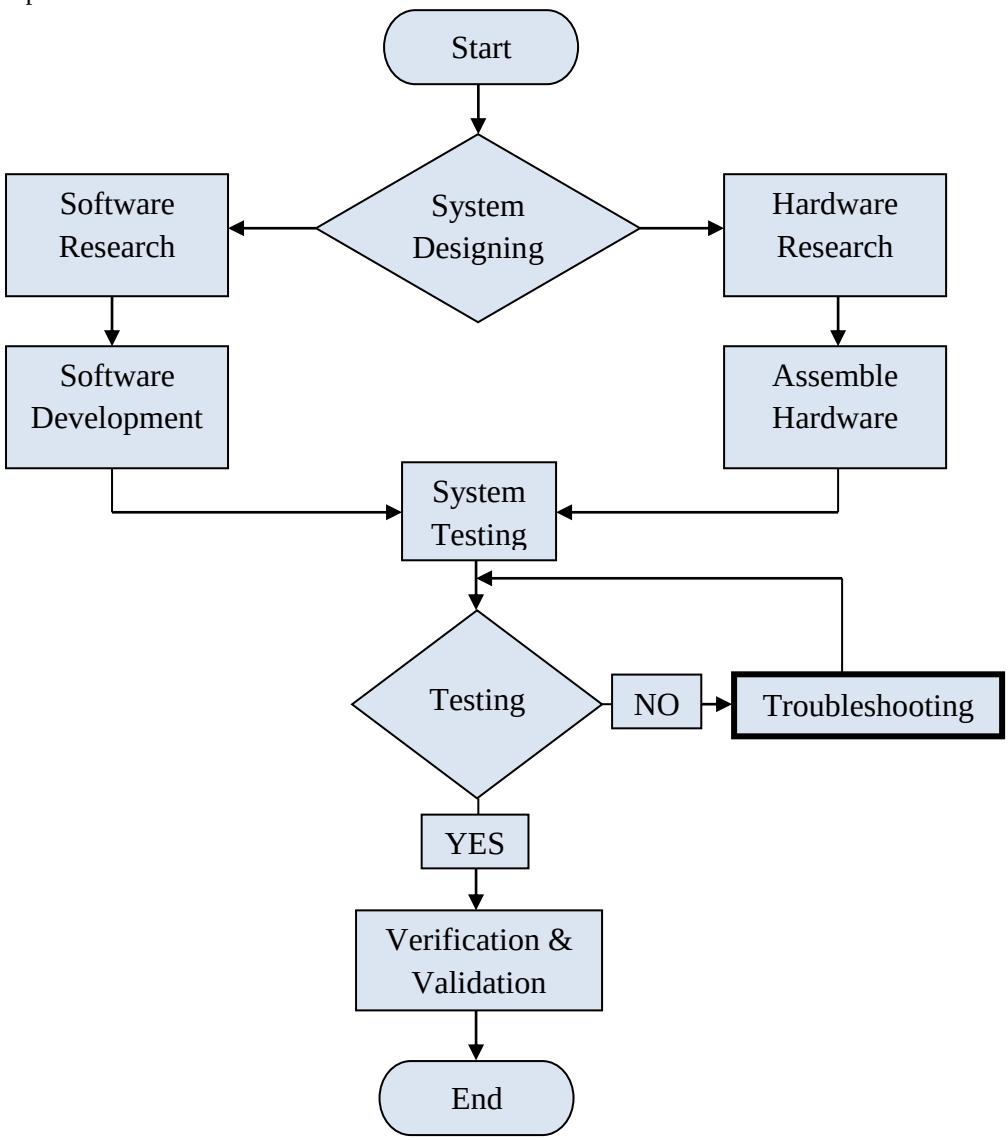


Figure1.5: work Process Flowchart

VIII. SOFTWARE DEVELOPMENT METHOD:

In software engineering, a software development process is a division of work into phases that contain activities, with better management and planning. The phases include the pre-defined activities that are completed by a team to develop or maintain the

application. Common software models include; waterfall model, iterative and incremental model, prototyping model, spiral model, V-model, rapid application development model, extreme programming model and different types of agile methodology.

Software Model:

The software model, which is used in the development of an android based E-voting application, is a RAD model (Rapid Application Development). This model is used because of rapid prototyping. The detail about the RAD model and its phases are defined below:

RAD Model:

Rapid Application Development is a technique that speeds up the development process and produces the functional system. RAD model is a complete methodology which consists of four phases that use a CASE tool for prototyping and combining high-level development tools and techniques in development. The RAD process allows the analysis of the model as early as possible and recommending changes to meet the requirements of the system. RAD is mostly used to reduce the development, time and cost and is also used to increase the productivity of an application or software.

RAD Phases:

The RAD model is based on four phases which are:

