A MOBILE VOTING APPLICATION USING BVN AUTHENTICATION

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DECLARATION

I hereby declare that this project has been written by me and is a record of my own research work. It has not been presented in any previous application for a higher degree of this or any other University. All citations and sources of information are clearly acknowledged by means of reference.

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CERTIFICATION

This is to certify that the content of this project entitled '**Mobile Voting Application Using BVN Authentication'** was prepared and submitted by **AGBABIAKA, ADEWALE AYOMIDE** in partial fulfilment of the requirements for the degree of **BACHELOR OF SCIENCE IN COMPUTER SCIENCE.** The original research work was carried out by him under by supervision and is hereby accepted.

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DEDICATION

I dedicate this project to my parents, Mr. and Mrs. Agbabiaka, for their unending support and assistance in facilitating all of my endeavours, and to my father in heaven for assisting me in achieving all of my academic, career, and family goals, as well as to my hardworking and motivating supervisor for all of her assistance.

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ABSTRACT

In Nigeria, the conventional voting system has proven inefficient as a means of carrying out democratic electoral practices. This study aims to create a secure and convenient voting system with the following specific objectives which are to Identify and plan requirements for the users of the mobile voting application, and its protocols, system design specification, authentication and database of the voting application, implement, secure, and test the application. The methodology used in this study includes; research to be carried out to identify the voter and administrator requirements and operations, analysis and identification of functional and non-functional requirements of the system, system design specification using UML diagramming tools. This study results demonstrated a mobile voting application using react native framework that authenticates users by using a bank verification number as a key unique voter identifier and confirms users using an OTP one-time password delivered by email confirmation. After installation and registration, this application can efficiently store user credentials, voter ballot results, poll records as well as others, all of which are maintained in the database. Recommendations include training of voting officials on database management and automation, training voters on operating smartphones and modern electoral practices. This project can be used to further automate voting processes in organizations and higher institution. This study's limitations include limited time, resources and finances to completely execute the project and further improvement include cloud computing, central database management system and further automation of operations for institutional integration.

Keywords: electronic voting, information and Communication Technologies, the Independent National Electoral Commission, polling server, voting system.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Voting is a vital component of any governance. It is the process through which a country's citizens express their opinions to select the best candidate to govern the people, it could also be defined as the process by which the general public chooses the winner of a reality television program. According to (Thakkar et al., 2016), voting has been around for a long time, and the mechanism of voting has evolved. In several nations, voting has shifted from paper ballots to more computerized methods, such as online voting. Since the creation of the Independent National Electoral Commission (INEC), Nigeria has used a manual voting system that involved the use of ballots, which are devices used to cast votes in elections and can be found as a piece of paper used in secret voting during elections. But (INEC) has recently introduced a system that requires the use of a Private Voters Card (PVC) to verify voters using a card reader. On Election Day, every registered voter must go to the polling station, obtain information from poll officials about the voting procedures, and vote in secret. In Nigeria, the mobile app voting system has never been completely applied and fully deployed. Conducting free, fair, and effective elections in Nigeria has become nearly impossible, significantly impacting the country's economic and socio-political well-being as stated by (Emeka, 2016). Information Communication Technology (ICT) has taken centre stage in today's globalization since nothing can be organized and completed with higher success without it. This has prompted it to be used in electoral processes in several nations throughout the world according to (Njoku, Amaefule, Ikenna, & Janefrances,

2018)Electronic voting, as opposed to traditional paper voting, is growing more common around the world. This research attempts to create a mobile voting system that can withstand various hacking and fraud techniques. To overcome numerous obstacles and to reinforce the verification and calculating of findings, the project advises utilizing a one-time password. According to the system, the voter ID, bank verification number, and one-time password (OTP) are utilized for authentication. implemented by (Thakkar et al., 2016). This study involves the use of Bank Verification Number (BVN) and Voter Identification and also the one-time password (OTP) sent through email or SMS for user authentication. The voter's information, as well as their preferred casted vote, will be submitted to the Independent National Electoral Commission's (INEC) database. This process would help Nigeria registered voters vote in their respective constituencies from the comfort of their location, speeding up the voting and election process. This android application will enable registered voters to log on to the system using their voter ID, Bank verification number (BVN) and password to be further authenticated. When the voter's Voter ID Password matches the information in the database, then the voter is given the option of receiving an OTP through SMS or email. This OTP will be confirmed and encrypted. After that, the voter's dashboard will display a candidate list where they can vote for their preferred candidate and political party. After voting, all the votes are sent to the database and after confirmation, the voter is notified that his/her voting process is completed, then the user's account is disabled to prevent the user from voting more than once as explained by (Thakkar et al., 2016). This project reduces the risk of hacking and other attacks and frauds that have previously occurred in electronic voting machines and

manual ballot paper voting processes by being uniquely self-contained during operation which means it performs a single specific function (i.e., Databases).

1.2 Statement of the problem

In this current era, where practically every work and daily activity is mechanized and made easier by the use of technology, a simple, dependable, secure, and trustworthy electronic voting system has become a requirement. In a country like Nigeria, implementing a completely functional mobile app voting system would be tough. In Nigeria, the traditional voting system involved the use of ballot boxes, polling booths, and manual counting, which was inefficient. This antiquated system has a variety of shortcomings, including slow computational speed and counting difficulties, as well as other topics that dominate Nigerian elections, such as defence, the economy, and corruption, according to (Bone, 2020) None of these candidates inspire a large number of people in the country. The turnout is expected to be low, in particular among young people, and many Nigerians feel they choose between two bad candidates. If Nigerians think the next presidential candidate will enhance the country's position on the three above-mentioned issues, the elections are probably decided. The Independent Electoral Committee has recently developed a mobile app to improve voter education and access to information for users. (inecnigeria, 2019), this mobile app was only made for this purpose and has barely been put into use since its deployment. Since the establishment of INEC, there has not been a consistent, trusted, secure, and efficient method of voting. The major influences on the introduction of the electronic voting system are the desire to recover the lost integrity of INEC, to increase the veracity of the results of the elections and the search

for an excuse to manipulate the results of the elections by collaboration with the ruling party , as specifically stated by (Idris & Yusof, 2015). According to (Adebayo, Ugiomoh, & AbdulMalik, 2013) another factor is the urge by the citizens to elect credible and committed leaders for infrastructural development and the need to curtail post-election violence that has claimed many innocent lives in the past election.

1.3 Aim and objectives

This study aims to create a secure and convenient voting system with the following specific objectives:

a. Identify and plan requirements for the users of the mobile voting application

b. Identify requirements for the voting application system software and its protocols

c. Specify the system design including the authentication and database of the voting application

d. implement, secure, and test the application

1.4 Methodology of Study

Concerning the below-stated objectives the following methods will be used;

a. Research will be carried out to identify the voter and administrator requirements and operations

b. Analysis and identification of functional and non-functional requirements of the system

c. System design specification using UML diagramming tools to describe the system such as use case, activity, and sequential diagrams

d. Backend implementation will be modelled using firebase as the (no-SQL) database

e. The authentication of users using email will be done using firestore

f. Front end implementation using react native cross-platform mobile application development framework will be used to develop the application which will be used by the voters.

g. Unit, integration, and acceptance testing will be done using jest which is a react native testing software.

1.5 Scope and limitations of the study

The research work encompasses all fields related to electoral practices, The Independent National Electoral Commission, mobile app development frameworks, database management, and all information on electronic voting and security, authentication, and verification of users. This research aims to create a mobile voting system for presidential, senate, federal house of assembly, and governorship elections that will efficiently collect, count, and cast votes, as well as save all registered voters' credentials and results to the INEC database. These are some of the drawbacks that could be faced due to the features and characteristics of this mobile app voting system.

    a. The system may require additional authentication and registration

b. Only bank customers with bank verification numbers can use this system

c. Only registered citizens can use this application

d. Voters can only vote using a smartphone with internet access

1.6. Significance of the study

This research work is beneficial to the society and economy of Nigeria as a whole, it plays a very crucial role in societal development and democratic practices. The Electronic voting system serves as a modernized method of voting unlike the manual ballot paper system, the former provides some level of automation, trust, security, and convenience. In order to improve participation, dependence, access, transparency, coherence and security, it meets Nigeria's requirements. This study is specifically imploring the use of the existing mobile voting app development frameworks to develop an efficient platform for secure voting, due to the nature and reliability of the mobile smartphone as well as its characteristics, it serves as a better and more convenient system. If this voting system is properly implemented, it can serve as a modern and developed alternative for efficient democratic voting in Nigeria. It will also address existing paper ballot system issues medium for electoral practices. It meets the automation requirement more responsibly and efficiently by using technology. It could reduce corruption and ensure economic growth and ultimately develop an accountable trusted and secure voting system and environment to encourage citizenship participation. More so it could resolve counting errors, increase computational speed to establish a truly free and fair electoral process in Nigeria. This

would increase voter willingness to participate in elections and, as a result, lead to the holding of a credible election.

1.7 Definition of terms

• **National Identity Management Commission (NIMC)**: In Nigeria, the national identity issues shall be regulated by services relating to registration and issuance of the National Identity Number (NIN), issuance of national e-ID cards and verification of IDs.

• **The Bank Verification Number (BVN):** Each individual in the Nigerian banking industry has a unique 11-digit identity. The BVN ensures that you are securely involved in transactions everywhere in Nigeria.

• **The Independent National Electoral Commission**: The mission of INEC is to act as a free, fair and believable election in Nigeria to ensure long-term democracy in the country, an independent and effective EMB. The vision of INEC is to be one of the world's largest electoral bodies, fulfilling Nigerian people's aspirations.

• **An (EMB)Electoral management Body**: is an organization or agency that is exclusive to manage some or all the elements that are essential to conduct elections and direct democratic instruments and has a legal responsibility for them.

• **A voter identification law**: is a law requiring an individual to show some form of voting ID.

• **Permanent voter' cards (PVCs):** is used to verify electoral accreditation

• **Electronic voting (also known as e-voting):** Vote using electronic means either to support or to cast and count votes. E-voting may use standalone electronic voting machines (also known as EVM) or Internet-connected computers, depending on the particular implementation.

• **Polling server**: polling is a technique whereby the customer regularly requests new data from the server. Short polls are simply an AJAX timer which calls for fixed delays. Long polls are based on the Comet (i.e., server will send data to the client when the server event happens with no delay).

• **Information and Communication Technologies (ICTs)**: This term covers all communication technologies including, Internet, wireless networks, cellular phones, software, middleware, videoconferencing, social networking and other media apps and services, and includes a broader term for the information technology sector (IT).

• **Electronic voting**: a form of electronic mediated vote in which voters use an electronic system to make their selections.

• **Ballot paper system**: An open voting method, as opposed to a secret ballot, where the voting choices are confidential, is a vote method in which the voting is open.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this modern era, as the world constantly grows and evolves, technology has revolutionized how we perform our everyday activities including democratic and electoral practices. The use of mobile apps is one of the most efficient methods of delivering a service and its portability and security and is paramount in its delivery explained by (Philanthropies, 2021). Voting issues could be addressed by using smartphones as voting platforms. Distributed votes on mobile devices can increase voting participation, reduce election management costs and enable voters to interact with known technologies if properly implemented. Mobile voting refers to the opportunity to vote in any election using your smartphone, tablet, or another electronic device from anywhere. (Philanthropies, 2021) explains that voters can participate in an election from anywhere they have access to a cellular or WIFI network. (Zsolt Szolnoki, Szolnoki, & Staak, 2020) When and where ballots are made accessible is decided by election officials, and voters pick when and where they want to vote. Modern smartphones and mobile devices continue to improve identity verification features in terms of security. For enhanced protection, verification, and auditing, mobile voting can easily be complemented with a paper record. (Philanthropies, 2021).

2.1 Elections and voting

elect indicates "to choose or make a decision," other types of ballots, such as referendums, are frequently referred to as elections, particularly in the United States. According to (maxweber, 2021) An election is a formal collective decision-making process in which a population selects one or more people to serve in public office. Elections have been the main way contemporary representative democracy worked since the 17th century. Elections may be held to fill positions in the legislature, the executive, and the judiciary, as well as regional and municipal government. This procedure is employed by many other private and corporate organisations, from clubs to voluntary associations and companies. (maxweber, 2021).

2.1.1 Types of elections

    a.   Presidential elections

Any head of state whose formal title is President is elected in a presidential election.

    b.   Local Government elections

Many regions of the world have local elections to elect local government officials such as mayors and councillors. "Municipal elections" refer to elections for offices inside a city or town. Their appearance and behaviour differ greatly between jurisdictions.

    c.   Parliamentary Elections

an election to choose members of a national legislature election to choose members of a national legislature

d. Governorship Elections

The governor is the elected leader of a state in a country, therefore anything gubernatorial having to do with governors and their administration.

2.2 Electoral systems

This means to give or register a vote. It is used to convey a wish to take a particular course of action. to utilize a vote to make (someone) acquire or lose a certain position or honour. According to (Htet, ne oo; Aye, Moe Aung, 2014). Voting in favor of electing national legislators. Voting is a means to reach a consensus or express an opinion of a group, such as a meeting or an electorate, after discussions, debates or elections . Voting elects high-ranking officials in democracies.
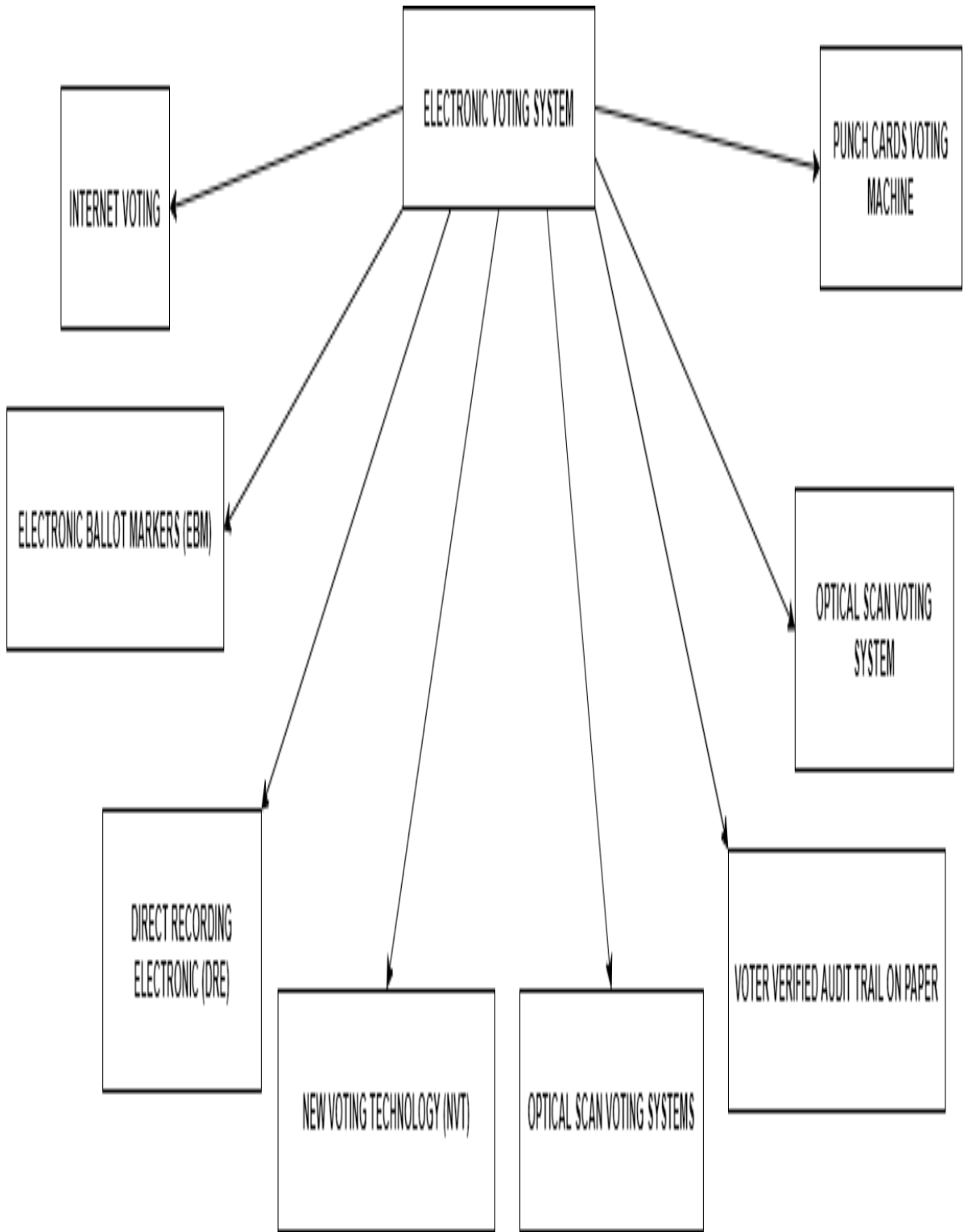
Fig 1.1: Types of Electronic voting systems

Electronic voting is becoming increasingly common around the world, replacing traditional paper voting. Geographically remote regions can become closer and more easily accessible thanks to advances in communication technology. (Htet, ne oo; Aye, Moe Aung, 2014) explained that People who are physically unable to arrive at the polling place or who are absent from the voting booth can cast their vote using electronic voting equipment. Only a basic comprehension of how to utilize electronic voting equipment or a website to vote electronically is required. People can now cast their votes even via their mobile phones, thanks to new technologies according to (Htet, ne oo; Aye, Moe Aung, 2014)

2.2.3 Electronic voting benefits and disadvantages

Benefits of Electronic Voting Electronic voting has several advantages which include the following:

a. Voting provides several advantages over traditional voting methods. Less cost, faster tabulation of results, more accuracy, and decreased danger of human and mechanical errors are just a few of the benefits. It also improves accessibility for individuals with impairments and delivers ballots in many languages (Sylvester, 2013).

b. Electronic voting will improve voter convenience and trust in election outcomes accuracy. Electronic voting can make recording and tallying votes more convenient, efficient, and secure. It can be used for a wide range of elections, from small-scale campus elections to national elections on a big scale (Sylvester, 2013).

Disadvantages of Electronic Voting;

a. Electronic voting, on the other hand, carries the potential of widespread and undiscovered fraud. One of the most significant issues in computerized voting is security. While online voting may appear to be simple and convenient, security concerns remain a serious worry according to (Sylvester, 2013).

b. Because of the numerous computer viruses and unpredictably malfunctioning computers, it is difficult to assure that each computer used to vote is safe and secure. Aside from computer concerns, ensuring the location of online voting poses a significant barrier in and of itself. Hundreds of attack tools and viruses are currently available that, if utilized, could easily corrupt the internet voting network (Sylvester, 2013). Because ensuring security is so tough, perhaps online voting security issues are simply too hazardous according to (Sylvester, 2013). Even though the method has been stated to have some advantages, it has not been denied that the system has some flaws of its own stated by (Sylvester, 2013).

2.3. Criteria for assessing electoral systems

Scholars proposed a wide range of criteria for the assessment of electoral systems. In this paper, we are reviewing three of the most frequently advocated criteria, namely: fair parties' representation, good governance, and/or appropriate local representatives. According to

which election systems should be developed. I would like to emphasize that these three requirements are related to three types of responsibility: accountability to their supporters of the parties; accountability to citizens of government and responsibilities of MPs to their supporters which cannot be maximized simultaneously.

2.3.1 Electronic voting security requirements

The sensitivity of the electronic voting scheme also influences the security requirements that must be met; for example, the security requirements for an electronic voting scheme used to elect a president at a university or the winner of a talent show (Nigerian idols, Big Brother Naija) are not the same as those for a large-scale e-voting scheme according to (Augoye, 2013). The security needs for a large-scale general election are the topic of this thesis. Many of the suggested electronic voting methods do not meet all of the required characteristics for an e-voting scheme, These requirements are, in many cases, inconsistent. For example, it seems difficult to achieve individual verification and receipt-freeness simultaneously according to (Augoye, 2013). Various assumptions may influence the security requirements that these electronic voting techniques may require.

2.4 Electronic Voting System Security

Security Criteria for Electronic Voting Systems; The protection of elections and voting infrastructure against cyberattacks or cyber threats, such as tampering with or penetration of voting machines and equipment, Networks and processes of electoral offices and registration database are called electoral cybersecurity or electoral security . (Javaid, 2014) It stated that the purpose of electronic voting is to accurately and reliably record voting by electors to ensure a fair and transparent voting process . According to (Neumann 1993), to

ensure the integrity of the election process, electronic voting systems should adhere to a few key principles.

2.5 Electronic voting authentication methods

Electronic voting systems face several challenges that can determine whether they succeed or fail; Security and privacy are the most important issues of all, especially how people voting are legitimate voters and not somebody else . (Rao, Patil, & Deep, 2011) explained that Eligibility, authentication, privacy, robustness, and fairness are some of the security requirements that an electronic voting system must meet. Eligibility ensures that only eligible voters are allowed to vote during the election period. Authentication ensures that the person voting is the correct person and not someone else. Voter privacy allows voters to vote in a highly secret manner, with their personal information and voting process information is kept private and unavailable to others. The term "robustness" refers to the ability of an electronic voting system to withstand attacks, fraud, and disruption. Finally, only announcing vote results at the end of the allowed voting period is fair. (Rao, Patil, & Deep, 2011) explained that there are a variety of authentication schemas and methods available, which can be divided into three categories: knowledge-based methods, token-based methods, and biometrics-based methods

a. Knowledge-Based Methods: Methods based on a person's knowledge, often known as password-based methods, are based on that person's knowledge. A password or a PIN are examples of what a person knows (Rao, Patil, & Deep, 2011) This chapter describes various possible electronic voting systems using authentication methods based on knowledge.

b. Token-Based Methods: Using token-based strategies rather than knowledge-based methods can be more effective. Even while employing token-based approaches has various advantages, including the possibility to produce a more secure procedure than using merely passwords, knowing the user's password is required if the token is stolen, resulting in two levels of protection. On the other hand, consideration of token attacks and the high expense of obtaining high-quality token readers should be given further thought according to (Rao & Patil, 2011).

c. Methods based on biometrics: Biometric approaches are based on a person's bodily traits, which differ from one person to the next (Rao & Patil, 2011; Deep, 2011). Face recognition, fingerprint, iris, and vein biometrics have various advantages depending on their accuracy, uniqueness, and complexity, especially the fact that they cannot be stolen, altered, or used by anyone other than the owner or holder. The biometric-based technique is considered a secondary element in this study, which concentrates on the Bank verification number form of authentication.

2.6 OTP Verification

A one-time password (OTP) is a numeric or alphanumeric string of characters that is generated automatically and used to authenticate a user for a single transaction or login session (Kathleen & Ivy, 2018). A user-created password, One weak and/or reused on many different accounts, in particular, is less secure than OTP. OTPs can be used to replace or add authentication login data, providing an additional safety layer. The unique password removes key IT and security professionals facing password security vulnerabilities. They do not need to worry about password composition guidelines, bad and weak passwords,

sharing credentials or the reuse in several accounts and systems of the same password. (Kathleen & Ivy, 2018). Another benefit of one-time passwords is that they expire in minutes, preventing attackers from collecting and reusing the secret codes clearly explained by (Kathleen & Ivy, 2018).

2.7 Review of related works

The purpose of this section is highlighting other similar projects relating to the voting system proposed. This includes research that is based on and work that displays other proposed solutions to the same problem. This section covers the topics that are most closely relevant to the proposed system. Here I will better illustrate the present constraints and the need for new methods by explicitly describing earlier work and also the expertise of the field and other researchers to connect this current study to other scientific fields. In a research article by (Emad , Rawan, & Izzat, 2016) the major e-voting system types were states as the following: Mechanical punched cards, Optical-based systems, Using phones in e-voting systems, Fax-voting, E-mail voting, Direct E-voting, Internet voting. They also stated the methods of authentication Implementing electronic voting systems is fraught with challenges that could determine its success or failure; the most pressing of these is security and privacy, particularly how to ensure that the person voting is the real voter and not someone else according to (G. Rao et al., 2011). In a research work done by (Nwogu, 2015) the researcher addresses electronic voting in the Nigerian electoral system, modelling a two-level hierarchical design that incorporates national and state infrastructure. The majority of the electoral problems in the country are taken care of. The suggested system is a PNDRE Electronic Voting System (Public Network Direct Recording Electronic Voting System) with VPN built on the current GSM communication

network. In a research solution proposed by (Firas & Seifedine, 2012) this work discusses the design and development of a fingerprint-based web-based voting system to provide high performance and security to the voting system. The study also employed web technologies to make the voting system more practical. The new design proposes a university election to determine the president of the university. The planned EVS allows voters to scan their fingerprints, which are subsequently compared to images stored in a database. In the Research work carried out by (Asiamah, Adjei, prince, & Singh, 2019) it was explained that an election system that uses the internet to ensure access to a domain or website and allows qualified voters to cast their secure and secret ballot electronically Online voting is referred to. The vote takes place through the use of computerized technology. In the elections there was an attempt to develop a token-generated electronic voting system to verify the electorate. Once the form is completed, the voter will be able to vote for his favorite candidate. The system shall not allow multiple votes with the same token generated. This work discusses the design and development of a web-based fingerprint voting system that provides the voting system with high performance and security. The study also used web technologies to enhance the practice of the voting system. The new design proposes an election of the university's president . In a Project work carried out by (Adesuwa, 2015) proposed A biometric authentication online voting system shall be an electronic voting system aimed at using a unique minute of human fingerprint to enhance the confidentiality of the system's voters, while at the same time making the actual process available to all as widely as possible through Internet deployment. The two major problems that arose during the election of personnel at the University of Ibadan are expected to be addressed as a case study for the project.

In the research carried out by (WANG, 2014) he stated that Since voting is a simple and classic way of reflecting ideas from a group of people, this researcher's report explored social voting behaviours on mobile platforms. The researcher intended to learn how to improve the user experience of social voting by undertaking this research study the focus is on how a change in voting interface affects people's voting behaviour. This report gives two interfaces: one that ranks negative to positive measures, and another that ranks all positive measures.