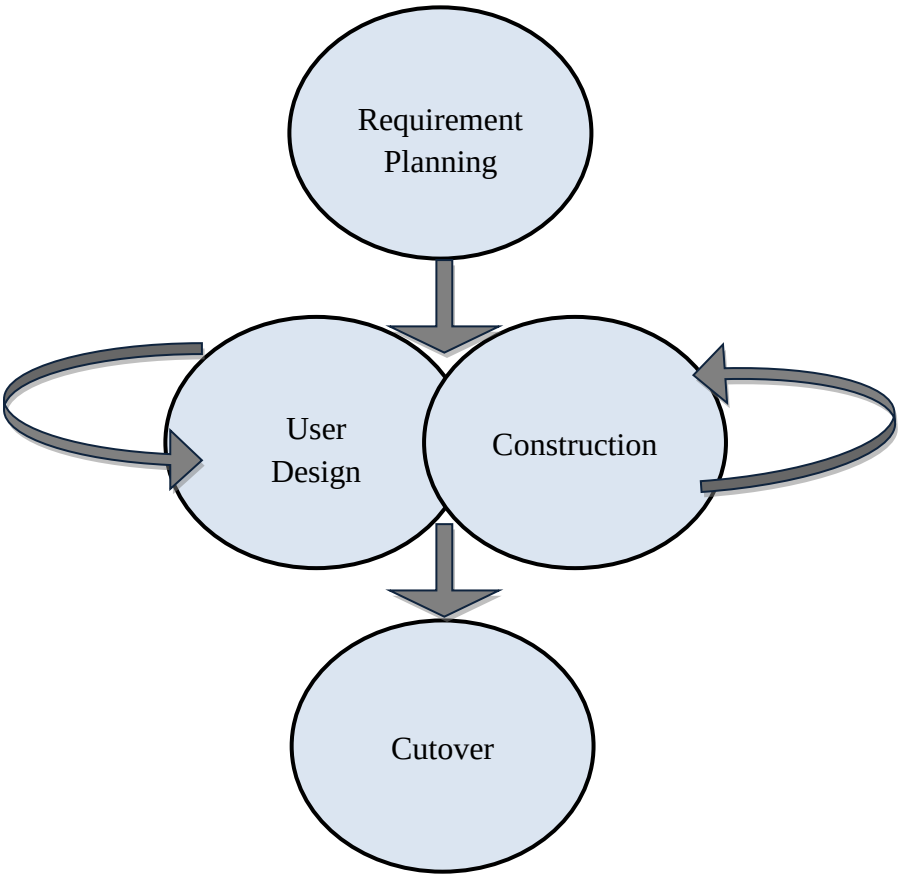


Figure: 1.5:. RAD Model Diagram

- **Requirement Planning:**

This phase combines the elements of system analysis, system planning and system requirements. This phase is known as the concept definition stage and determines the system scope. This phase also briefly defines the system components which are used in the development of an application or software.

- **User Design**:

This Phase interacts with the prototypes and models that represent the entire systems environment and processes. This phase uses CASE tools and JAD techniques to translate needs into model. It is a continuous interactive operation and recognized as a functional design stage. Generally, this phase is used to build a design and working model of critical system components.

- **Construction:**

Construction phase starts when the process of developing the system model and designing the interface is completed. This phase focuses on application development tasks and is also known as the development stage. This phase also gives room for suggesting improvements or changes that are developed. This phase is generally based on coding unit, system testing and integration testing.

- **Cutover:**

This phase resembles an implementation phase or deployment stage. It entails an overall testing, data flow conversions, user training and also the implementation of an application system. Compared with other methods and models, this whole process is compressed and as a result, the system is developed, delivered and placed in a working environment.

Software:

An Android Application based E-voting system's hardware is useless without integration and implementation of software in it, so, different types of software are used to operate or develop the E-voting application they are:

IX. ANDROID STUDIO

Android Studio is an official I.D.E (Integrated Development Environment) for Android apps development which is based on Jet Brains' Intelli J IDEA software. It was introduced in May, 2013 at the Google I/O conference. Availability of android studio is free under the Apache License 2.0. Android studio offers more features like developer tools, powerful code editor, testing tools, and frameworks etc. which enhances productivity in the development of an Android application. It is available for Mac OS X, Windows and Linux and it also replaced the Eclipse Android Development Tool (ADT) which was used in the early stages for android apps development. The official supportive programming language for android studio is JAVA. The current android studio version 2.2.2 is used in this work for the development of an android application.

Adobe Photoshop:

Adobe Photoshop is a raster image maker and graphics editor developed by Adobe Systems for Windows and Mac OS. It is currently licensed software. It can compose and edit raster images in multiple layers and supports alpha compositing masks tools and various color models. Adobe Photoshop has a wide support for graphic file formats such as PSD, PSB, JPEG and PNG etc. In addition to raster graphics, it has many abilities to render text, make 3D graphics or videos and vector graphics etc. The Photoshop version 7.0 is used in the project for making GUI designs such as splash screens, login boxes, background interface etc. It is also the important component because the graphical images help to communicate easily with the application.

Firebase Database:

Firebase is a free source database that stores data in a text file on a device. Android comes in with built-in implementation of firebase database. Firebase supports various relational database features. The file format is android, databases slate that contains the classes to manage the database information. It is a widely deployed database engine and used by different browsers, embedded systems (such as mobile phones, tablets etc.) and operating systems. Fire base database has also bindings to different programming languages. The several versions of Firebase database depends on the android versions. The Firebase database is used in the project to store the different data and the main purpose for choosing this database is because of its compatibility and easy handling of information.

Components Specification:

All the components specification is described in this section. So, the specification chart software used in development of E-voting system is as follows:

Table 1.0:. Software Components Specification

Software	IDE	Android Studio V.2.2.2
	Database	SQ Lite
	Integration Kit	Android Secu Gen Software Development kit (SDK)
	Layout Designing	Adobe Photoshop 7.0

XI SYSTEM DESIGN

The system developing process starts when the research about the components that will be used in the development of an application to achieve the task has been completed. The development of the E-voting system contain hardware; which is the fingerprint scan device and tablet that is going to operate the voting application then, the software will control or manage the verification, identification and the voting process. All the components of the system have to be integrated well together to achieve the task. The JAVA programming language is used in order to build an entire application. The figure below shows the process of system development:

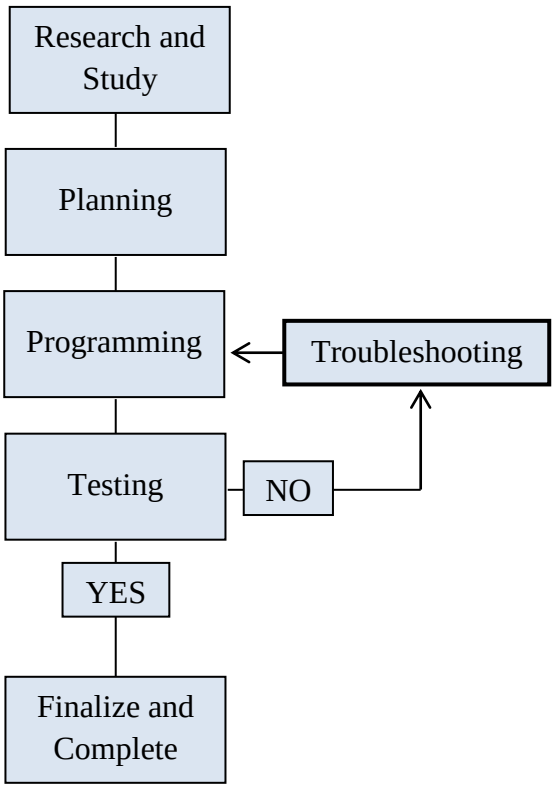


Figure 1.6; System Development Flowchart

System developing is divided into two parts which are system architecture and system development. The Architecture part shows the conceptual overview of the main parts of the system while the development part shows the functional overview of the system. Both parts are briefly described below:

System Architecture:

In the system architecture section, block diagrams are created to show the main parts of the E-voting system which also gives a conceptual overview of the main software components that is used in designing the application. This section also includes the flow chart to show the flow of integrated system and also gives an overview of the application interface design and layout.

Conceptual Overview of System:

The system consists of Control and ballot units. The control unit is designed using the JAVA language and executed by the fingerprint scanner and Android tablet. The other unit called ballot unit consists of Graphical pages that allow the administrator to activate the voting process and also allows voters to give the vote by choosing the political symbol (candidate) by touching the sensitive screen and then, all the information is stored in the database.

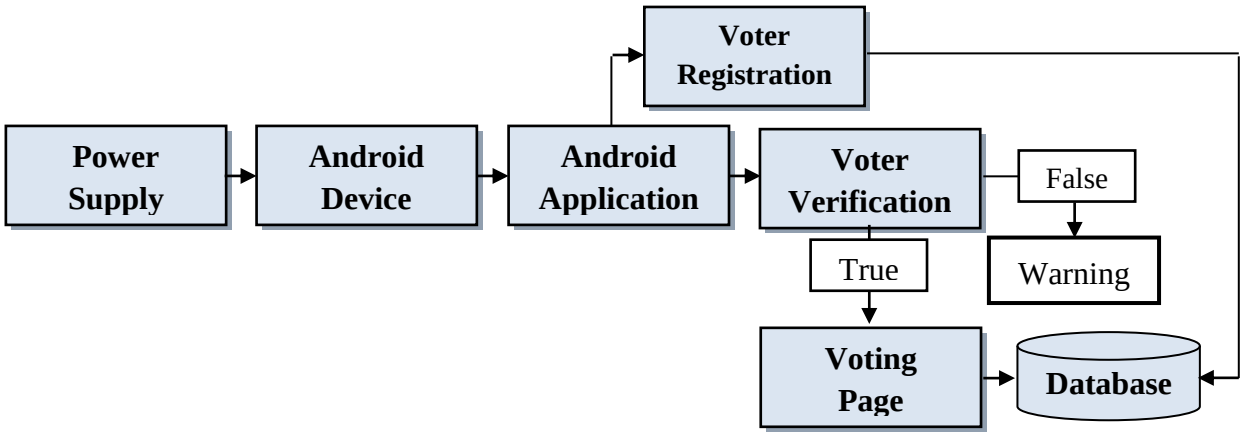


Figure 1.7: Conceptual Overview Of E-voting System

XII. SOFTWARE ARCHITECTURE:

Different software's are used in this work in order to build the E-voting system based on android application. The block diagrams of conceptual overview of E-voting system show the software's technical processes

Database Block Diagram:

The database for the E-voting system is developed using SQ Lite.

The algorithm for the fingerprint scanning and verification is pre-defined in the SDK (software development kit) of fingerprint scanner and is based on android JAVA code. The system reads the fingerprint with accuracy and performs some steps by using algorithm. Some of the steps done by the algorithm are:

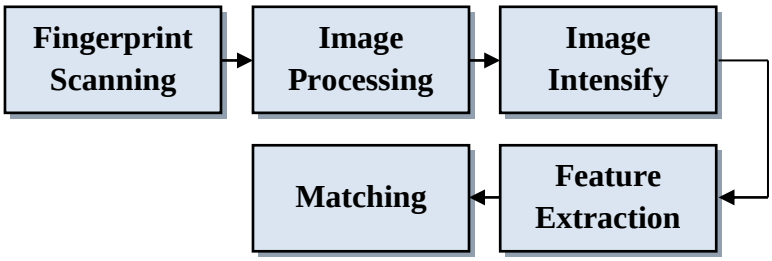


Figure 1.8: Fingerprint Algorithm

- **Integrated System:**

An Integrated system work flow is shown in the figure below:

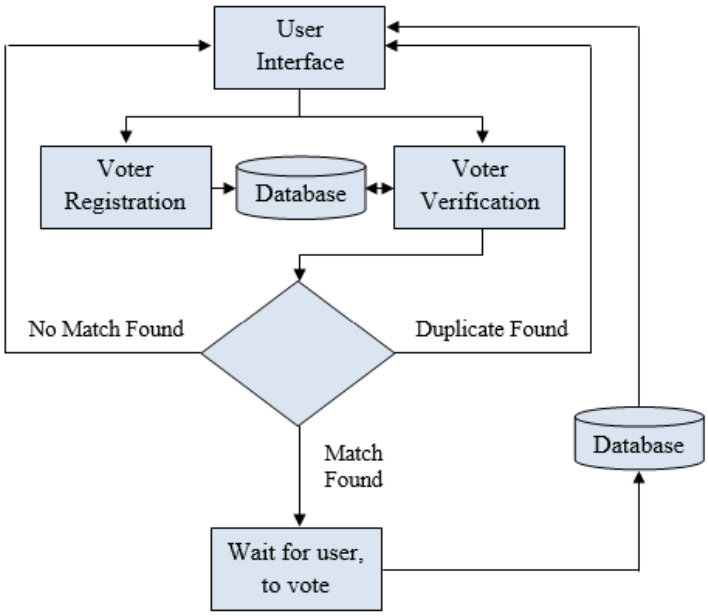


Figure 1.9: Integrated System Workflow

- **GUI Design and Layout:**

The graphical user interface (GUI) provides friendly front-end environment to make the voting process easier for the voter. The Android framework gives the flexibility for managing and declaring application's interface. Using an Adobe Photoshop, the GUI can be designed easily by the use of dragging and clicking on different images such as splash screens, customized buttons, login box etc. The file will be stored as (.psd) format file.

Then, the Layout is declared in XML including the screen elements with their properties and then the code is added to modify the objects and state of the screen. Declaration of layout in XML makes for better and easier visualization of the of UI (User interface) structure. The figure below shows XML code for making a user interface

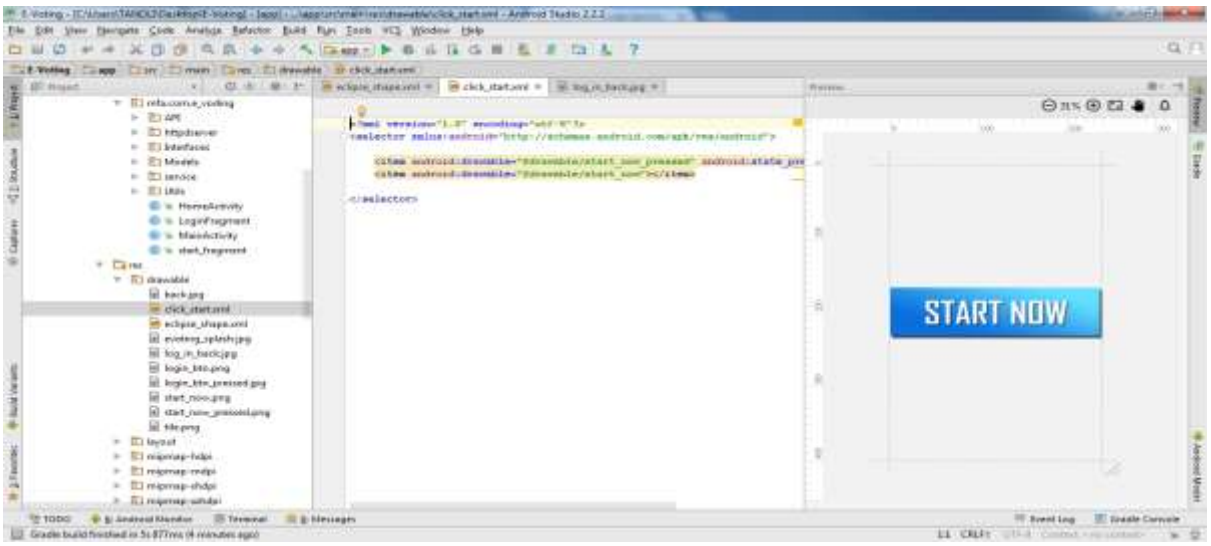


Figure: 2.0. Interface Design using XML

System Development:

System development is the collaboration of devices and tools used with the Software and hardware modules. The elaboration of these tools from the functional point of view is explained below:

XIII. ALGORITHM FUNCTIONALITY

An algorithm is very essential because it actually authenticates the voters fingerprint. This algorithm includes image processing, enhancement and feature extraction. The matching process starts by scanning the fingerprint of the voter then; the algorithm intensifies the image and extracts the image characteristics. These characteristics are converted into fingerprint template and then the template will be matched with the same template which is stored in a database. The block diagram below shows the detailed algorithm functional process:

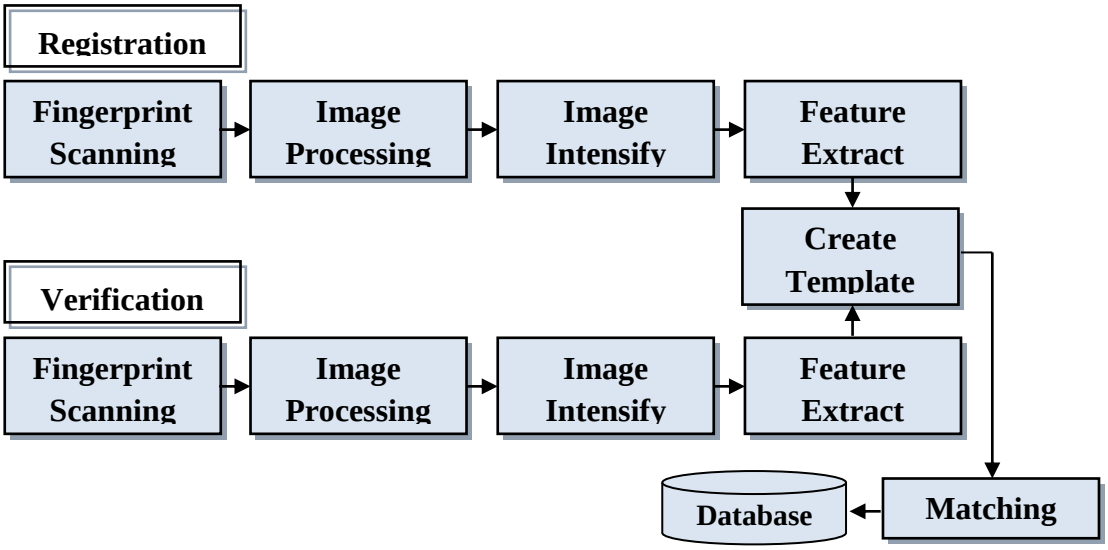


Figure: 2.1Algorithm Functionality Block Diagram

XIV. DATABASE

The database is one of the core parts of the system which is used to contain all the data regarding the voter such as (name, number, fingerprint template or code etc.). It is also used to verify the voter's fingerprint to determine if the voter is eligible or not. It also contains the overall voting results.