Introduced in the work done by (Njideka , Umeh , & Chukwunonso, 2021) the study offered the notion of designing and implementing an online voting platform (OVP) for the Independent National Electoral Commission to combat fraud, malpractice, and blatant lack of transparency (INEC). This application, which was developed using Python, a strong online programming language, provides a fair, electronic, and readily manageable method of holding gubernatorial elections in Nigeria (in one of the states). In a research technical report proposed by (Augoye, 2013) The security needs of an electronic voting mechanism will be discussed. This report then talks about the Fujioka, Okamoto, and Ohta (FOO) system and the GSM voting method, and compares their security to the security requirements of an e-voting scheme to illustrate their flaws. In a research work carried by (Okpara, 2018) When it comes to voting, the majority of Nigeria's tertiary institutions have issues. This Android voting app aims to address these issues. The fact that voting was confined to methods such as voting papers, on-site counters, electronic voting etc. in these institutions was identified as rigging in elections, overpopulation of voting centres, inaccessible and unprotected polling arenas, inexperienced staff and other problems. Users of this software could have more time during voting sessions in university / school for

educational / polytechnical students. You will also be told how to use the app before the election, although this will be minimal because the application is user-friendly. . In a research work carried by (Adel, Yasmin, Dima, & Dalya, 2013) they introduced the M-Vote system, which is capable of completing activities that can reduce the risk inherent in the voting process, such as the addition, deletion, and adjustment of votes, to facilitate and ensure the integrity of elections. In another work proposed by (Krisheswari, Jagadeswari, & Kannan, 2018) Android application is used to create the Smart Voting System. The application contains the voting Aadhar ID and face picture to ensure that each voter's Aadhar ID and face picture are unique in the system. This technique reduces the manual work of the electoral committee. Authenticates voters to prevent re-examination and fraud and to facilitate the vote. It ensures that the voting process does not involve any unauthorized person. Using UIDAI (Unique Identification Authority of India) data and gathered data maintained in a centralized database, voter authentication can be done in real-time.

2.8.1 Summary of Related Works

The table below summarizes findings from other similar papers on electronic voting systems, as well as the various verification and authentication procedures employed and the proposed technique described.

Table 2.1: Summary of Related works

S/N	Author	Year	Title	Methodology

1	Emeka Nwogu	2015	Mobile, Secure E-Voting Architecture for the Nigerian Electoral System	GSM communication network
2	Firas & Seifedine	2012	New System of E-Voting Using Fingerprint	Fingerprint biometric technique
3	O.B. Asiamah, A. A. Adjei, Prince Yeboah, and K. Singh	2019	Design of a simple remote online voting system with token generation	Secure Token generation
4	Oluwatosin Adesuwa	2015	An online voting system with biometric authentication for UI elections	Biometric authentication
5	Jicong Wang	2014	Voting on a mobile platform	Registration authentication

6	Njideka Umeh , & Chukwunonso	2021	An Online Voting Platform for Nigeria's Independent National Electoral Commission	Voter id Authentication
7	Voke Augoye	2013	Electronic Voting: An Electronic Voting Scheme using The Secure Payment card System	The Secure Payment card System
8	Chinedu Reginald Okpara	2018	Development of a mobile android voting app for tertiary institutions in Nigeria	User ID authentication
9	Adel, Yasmin, Dima, & Dalya	2013	M-Vote: A Reliable and Highly Secure Mobile	Registration Authentication
10	Krisheswari, Jagadeswari, & Kannan	2018	A smart voting system using android	Biometric Registration Authentication

CHAPTER THREE

METHODOLOGY

3.1 System description

During the requirements collecting and analysis phase, it is critical to consider a product's desirability to buyers and market research. The collection and analysis of requirements are also known as requirements assessment and analysis. This makes sure the program meets the customer's needs . The purpose of requirement gathering is to collect as many known requirements as feasible. This is a significant and tough requirement-gathering technique. Electoral positions to which electoral candidates are elected using a set of procedures. You will learn about voting procedures in these procedures. Voters that vote using mobile phones from remote regions and also use email to prove their identification. How votes are transmitted, secured and maintained during the voting. Voters select the candidate and political party of their choice and their vote determines who wins the election. This chapter discusses the hardware and software environments and requirements. This chapter covers the hardware and software requirements, architecture diagrams, unified modelling language (UML), and a full description of the application's front end and backend.

3.1.1   System requirements specification

The proposed system has significant improvement over the traditional voting system with fewer limitations. The proposed system deals with all these traditional system's limitations

To determine the system requirement of the proposed system, there needs to be detailed documentation of the specification of the system. To verify that Voter success, the voter will receive a confirmation of casted vote success on his/ her email. To vote, the voter's eleven-digit bank verification number must match the one stored on the database The voter will communicate with the mobile app voter interface to select your candidate/party of choice.

3.1.2 Description and evaluation of the proposed system

In Nigeria, the existing voting method entails numerous activities; however, our proposed approach has reduced all activation to only three core operations:

a.   Registration and verification for pre-election

b.   Summary and Results of Voting and Elections

3.1.3 Analysis of the proposed system

This system uses a bank verification number to authenticate users (BVN). To overcome the authentication and verification problem, biometric information is added to the BVN.

This system authenticates, verifies voters, and meets all of its requirements by performing the following operations:

a.   Voter registration: The voter will sign up to be registered on the application.

b.   Identity verification: Once a user account has been created, the voter will be allowed to log in, and a one-time password will be issued to his/her email address to confirm the user's identity.

c.   Voter identification number: Each enrolled user will be assigned a unique voter id.

d.   BVN Verification: Obtains the Bank verification number and searches the database for a match.

e.   Vote interface: create a user interface that makes communication between the user and the system easier for the voters.

f.   Provides an effective means of notifying users when the voting process is complete.

3.1.4 The Proposed System's Design Goals

Vote interface: create a user interface that makes communication between the user and the system easier for the voters:

a. Voter confidentiality: No one should know how a voter voted.

b. Authentication of voters: Voters should be who they say they are.

c. Vote for individuality and originality.

d. Voter turnout accuracy. Each voter is followed from start to finish; thus, voter data may be accessed at any moment.

e. Votes are securely transmitted from the voter's app to the database server.

f. Voting services are terminated after each ballot is cast to prevent voters from voting more than once.

g. Below are some of the design objectives of the mobile voting system.

h. A voter should be able to double-check their vote before casting it.

3.1.5 The proposed bank verification number system

A Biometric technology with a secure unique identifier to analyse human characteristics as an enhanced form of authentication for real-time security processes. Every bank customer is given a unique number called a bank verification number. This study examines the Bank Verification Number, a centralized biometric identity system (BVN) The Bank Verification Number, or BVN for short, is a biometric identification system used by the Central Bank of Nigeria to prevent or minimize unlawful banking activities in the country. It is a modern security mechanism designed to combat banking fraud following the Central Bank of Nigeria Act 1958. The system operates by capturing fingerprints and a snapshot of the client's face. The BVN is intended to supplement existing methods of consumer identification, such as driver's licenses, international passports, national identity cards, and permanent voter's cards. The BVN project was launched in response to an increase in the number of cases of traditional security systems (password and PIN) being compromised, as well as strong demand for enhanced security for access to sensitive or personal information in the banking system.

3.1.6 Bvn Advantages

The BVN Matching System will help all banks uniquely identify customers. This method will also aid in the reduction of transaction repudiation. Identity can be verified without

the use of documentation that could be stolen, misplaced, or tampered with. Other benefits include:

a. Individuality A person's fingerprint cannot be easily shared or stolen, and no two people's fingerprints are identical.

b. Usability Biometrics is simple to use, has no associated stress of forgotten passwords /password resets, and can never be forgotten because it is based on a person's bodily traits.

c. Accountability and traceability are the third and fourth factors to consider. A biometric trait unmistakably links a person to a certain event. Regulatory authorities and banks would have an accurate record of the customer engaged if there was a fraudulent or questionable transaction.

d. Fraud prevention and control This technology will aid in increasing financial transaction deterrence controls and reducing/mitigating fraud risk.

3.1.7 Biometric Data

Biometric data refers to information gathered during the enrolment, verification, or identification process; nevertheless, it excludes end-user information such as user name, demographic information, or authorizations. Biometric Computer data created during a biometric operation refers to data. Raw sensors, samples, models, templates and/or similarity results are available.

Data Required for Enrolment: Title, Name (Surname, First Name, and Other Names), Marital Status, Customer ID (Optional), Gender, Date of Birth, Nationality, State of Origin, LGA

3.1.8 System software design and implementation tools

Software documentation Text or pictures written with or in the source code accompanying a computer software. The paper explains how the software works or how it can be used.

React Native

React Native (also known as RN) is a popular JavaScript-based mobile app framework that lets you construct natively rendered iOS and Android apps. The framework enables you to build applications for many platforms from a single codebase. Facebook introduced React Native in 2015 and has been actively supporting it since then. Cross-platform development refers to the process of developing software that is compatible with more than one type of hardware platform. A cross-platform application can run on all three operating systems, Windows, Linux, and macOS, or just two of them. A cross-platform application is a web browser or Adobe Flash application that functions the same regardless of the computer or mobile device on which it is run.

Android studio

React Native requires the installation of Android Studio for Android programming and XCode for iOS development. React Native applications can be created using an IDE such as Atom, Notepad++, Sublime, or Visual Studio Code. CSS and HTML are not used in React Native.

User interface

React Native's approach to structuring UI is Flexbox, which is already very popular in web development and enables the developer to create a responsive web or mobile UI very easily. As such, it is a technology that rivals Android's XML / Constraint layout approach, or iOS's Storyboard / XIB / Coding with UI libraries such as the Neon approach. Flexbox operates in React Native just like in CSS on the Web with few exceptions.

Choice of language used in the implementation

JavaScript, sometimes known as JS, is a computer language that adheres to the ECMAScript specification. JavaScript is a high-level, multi-paradigm programming language that is frequently compiled just in time. React Native is built on JavaScript-based React.js. This is a significant benefit because JavaScript is such a large and popular language that it's difficult to find a programmer who hasn't used it at some time in their career. React Native allows you to use a single JavaScript codebase for two different platforms.

Choice of the database management system

Firebase is a cloud service that also serves as a NoSQL database. SQLite is an Android smartphone's local database (data stored/processed on the device) with a SQL interface. ... Firebase is appropriate for real-time applications. Firebase Realtime Database is a cloud-hosted database, which means it operates in the cloud and provides access to users as a service. It saves data in the JSON (JavaScript Object Notation) format, which is a data storage and communication format. All people who are linked to the data have real-time access to it. Firebase is a Backend as a Service (BaaS) that assists React Native mobile developers in building mobile apps. As a developer of the React Native, you can use Firebase to start developing an MVP while keeping costs and using the prototype quickly.

Advantages of Firebase: Options for database storage, firestore, and Realtime are two database alternatives from which to develop a product, beginners can use it for free, community, integration is simple, it is inconvenient to store data, data movement is restricted, android-centric.

3.2 Functional requirements of the proposed system

The following are the application's primary functional requirements:

a. The system should register polls by authorized users.

b. Verify users should be able to vote on the platform.

c. The user's name, age, address, BVN, voter eligibility, password, and other information will be stored in the system.

The following functional requirements apply to the mobile app voting system :

a. The system must deliver reliable data to the voters.

b. Voting administrators should be able to make changes to the voter information database using the system.

c. Offline graphical user interface use should be supported by the system.

d. Means to Provide Authentication

e. Cast a ballot

3.4 Non-functional requirements

Non-functional requirements are limitations on functional or quality requirements.

The system's non-functional requirements include:

a. All voting takes place on specifically designated dates for each election type.

b. Voting is done using a mobile smartphone connected to the internet.

c. The system's time and date settings should be precise.

d. The system must follow election regulations and protocols

3.5 System security requirement

a. The system only allows a voter to vote once

b. The system restricts voters from performing corrections and changing system settings

c. The system prevents voters from editing votes after the ballot has been cast and confirmed

d. The system provides a method of securing the voter's important personal details

3.6 System Requirements

They consist of the required software or hardware specifications for the implementation and design of the system. The system requirements are the settings a system needs to run smoothly and efficiently for a hardware or software application.

3.6.1 Software Requirements

The following software prerequisites must be met for this program to execute successfully:

a. Android operating system (6.0 or greater)

b. A version of the Android SDK (16 or greater)

3.6.2 Hardware Requirement

The recommended requirements for the designed application are as follows: The program is written to run on an android 6.0 smartphone or higher. The application was tested on the android x version of the android operating system mobile phones that the program will work with are Android 6.0 and higher. A smartphone powered by android, storage area (1GB or greater), Internet access (3G or greater), Ram (random access memory) (500MB or greater), central processing unit (single-core processor or higher).

3.7 Software Methodology

The model being used is called Rapid Application Development (RAD) it is a development methodology that is intended to provide significantly faster outcomes and of greater quality than the normal lifecycle. It is designed to make full use of the most recent generation of advanced development software. Stages of a rapid application development life cycle; Requirements Planning, User Interface Design, Rapid Development, Transition. The Rapid Application Development approach has four separate stages. These are the following: requirement planning, user description, construction, and cutover. Each of these is detailed in detail below:

3.7.1 Requirements planning

The Rapid Application Development model begins with this step. It entails acquiring requirements for the software project in progress. However, the paradigm for doing the aforementioned is what distinguishes the RAD model from other software development models. The requirements planning phase also includes the complete structured plan. It describes:

a. The critical data

b. The methods for obtaining critical data

c. The procedure of processing the critical data to form the final model

Requirements Planning: The suggested system is associated with the following areas:

a. User Voting Process: The following phases would be completed by this proposed voting system to facilitate the election and voting process: Voters use their personal

Bank verification number and National identification number to use the mobile voting app and check their voter's dashboard. After submitting the login request, the system checks if the details of the elector match those on the database and determined that, based on the result status provided on the check, the voter is still entitled to vote in the election and takes appropriate action. When users are validated and eligible for vote, they will have to enter an OTP (One Time Password) to which they can vote by email or SMS. The system prevents a user from voting and warns against unable to vote if they are unable to vote .

b. User Authentication: This accomplishes our goal of assuring a secure method of verifying voters before they are permitted to vote. Voters would be validated by verifying their unique identifying details. The major way of verification in this study is OTP (One Time Password) paired with the unique Bank Verification Number and National Identification Number.

c. Registration and Verification of Voters: Before they may be verified, voters must first register on the app with their Gmail and login password.

3.7.2 User description/ design

The second phase of the Rapid Application Development model is the user description. It involves taking user feedback and then building several prototypes of the project under development using developer tools. This stage involves the use of various tools for modelling and describing the systems processes and functions and a visual representation of the vital system. The user description phase includes the re-examination and validation

of the data collected during the first phase. This phase also includes the identification and elucidation of the dataset attributes

a. User design and description using flow-charts

A detailed description of all the system and user interaction steps and proceedings using a process flowchart.

User: The user is the voter who is registered in the database and is eligible to vote on the appointed election dates. . This category of voters are users of the mobile app which passes through verification, registration, and voting phases.

Administrator: The administrator is responsible for managing voters' registration, authentication, and election protocol setup. The administrator maintains and monitors the integrity of the database.

Authentication: Once the voter has been registered, to vote he/she has to confirm the one-time password (OTP) sent to their registered email, to confirm their identity before proceeding to vote. If the user does not confirm or receive the OTP, he/she will not be able to cast their vote.

Voting process: After the voter has confirmed his/her input entry, him/her can then click on the vote option and select their preferred candidate and political party after casting their vote, all the details will be sent to the voting database and the user will receive a confirmation message that his/her voting process is completed.

Verification: This phase must be completed before registration, Firstly the voter has to provide his/her bank verification number and Email, then the system runs a check in the database to determine if the details provided match the one stored in the voter's database, once the voter is verified, then he/she will be allowed to register.

Registration: For any voter to be identified as a registered voter he/she has to pass through the verification phase. This page contains a form in which users can submit information that they qualify to qualify. In this phase, the elector must check his/her details and a password to register with the server of the application. (An eligible voter is a registered voter in the INEC database).

Login: Once the Voter has been registered and verified, then only a password and name will be required to login into the application and the voter's dashboard will be displayed.
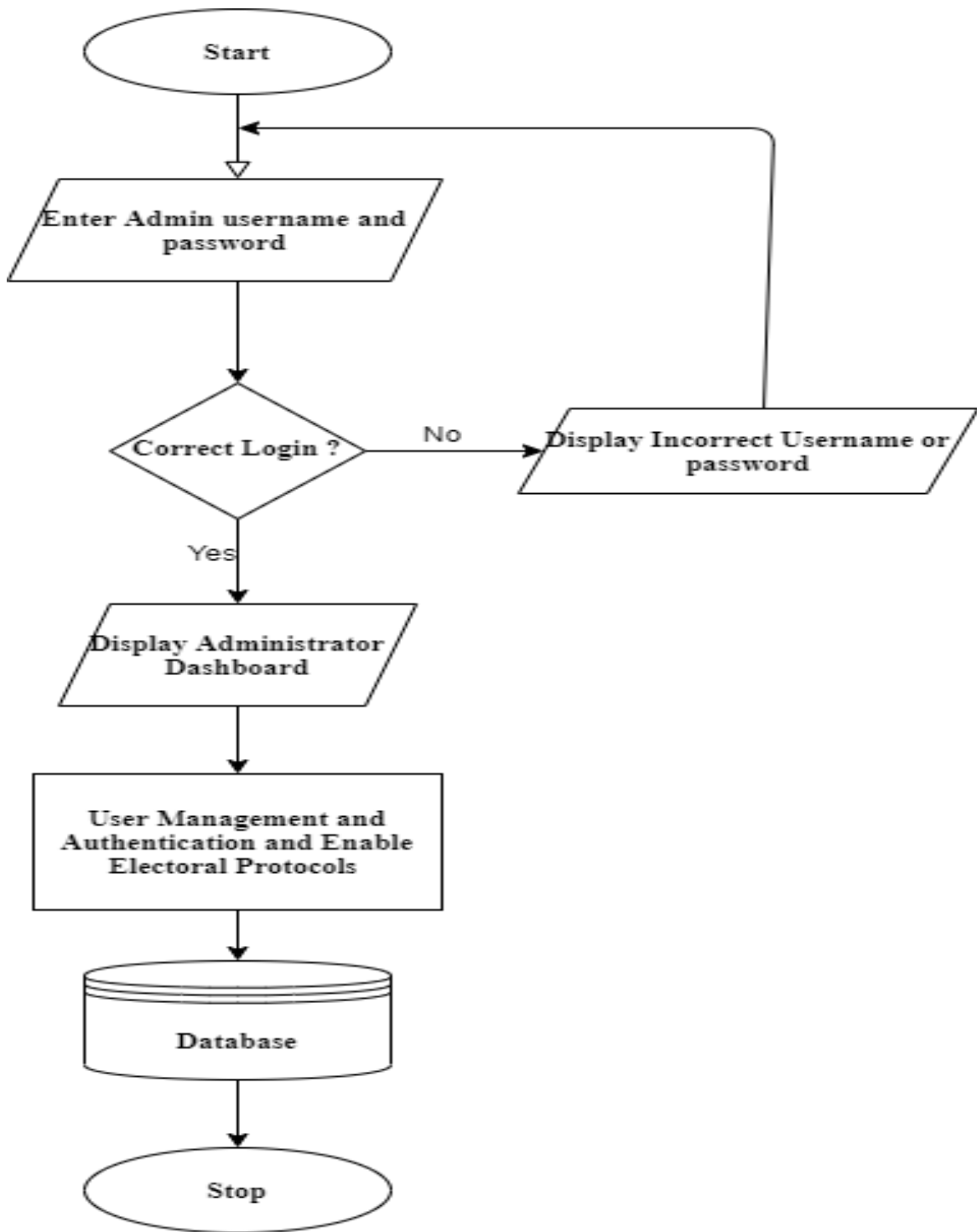
Fig.3.2: Administrator login process flow chart
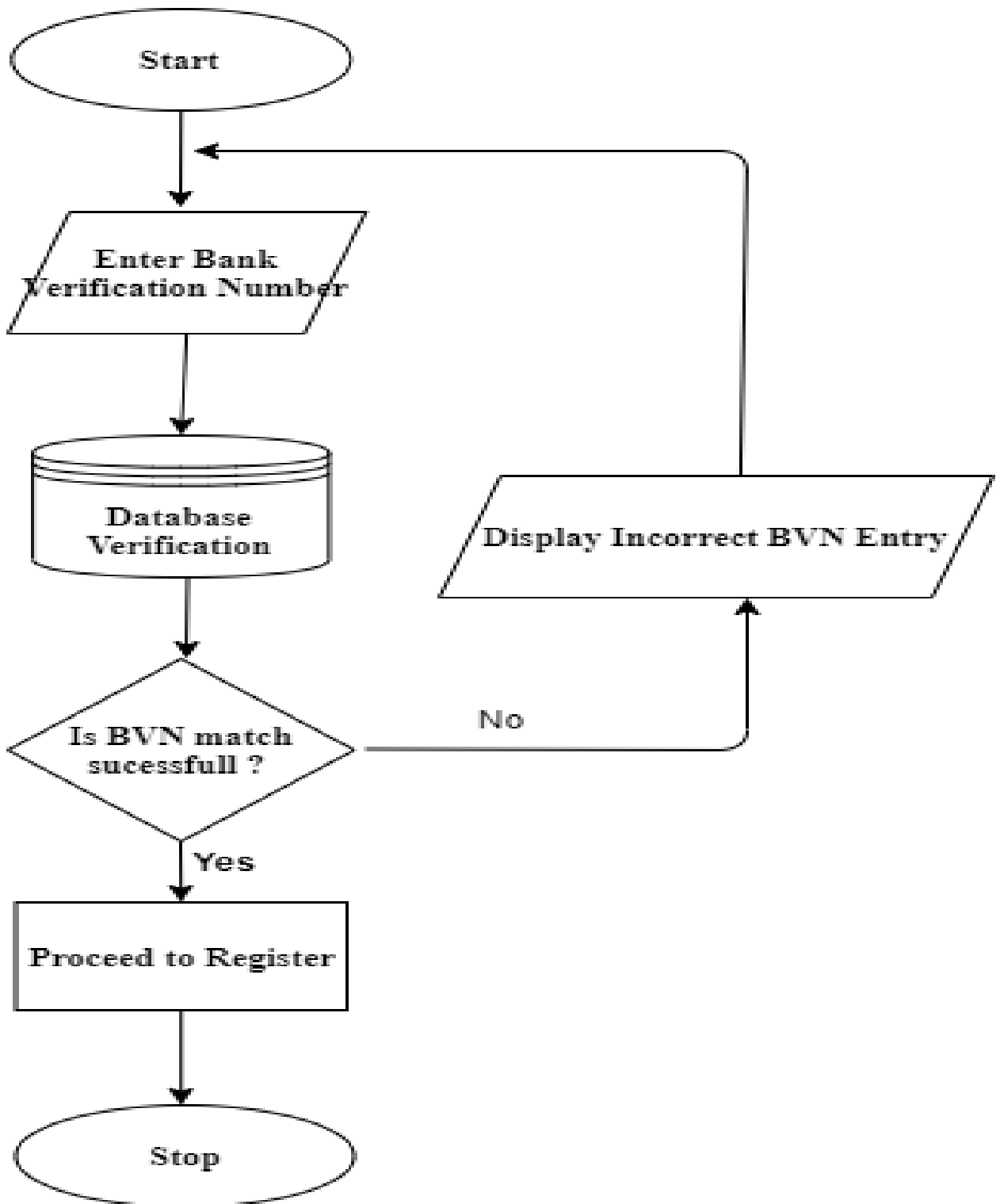
Fig. 3.3: Voter bvn verification flowchart diagram
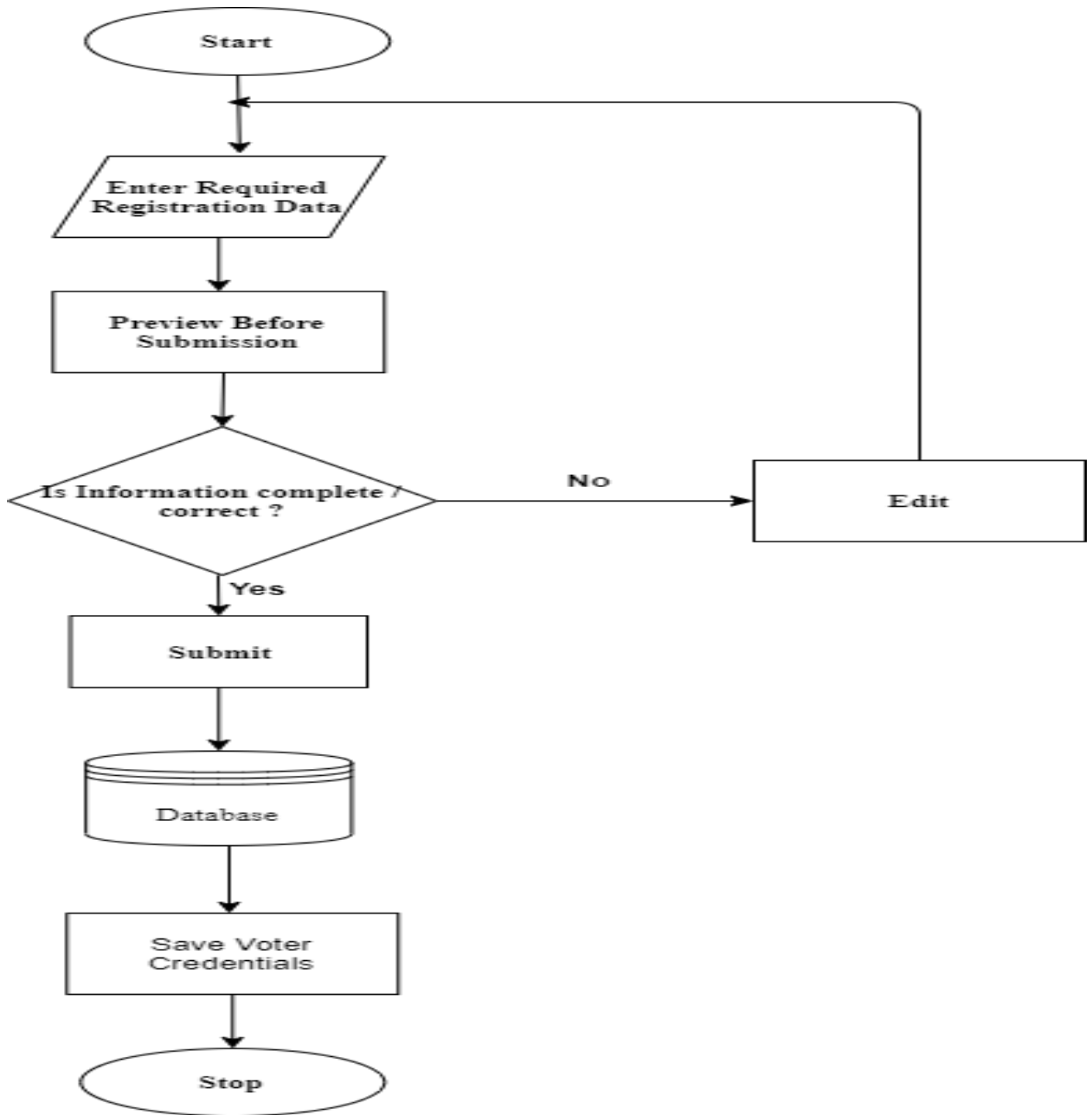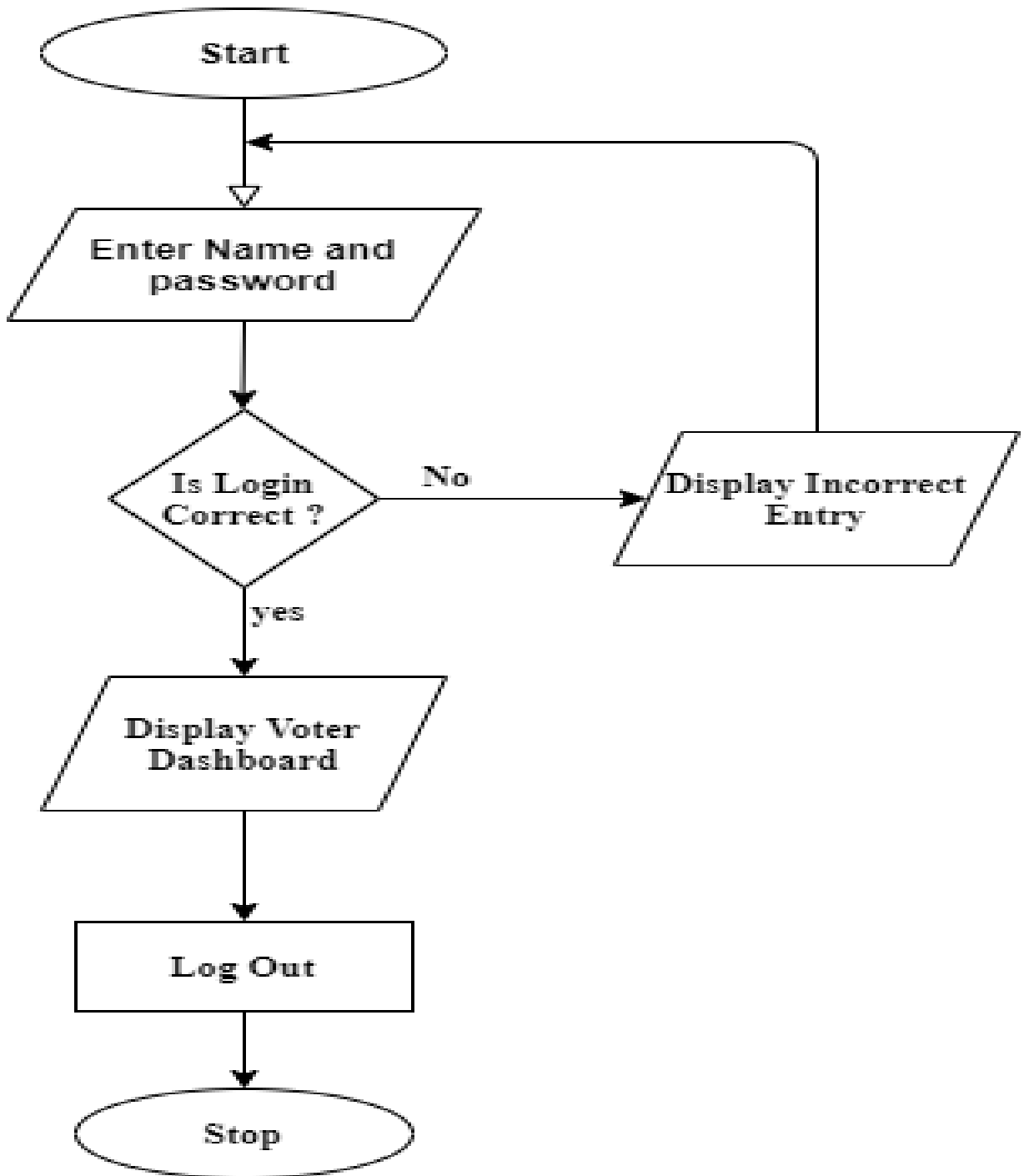
Fig. 3.4: User registration process flowchart
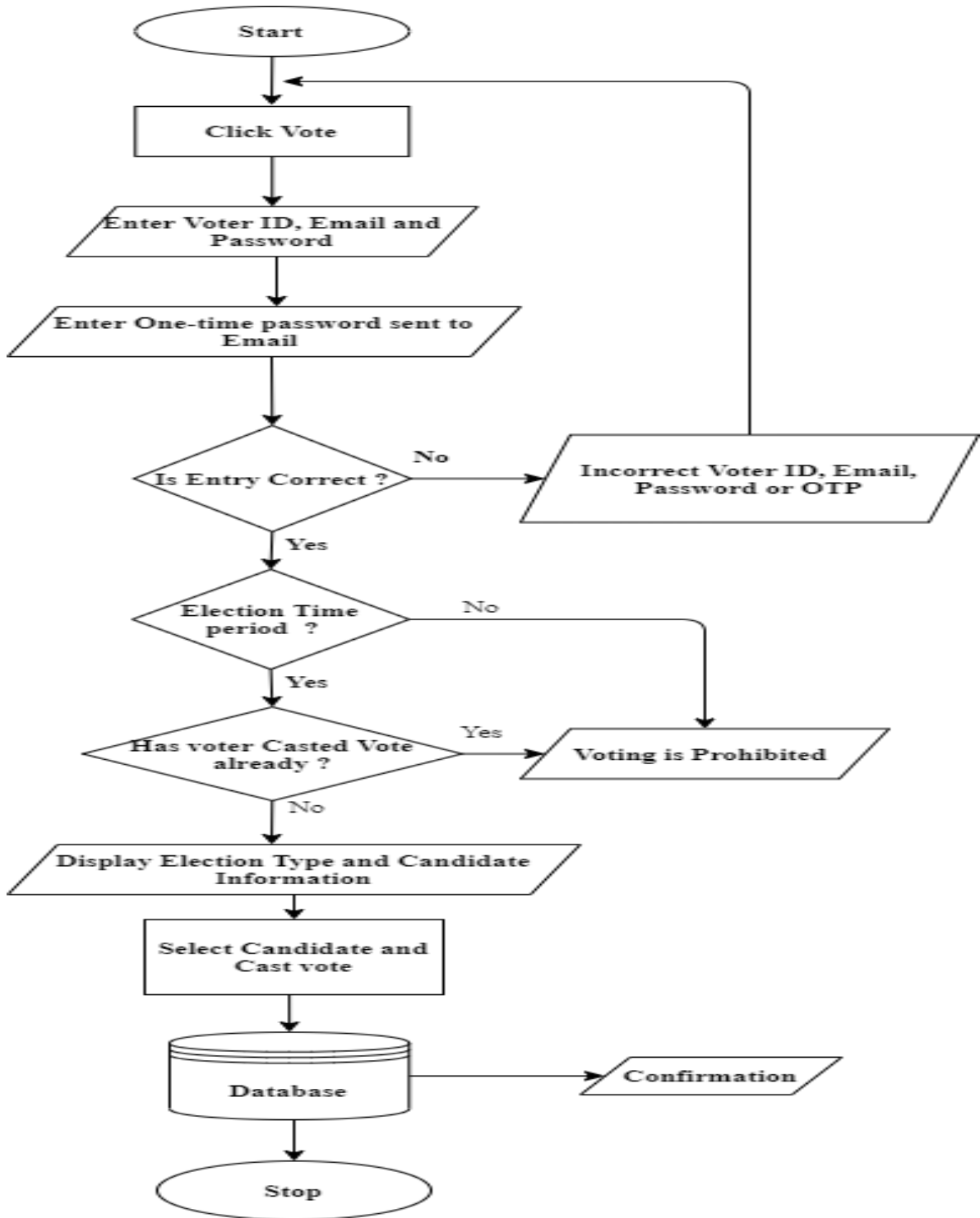
Fig 3.5 Voter login process flowchart