The above system designing section describes the conceptual and functional overview of components. Now, the section below describes the overall system functionality by block diagram.

System Functionality:

System functionality diagrams demonstrate how the data operates by an application that flows through the different processes. It also shows the two levels of data flow block diagram of voting system.

Overview:

The voting system contains a fingerprint scanner, and Tablet as a user interface. There are two modes of authentication; one is for the administrator that handles the registration panel to activate the voting process by login through his ID and password and the second mode controls the process of verifying the eligibility of the voter by taking the fingerprint template and matching or comparing it with the database's fingerprints template; if the system finds similar template in the database then, the voter is eligible to cast the vote, if it is not found, then the system will show a message or prompt on the screen and all the votes will be stored in the database. At the end of the voting process, the election result can be checked through result panel. The below diagrams show the functional overview of the whole system:

Low level Diagram:

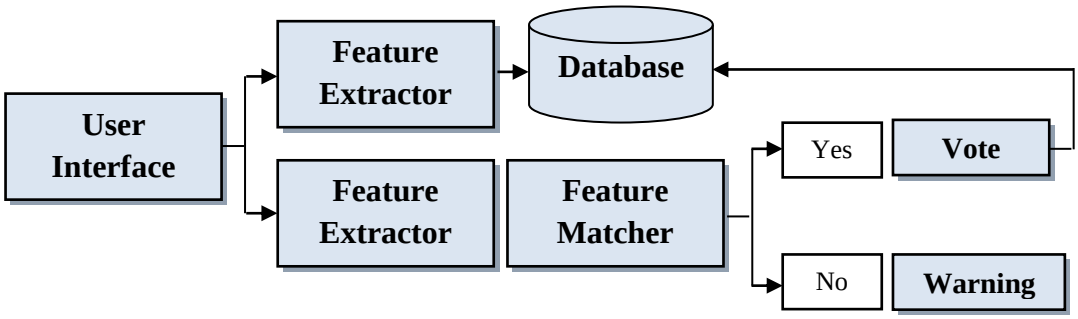


Figure 2.2: System Functionality Block Diagram

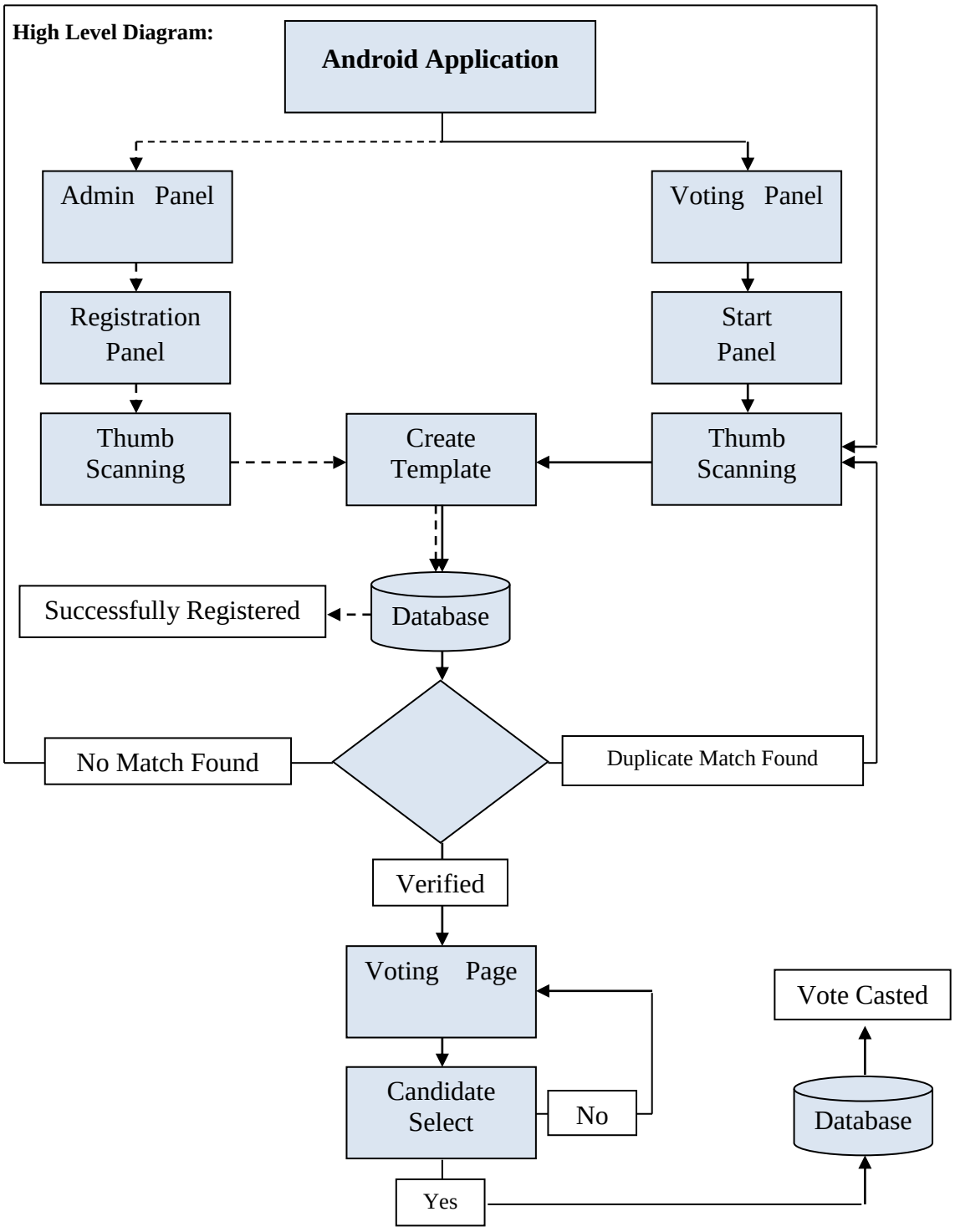


Figure 2.3: System Functionality Block Diagram

XV. IMPLEMENTATION AND RESULTS

System implementation has to do with the conversion of the system's conceptual and logical developments into a physical implementation. Implementation activities include coding, debugging, testing, installation, documentation, training and user manual. To implement this, project Android Studio was installed on the system.