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Fig 3.6 Voting process flowchart

3.7.3 Development phase

The construction phase includes the refinement of the prototypes developed in the previous phase. It also includes the use of powerful automated tools for transforming processes and data models into the final, operational product. All the collected enhancements and modifications are applied during this third phase of the RAD Model. Feedback about what is good, what is bad, what to keep, and what to remove, is given in this phase. The feedback given during the construction phase is not limited to functionality, but also includes aesthetics, interfacing, etc. The prototyping then continues with all the received feedback taken into consideration. Both prototyping and feedback continue until a final product that fits the client's requirements most suitably is developed.

3.7.4 Rapid transition/ cutover

The last phase includes the finalization of the aesthetics, features, functions, interface, and everything else related to the software project. Interfaces between the various independent modules require proper testing.

3.8 The proposed system design methodology

System design methodologies of Jacobson et al. (for example Object-Oriented Business Engineering (OOBE) and Object-Oriented Software Engineering (OOSE)) cover the entire cycle of life, stress traceability, and retrenchment between the different stages. This traceability enables the reuse of analysis and design work, possibly significantly more important factors in the time of reduction and reuse of code. The use case concept

developed with the objector is at the heart of their methodologies (Object Factory for Software Development).

3.8.1 UML use case diagram:

Cases are system-based comprehension scenarios, while a case of use is a user-system interaction in which the model use case incorporates the user's intent and responsibility. Actors are system users who interact with the system. An actor is a person, organization, or external system that interacts with your application or system. They must be external data-producing or data-consuming objects.

    a.   Voter use case diagram

This diagram describes all the operations and activities performed by the voter interacting with the system.

    b.   The administrator use a case diagram

This diagram describes all the operations and activities performed by the administrator interacting with the system

3.8.2 UML activity diagram

An activity diagram's purpose can be summarized as follows: Draw a system's activity flow, describe the progression from one activity to the next, describe the system's parallel, branched, and concurrent flow.
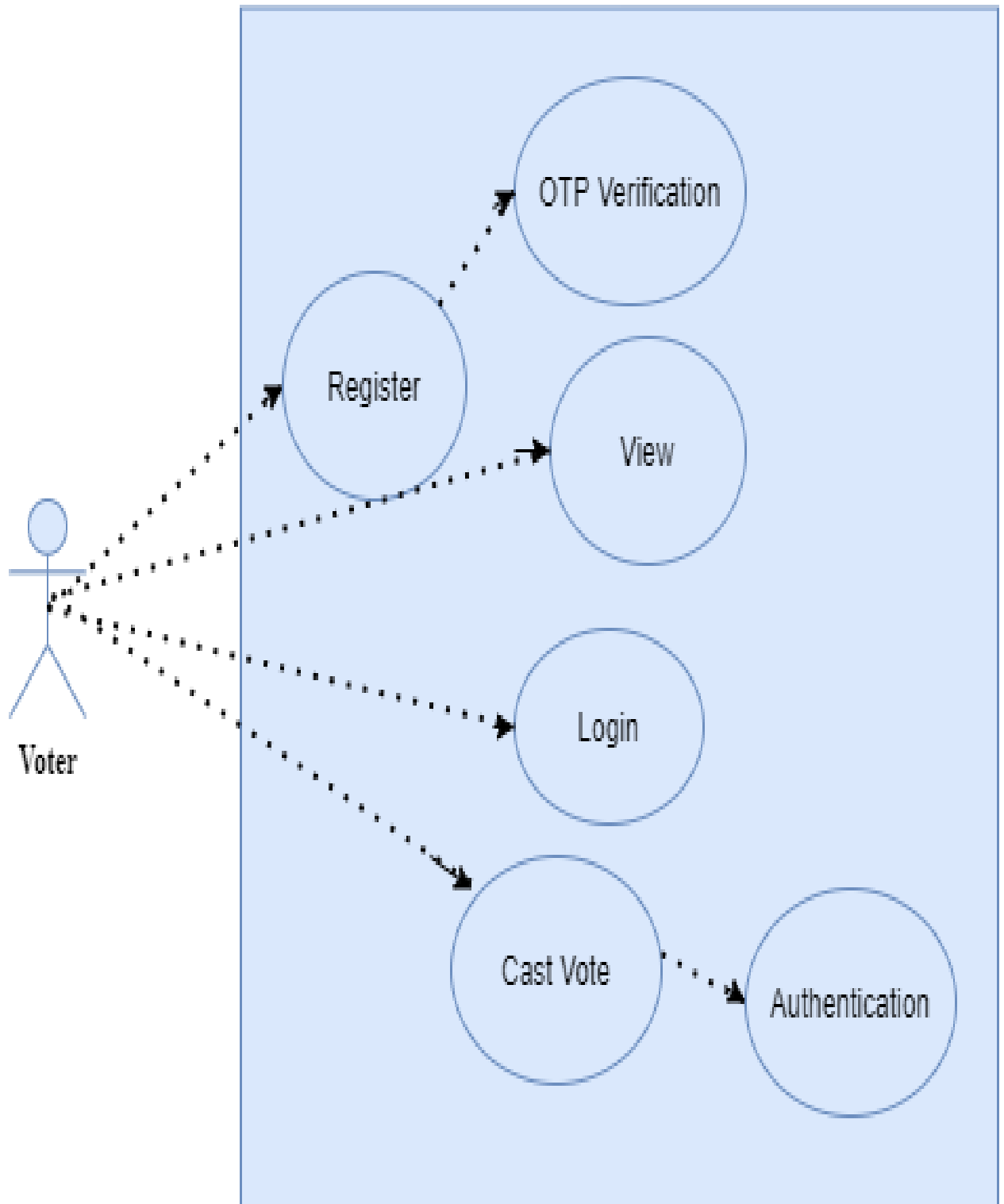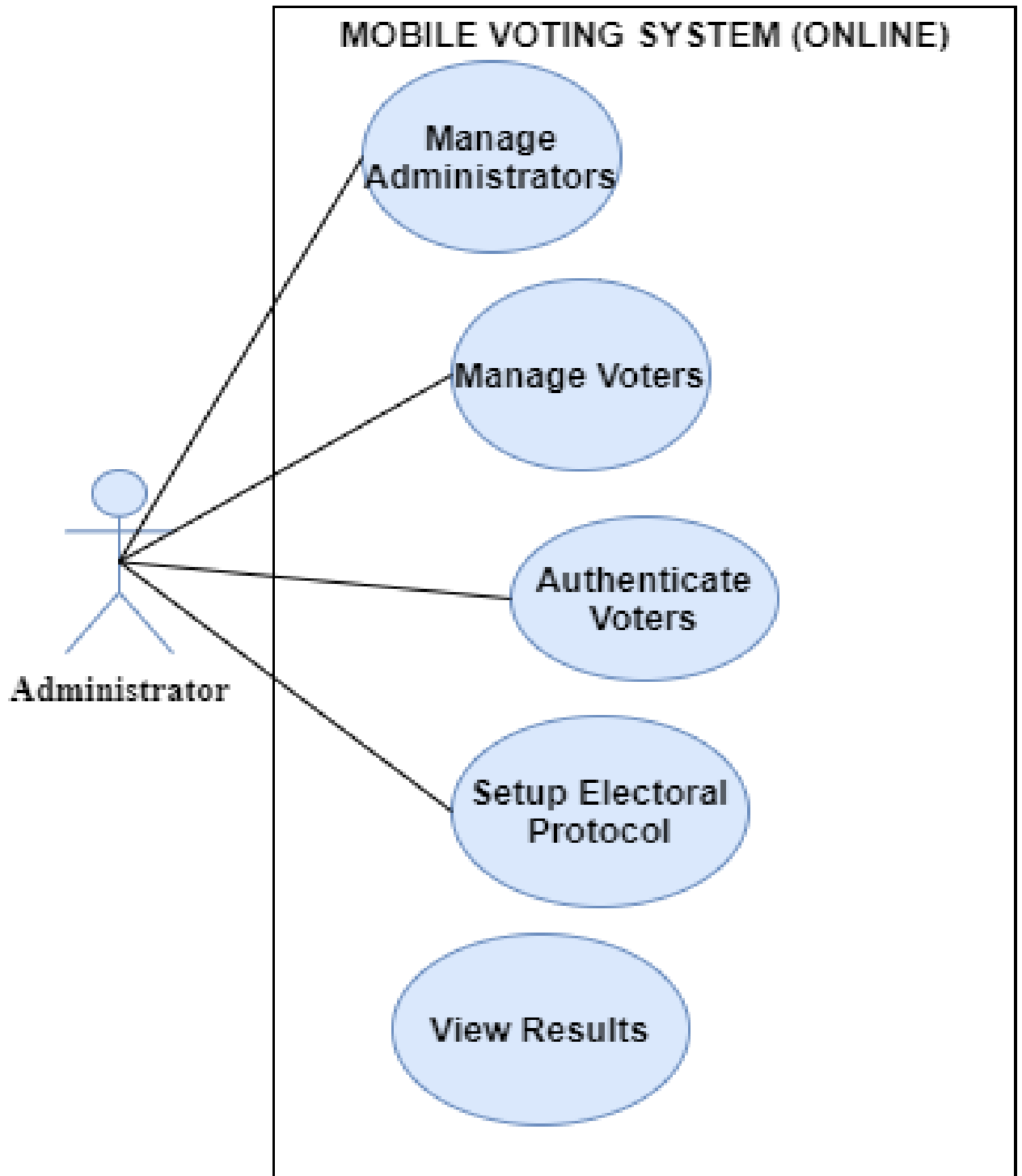
Fig 3.7 Voter use case diagram

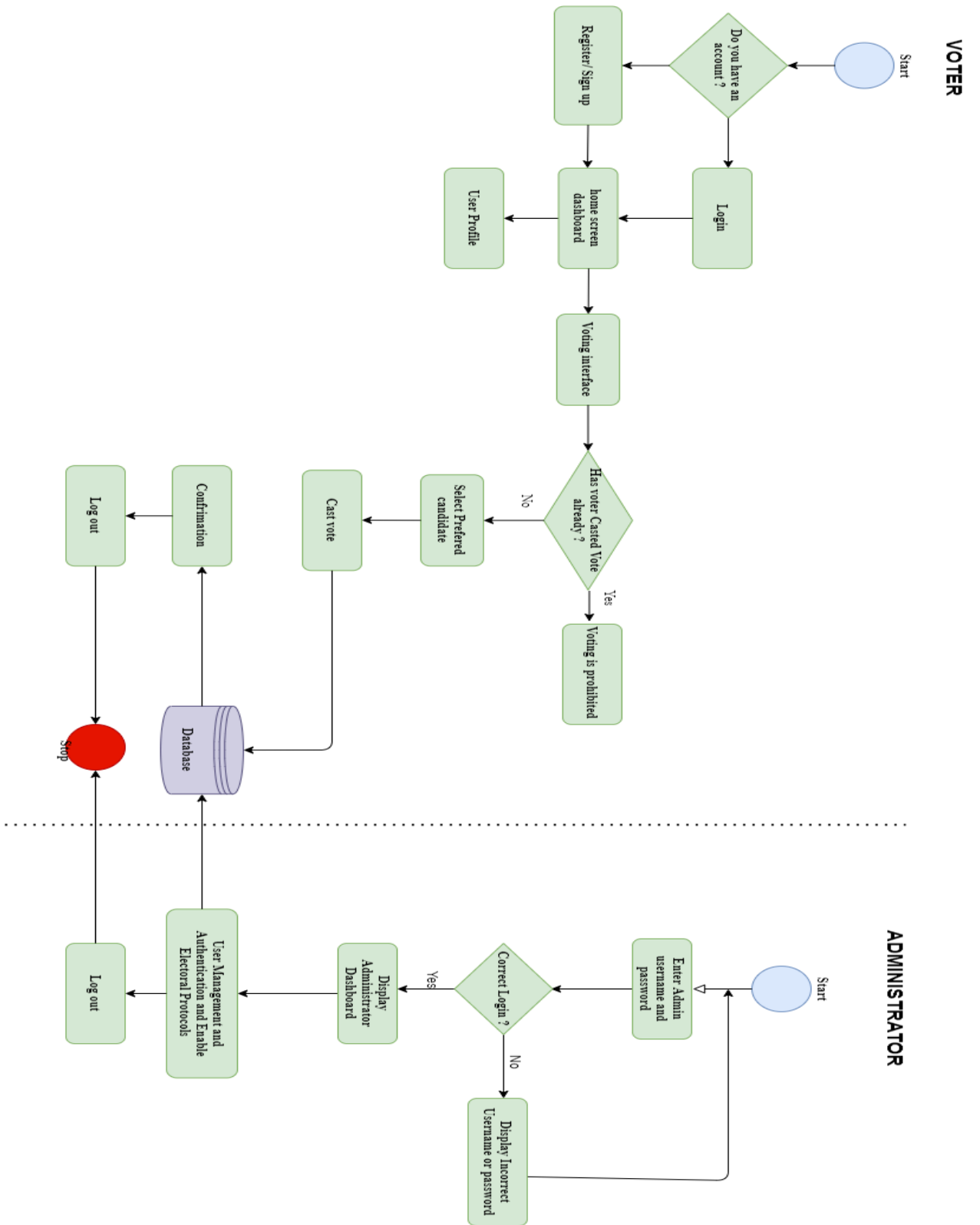**Fig 3.8 Administrator use case diagram**

Fig 3.9 Voter and administrator activity diagram

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3.8.3 UML sequence diagram

Making a flowchart to Represent a UML use case's details, create a model of the logic of a complex procedure, function, or operation, examine how items and components work together to execute a task.

    a.   Voter verification and registration sequence diagram

This diagram explains the interaction between the voter, database, and application server to perform user verification and registration.

    b.   Voter login and voting sequence diagram

This diagram explains the interaction between the voter, database, and application server to perform user login and Voting operations.