HARDWARE REQUIREMENTS

The specifications below are the minimal requirements for the hardware necessary for this system to be implemented on:

- 2GB Random Access Memory (RAM)
- Internet connection

- Android 10.0

SOFTWARE REQUIREMENTS

The software required to develop this work are:

- Mobile Application

XVI CHOICE OF PROGRAMMING LANGUAGE

The choice of programming language used depends on the suitability of the language's attributes to the scope and usage of the system development. Kotlin mainly targets the JVM, but also compiles to JavaScript for native iOS apps sharing business logic with Android apps), Language development costs are borne by Jet Brains, while the Kotlin Foundation protects the Kotlin trademark It is also a general purpose language that separate use to make lots of projects, including Graphical User Interfaces(GUI). It is an easy language to grasp and it is a great start before you dive into more complex web languages like HTML, CSS, SQL and Javascript. KOTLIN was used in this system for flexibility sake and easy transfer of the system from one person to another and also for easy updating of the system. The database used is FIREBASE, The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync data between your users in realtime. These servers are the database of the application, this is what holds the authentication of user in the app; a user that registers on the app has his data authenticated through firestore.

XVII. TESTING

Different units of the system were first tested for performance and they gave the desired output, the system was then tested as a whole and it gave the expected results.

SYSTEM MODULE IMPLEMENTATION

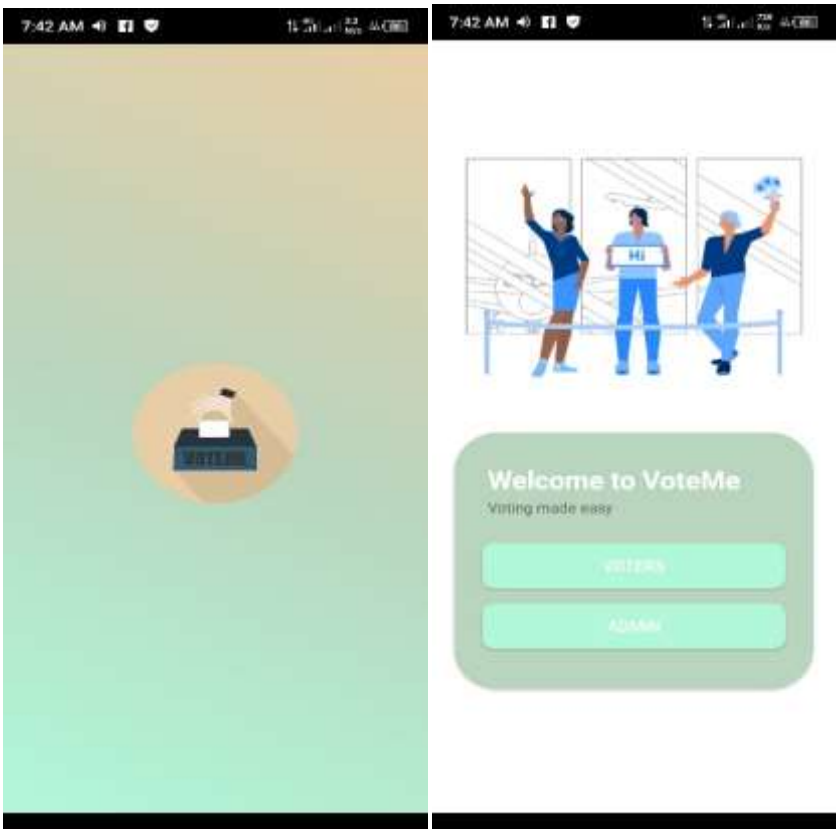
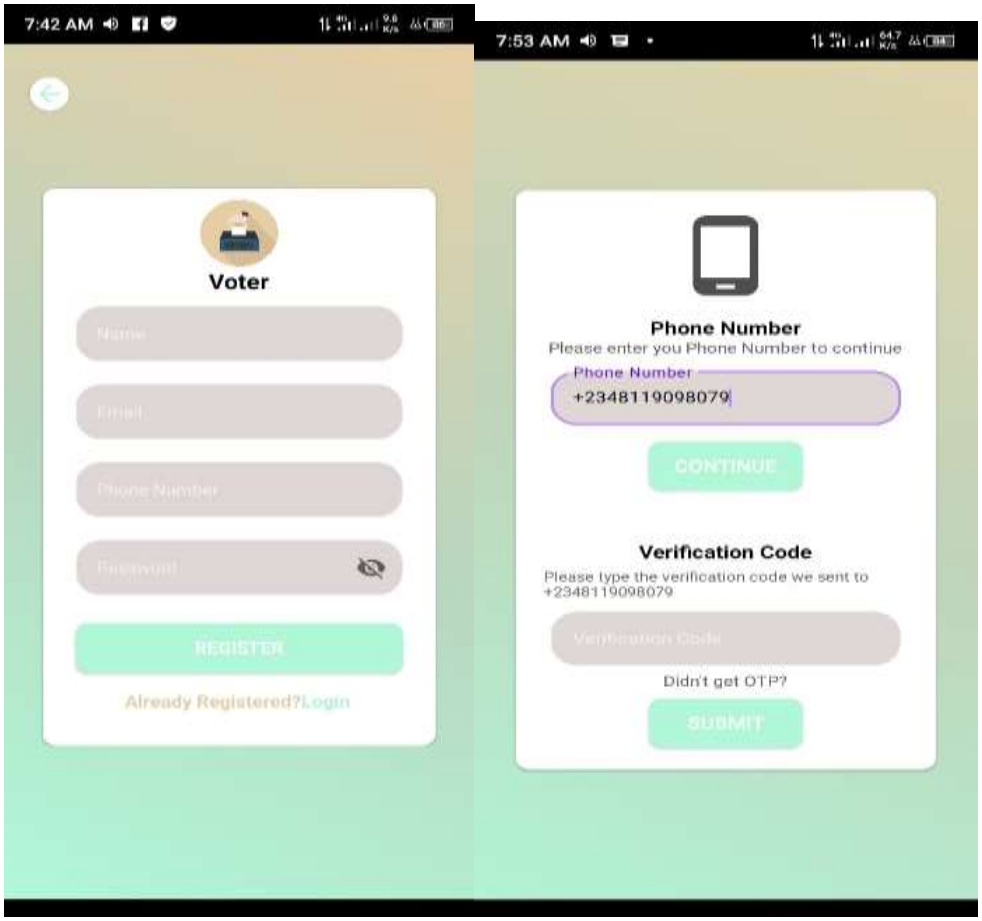


Figure 2.4: is the implementation of the Sign-up module.



- **Login Module: Figure2.5 is the implementation of the login module.**

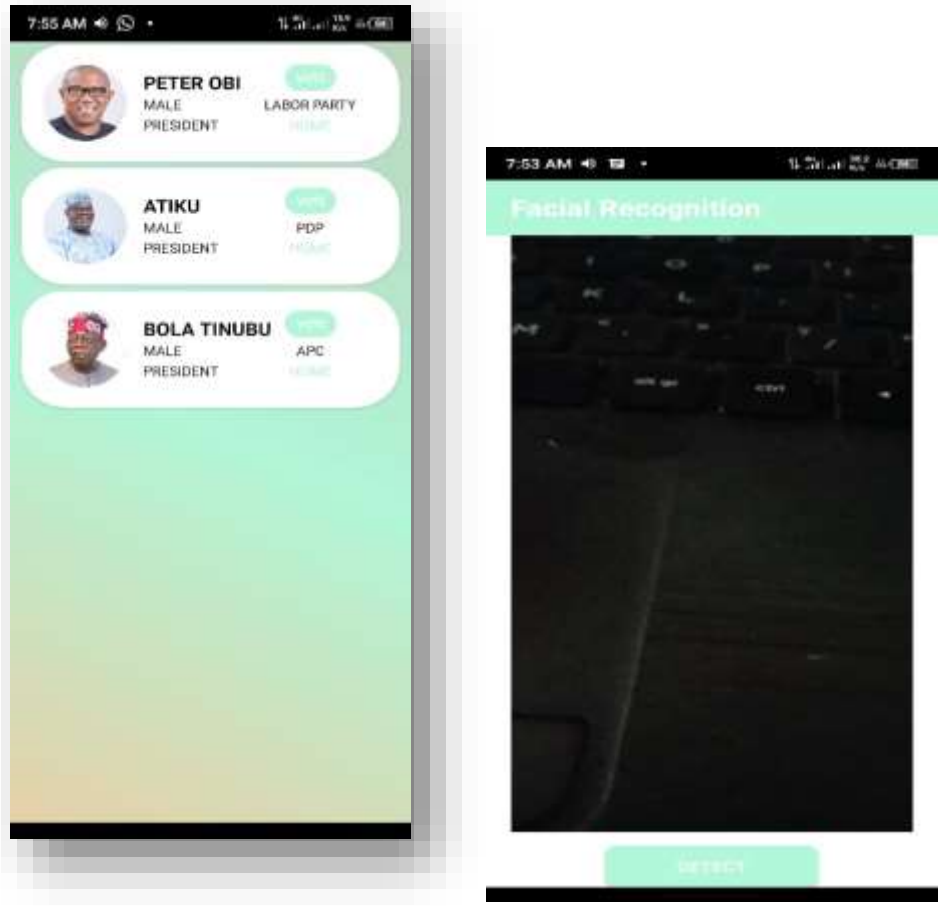


Figure 2.6 is the implementation of the voting and face recognition module.

SUMMARY

This E Voting system will manage the Voter's information by which a vote can login and use his voting rights. The system will include all features of voting system. It provides the tools for maintaining voter's vote to every party and it counts the total no. of votes of every party. There is a DATABASE which is maintained by the Admin in which all the names of voters with complete information are stored. Any user who is above 18 years registers his/her information on the database and when he/she wants to vote, he/she has to login by his id and password and can vote to any party only once. Voting details store in the database and the result is displayed by calculation. By online voting system, percentage of voting increases. It decreases the cost and time of voting process. It is very easy to use consumes less time and also it is very easy to debug.

RECOMMENDATION

The objective of this work is to review the existing/current system of voting in Nigeria

And also to provide a solution that can enhance and promote fairness in elections that

Are held in country rather than continue using the existing system which is regularly marred

With irregularities in the voting process. The work illustrates that the system can be used

Even in elections held in universities to avert any contention and

Manipulation of results through acts such as voter bribery, voter fraud and ballot snatching.

CONCLUSION

The manual system of voting in Nigeria has failed to tackle the basic issues necessary for a clean and trusted voting environment which has evidently driven some of its citizens to apathy. The E-voting system was invented checks to solve the problem of distances bottlenecks, unnecessary time delays, with very secure and accurate recording of votes. The system has been thoroughly tested in voting accuracy, ruggedness, responsiveness, battery life expectancy, and security by means of simulation and mini voting sessions and ascertained to be a successful one. It is seen that the system is fault tolerant at all end points (registration, voting platform and the server). The voting device can last for more than 6 hours which is very sufficient for a quick system like ours. This system will provide boundless voter participation in remote areas with very little or no cost on the voter's greatly reducing apathy. Further improvements can be done on the system to increase the credibility of the votes and further reduce proximity issues.