3.8.4 UML Class diagram

They show the various objects in a system, their characteristics, their operations, and their relationships. This UML diagram depicts the interaction between the administrator and voter including their methods and operations.
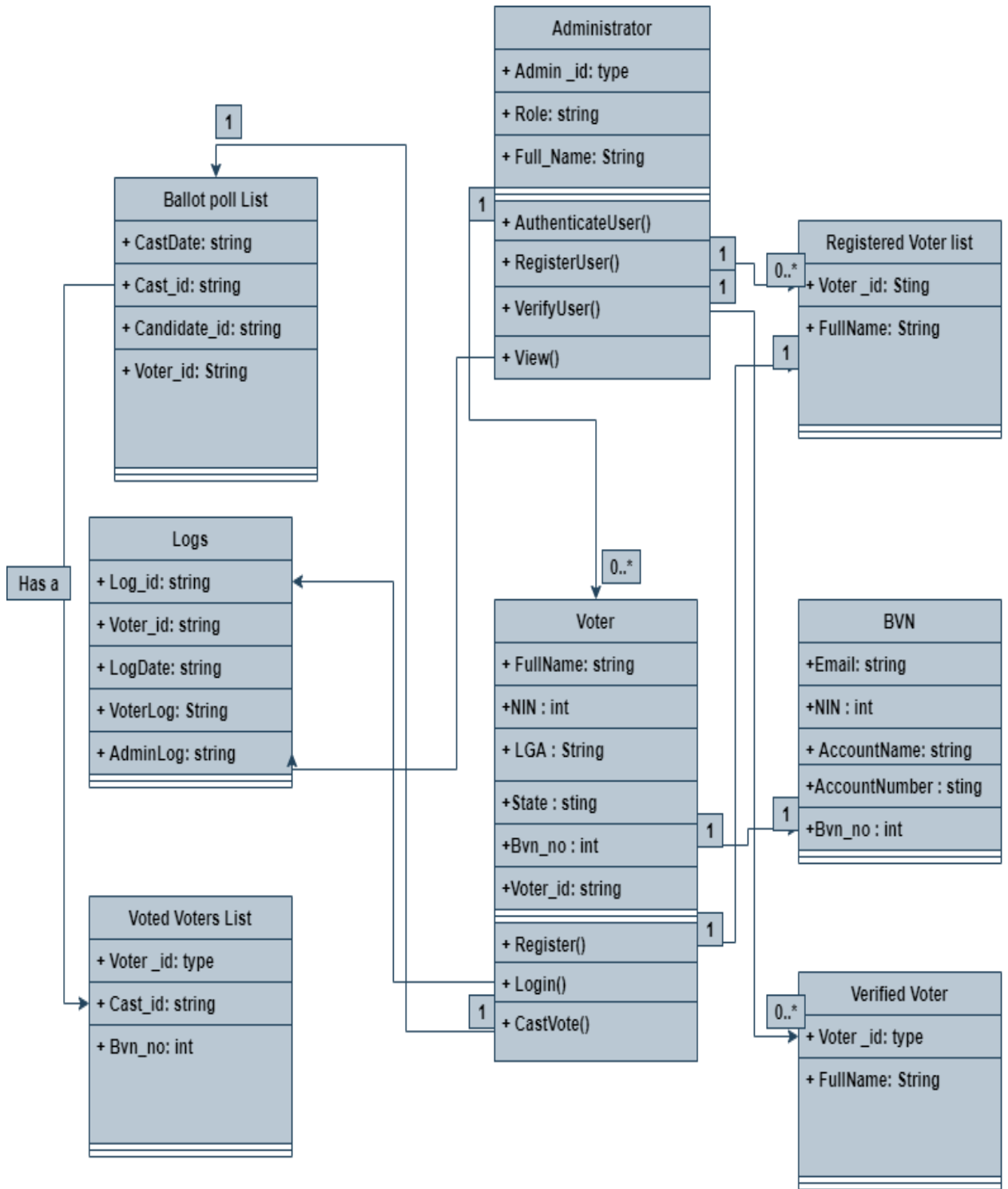
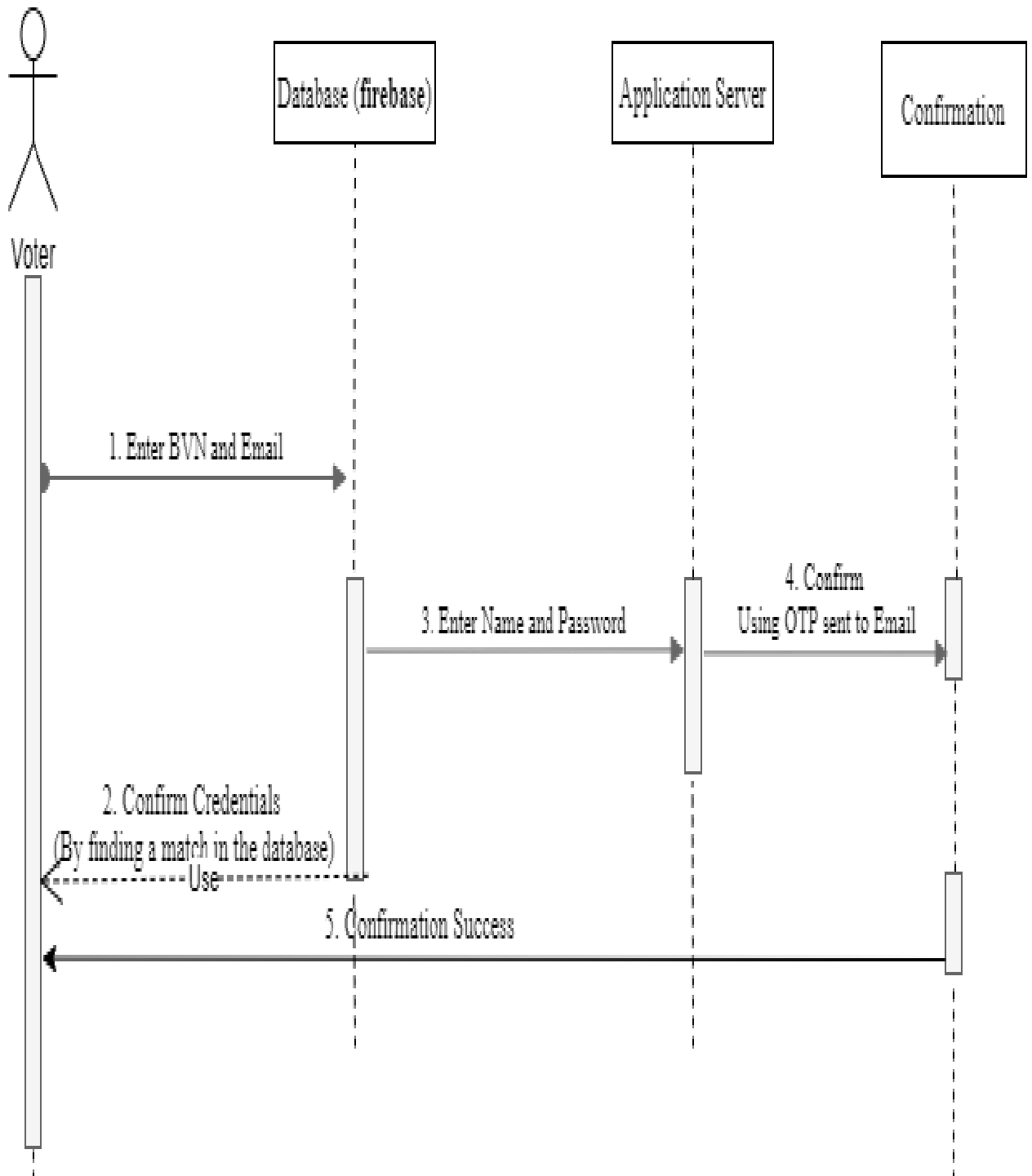**Fig 3.10: Voter and administrator class diagram**

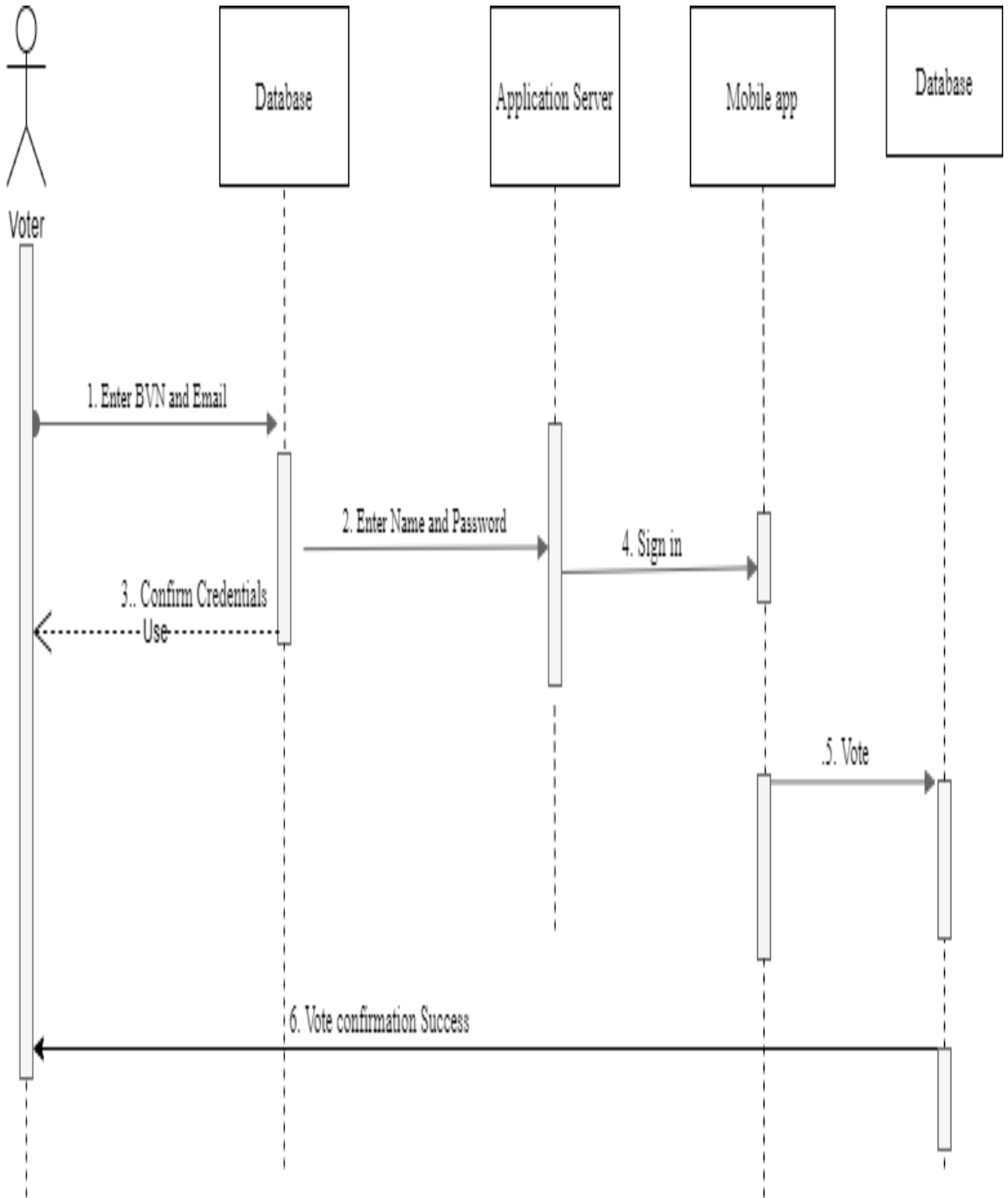**Fig 3.11: Voter verification and registration sequence diagram**

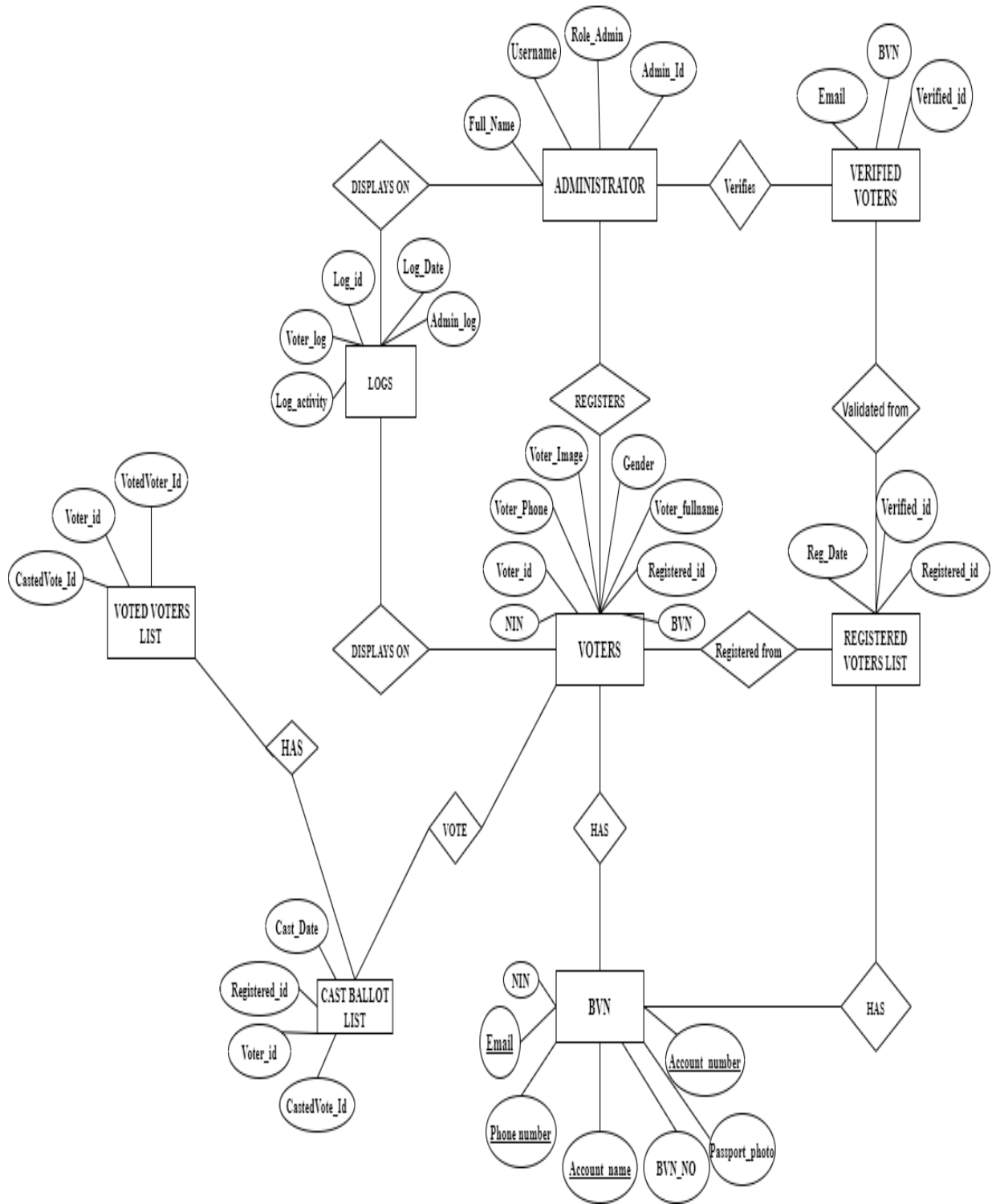**Fig 3.12: Voter login and voting sequence diagram**

Fig 3.13: Entity relationship diagram

3.9   Testing of the system

The ultimate test is to check that the delivered product complies with the requirement document specifications. Both functional and non-functional requirements should be investigated.