REFERENCES

1. Paul David Webb, Roger Gibbins, Heinz Eulau, "Election", Encyclopaedia Britannica. [Online]. Available: https://www.britannica.com/topic/election-political-science. [Accessed: Aug. 05, 2019].
2. Toba Paul Ayeni, Adebimpe Omolayo Esan, "The Impact of ICT in the Conduct of Elections in Nigeria", American Journal of Computer Science and Information Technology, February 09, 2018 . [Online]. Available: http://www.imedpub.com/articles/the-impact-of-ict-in-the-conduct-of-elections-innigeria.php?aid=22211. [Accessed: Aug. 05, 2019].
3. ACE, E-voting, The Electoral Knowledge Network, n.d., [Online]. Available: http://aceproject.org/ace-en/focus/e-voting/default. [Accessed: Aug. 07, 2019].
4. Victor Ekwealor, Inside Nigeria's first ever electronic voting exercise in Kaduna State, Techpoint Africa, May 14, 2018, [Online]. Available: https://techpoint.africa/2018/05/14/kaduna-electronicvoting/. [Access: Aug. 10, 2019].
5. Seth Rosenblatt, Jason Cipriani, Two-factor authentication: What you need to know (FAQ), CNET, June 15, 2015, [Online]. Available: https://www.cnet.com/news/two-factor-authentication-what-youneed-to-know-faq. [Accessed: Aug. 10, 2019].
6. Alexandra Petru , What is two-factor authentication (2FA)?, iPhone Backup Extractor, Oct. 08, ș, What is two-factor authentication (2FA)?, iPhone Backup Extractor, Oct. 08, 2017, [Online]. Available: http://www.iphonebackupextractor.com/blog/2016/jun/3/extract-data-twofactor-authentication/. [Accessed: Aug. 11, 2019].
7. van Tilborg, Henk C.A.; Jajodia, Sushil, eds. (2011). Encyclopedia of Cryptography and Security, Volume 1 . Springer Science & Business Media. p.1305.
8. Jason Cipriani, Seth Rosenblatt, Two-factor verification: What you need to know (FAQ), CNET, June 15, 2015, [Online]. Available: https://www.cnet.com/news/two-factor-authentication-what-youneed-to-know-faq. [Accessed: Aug. 10, 2019].
9. Alexandra Dmitrienko, Christopher Liebchen, Christian Rossow, and Ahmad-Reza Sadeghi "On the (In) Security of Mobile Two-Factor Authentication" Lecture Notes in Computer Science, pp. 365-383, Nov 2014.

10. Alireza Pirayesh Sabzevar, Angelos Stavrou "Universal Multi-Factor Authentication Using Graphical Passwords", Proceedings of the 2008 IEEE International Conference on Signal Image Technology and Internet Based Systems. pp. 625-632, 2008.
11. Olufemi Sunday Adeoye "Evaluating the Performance of two-factor authentication solution in the Banking Sector" IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 4, No 2, July 2012.
12. Rahul Kale, Neha Gore, Kavita, Nilesh Jadhav, Swapnil Shinde " Review Paper on Two Factor Authentication Using Mobile Phone" International Journal of Innovative research and Studies, Vol. 2, Issue 5, pp. 164 - 170, May 2013.
13. van Tilborg, Henk C.A.; Jajodia, Sushil, eds. (2011). Encyclopedia of Cryptography and Security, Volume 1 . Springer Science & Business Media. p.1305.
14. CardLogix Corporation, Smart Card Basics, CardLogix Corporation, 2010. [Online] Available from: http://www.smartcardbasics.com [Accessed 1/05/19].
15. Tarun Agarwal, How does the Smart Card Works?, ElProCus, n.d. [Online] Available from: https://www.elprocus.com/working-of-smart-card/ [Accessed 1/05/19].
16. MichaL Bairanzade, Smart card integration and specifications, ASPENCORE, 2002. [Online] Available from: https://www.eetimes.com/document.asp?doc_id=1200923 [Accessed 1/05/19].
17. Wikipedia, Smart card, Wikipedia, Wikipedia, n.d. [Online] Available from: https://en.wikipedia.org/wiki/Smart_card [Accessed 29/04/19].
18. D. Maio, and D. Maltoni, "Direct gray-scale minutiae detection in fingerprints", IEEE Transactions Pattern Analysis and Machine Intelligence, vol. 19(1), pp. 27-40, 1997.
19. S.L.Nita, M.I.Mihailiscu, V.C. Pau," Security and CryptographicChallenges for Authentication Based on Biometrics Data", www.mdpi.com/journal/cryptography, pp.1-22, 2018,
20. K. Nallaperumall, A. L. Fred and S. Padmapriya, "A Novel for Fingerprint Feature Extraction Using Fixed Size Templates", IEEE 2005 Conference, pp. 371-374, 2005.
21. M. Egele, D. Brumley, Y. Fratantonio, and C. Kruegel, "An empirical study of cryptographic misuse in Android applications," in Proceedings of the ACM SIGSAC Conference on Computer & Communications Security (CCS 2013), pp. 73–83, ACM, Berlin, Germany, November 2013.
22. Kumar,R. Chandra,P. Hanmandlu, M.,"Local directional pattern (LDP) based fingerprint matching using SLFNN", IEEE Second International Conference on Image Information Processing (ICIIP), Pages: 493 - 498, DOI: 10.1109/ICIIP.2013.6707640, 2013.
23. N. Vurukonda and B.T. Rao, "A Study on Data Storage Security Issuesin Cloud," Computing. Procedia Computer Science, 92, pp. 128-135, 2016.
24. Ruxandra Burtica, Eleonora Maria Mocanu, Mugurel Ionuț Andreica, Nicolae Țăpuș, "Practical application and evaluation of no-SQL databases in Cloud Computing", IEEE 2012
25. Hoxmeier, J. A., &DiCesare, C. (2000). System response time and user satisfaction: An experimental study of browser-based applications. AMCIS 2000 Proceedings, 347.