3.9.1   Unit testing

The test units can be produced at any stage of development or even before development as part of mobile application testing (test-driven development, or TDD, is one of the iOS unit testing best practices). Unit testing checks whether certain parts of the code work correctly. Every test case starts from a describe() function call, similar to how JUnit uses the Testcase class. The describe() function takes two parameters: title description and function to be executed. It () function includes all of the test steps and returns a series of expect() functions. By default, React Native provides **Jest** tests for unit testing, and this works for both Android and iOS. Currently, test coverage isn't perfect, but according to Facebook, more unit-testing capabilities will be introduced in React Native, and users can already build their own.

3.9.2   Integration/ System Testing

To create a complete system, system components are integrated. This process involves the identification of errors resulting from unforeseen interactions between components and the interface problem of components. Here is the need for testing of Android integration. Tests for Android Integration test the correct integration of these two modules. It will attempt to identify the integration failures between the two modules and

to check the proper communication of data between them. Integration testing for React Native. While performing React Native testing via integration tests, the communication goes through the bridge and requires both native components and JavaScript components to be in place. It is a cross-platform test framework that supports integration controls for React Native. Cavy employs the reaction ref functions generated to provide reference and simulation measures for deeply imbued components in an application. Cavy can run seamlessly on a host device (e.g., Android or iOS simulator). React Native testing using Espresso for Android provides APIs for writing UI tests to simulate user interactions for Android apps. It has three major components: view Matchers, view actions and view Assertions. The Express API's lightweight. Espresso automatically synchronizes test methods and test UI elements.

3.9.3 Acceptance Testing

This is the final stage in the testing process before the system can be used. Instead of simulating testing, the system is tested with data provided by the client.

3.10 System Application Architecture Diagram

This type comprises software components, their interactions, and their properties as a high-level diagram that displays the software's basic structure. Relationships with external components such as users, databases, and services can also be sent. An architectural diagram needs to establish some major functions: Cut down barriers to communication, the consensus is reached and diminishing ambiguity

3.10.1 Voting Architecture Interface Diagram

This diagram describes the communication of the interface that explains the elector and the administrator's voting and electoral activities.
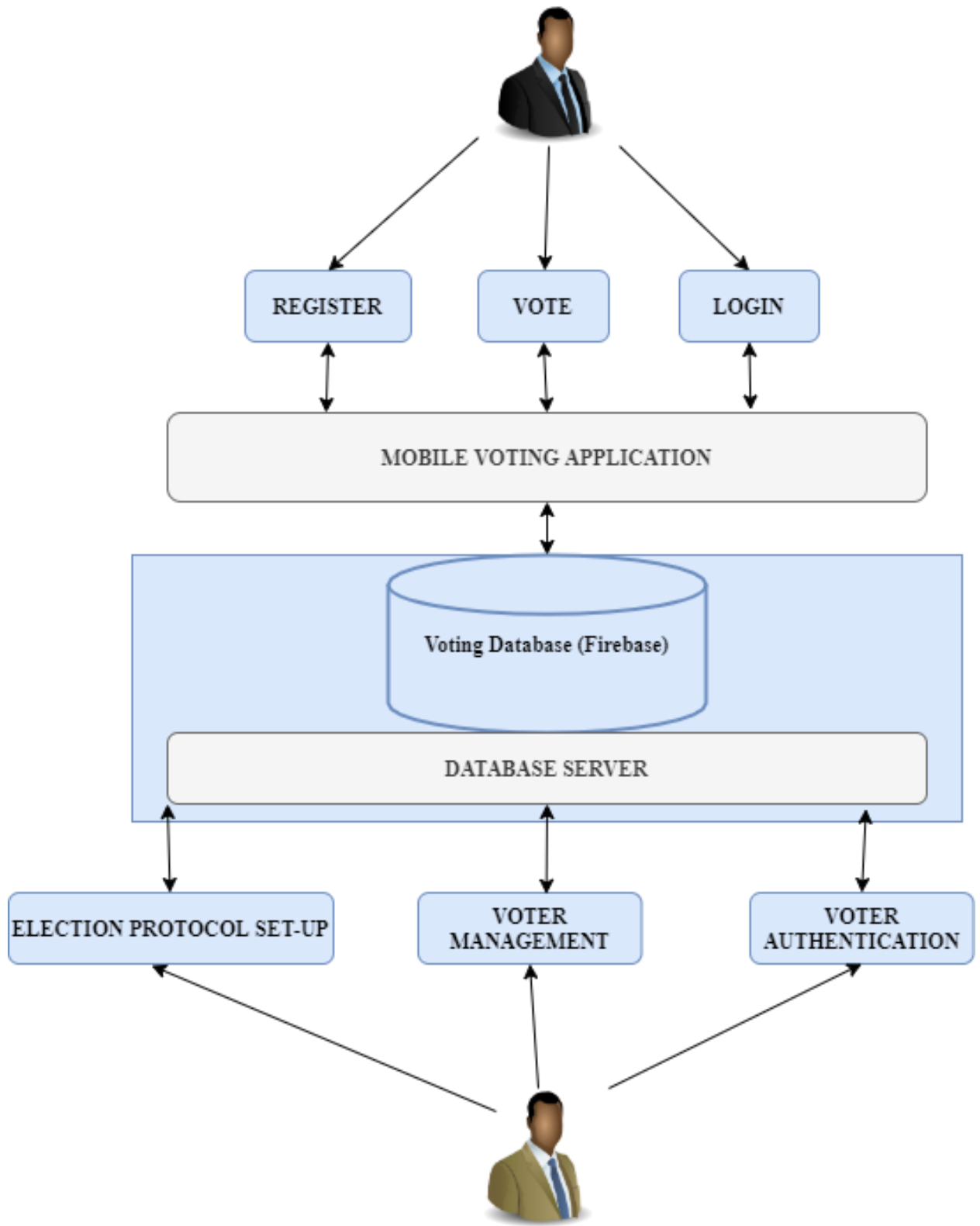
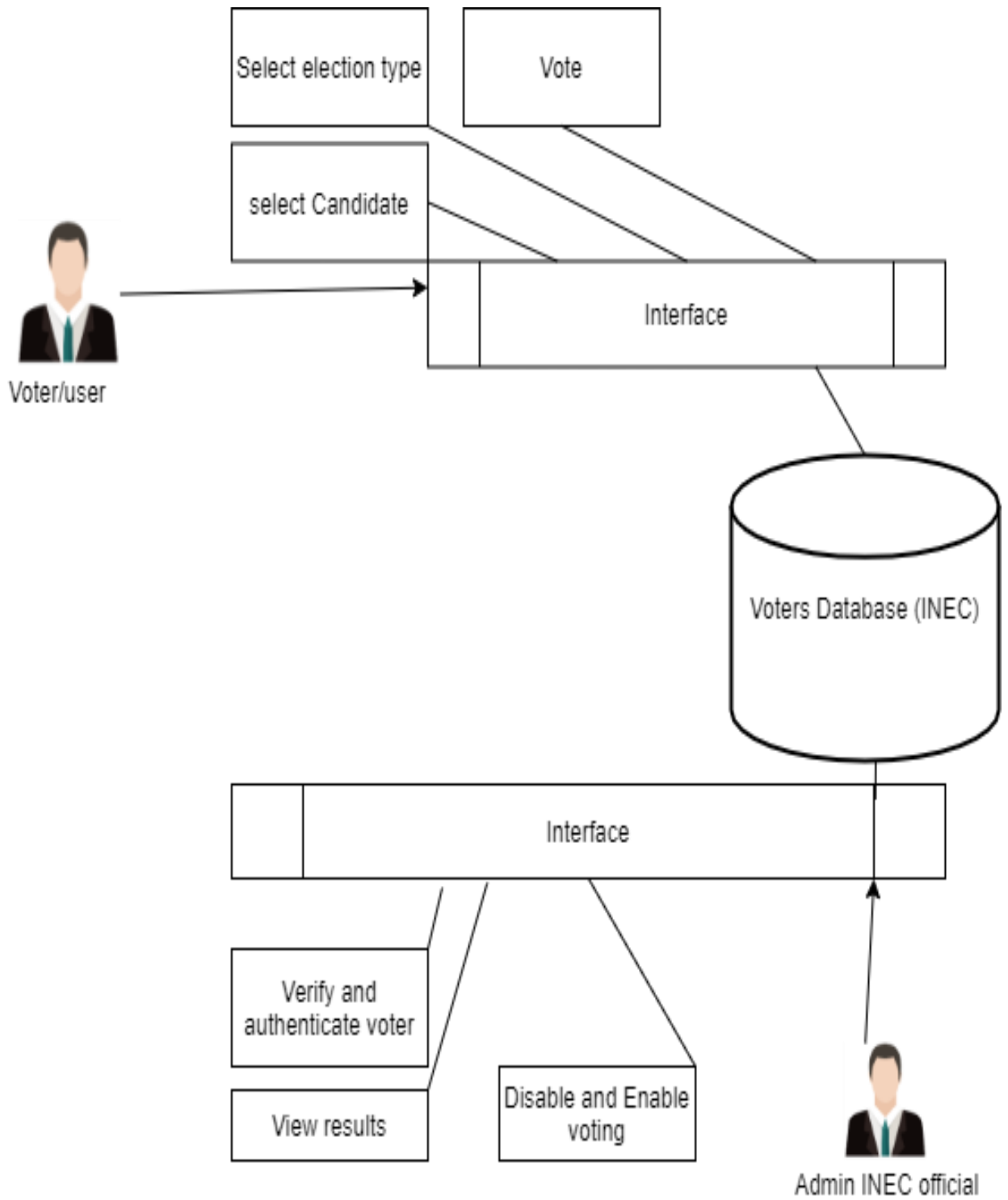**Fig 3.14: System application architecture diagram**

Fig 3.15: Voting architecture interface diagram

CHAPTER FOUR

IMPLEMENTATION AND RESULT

4.1 Introduction

This chapter describes the steps that must be followed to complete the design (if needed) provided in the authorized systems design document, as well as to install and begin utilizing the new or revised Information System. Complete the design provided in the authorized systems design document as needed. The purpose of System implementation is to make the new system available to a predetermined user group (voters) and to provide continuous support and maintenance in the organization (system) This chapter covers hardware and software environments.

4.2 Use of the system (program)

The main users of this system are the voters and the administrator

4.3 Screenshots of the system

The following pictures show the applications from the point of view or accounts of the elector and administrator.

4.4 Front-end Implementation

The design and front end of the application were implemented using react native application development framework with JavaScript as the programming language. The

user interface for the application was designed using react-native flexbox to implement a voter responsive and friendly interface

4.4.1   Mobile app home screen

This screen displays the options provided to the voter to select his/her preferred candidate to perform their electoral practices as in line with the protocols implemented by the administrator in figure 4.1

4.4.2 Voters verification screen

This screenshot requires the voter to input their bvn and email to verify their credentials this in explained in figure 4.2

4.4.3 Email verification page one

This screenshot describes the user receiving a confirmation email verification code to click as described in Fig 4.3: Email verification page one

4.4.4 Email verification page two

After the user has clicked on the link, he/she can proceed to sign in as described in Fig 4.4: Email verification page two

4.4.5 Sign up page

The Voter can sign up using their email and password as explained in Fig 4.5 Sign-in page

4.4.6 Sign-up confirmation screen

The user can confirm all the user credentials displayed on the screen before signing up in Fig 4.6 Sign-up page

4.4.7 Voter profile page

This page displays all the voter' information and credentials as seen in Fig 4.7 Voter profile page

4.4.8 Voting page for selecting a preferred candidate

This screen provides a list of election types and political parties, including the candidate name with an option to vote or choose a preferred candidate Fig 4.8 Voting page for selecting a preferred candidate

4.4.9 Cast vote screen

This screen provides only a single option to cast vote after selecting your preferred candidate as seen in Fig 4.9 Cast vote screen

4.4.10 Voting success screen

This screen informs the voter that his/her vote has been successfully sent explained in Fig 4.10: Voting success screen

4.5 Back-end Implementation

The software implemented is a firebase no-SQL database for authentication and database storage. Immediately the user registers on the application his/her details will populate and

be stored on the database. All this information is obtained and stored in the cloud firestore database in a JSON file format.

4.5.1 Administrator dashboard (Online firebase console)

One of the unique features is the syncing of data across multiple client apps using real-time listeners. The fire storage uses Google's authentication cloud identity and access control technology. It is secure, reliable and seamlessly integrated with Firebase and Google Cloud. explained in Fig 4.11 Admin firebase dashboard

4.5.2 Admin database user authentication setup

Backend services, easy-to-use SDKs and ready-to-use UI libraries are provided to authenticate users to your app in Firebase Authentication. Authentication is supported by passwords, telephone and e-mail numbers. The screenshot describes the Firebase Console authentication method -> Authentication -> Authentication Sign-in method set up to verify registered users by the administrator with e-mail and password in Fig 4.12 Admin voter authentication method

4.5.3 Firestore database

Cloud Fire store. It takes the form of a cloud-based NoSQL database server that does the job of storing and syncing data. Tables can be created with the click of the Start Collection link on the Database dashboard. It will ask you to enter the table name and click on the Next button. Once the table name is added, there will be a screen with the field name, field type, and default value this screenshot describes the BVN table and its attributes in Fig 4.13 Firestore database.
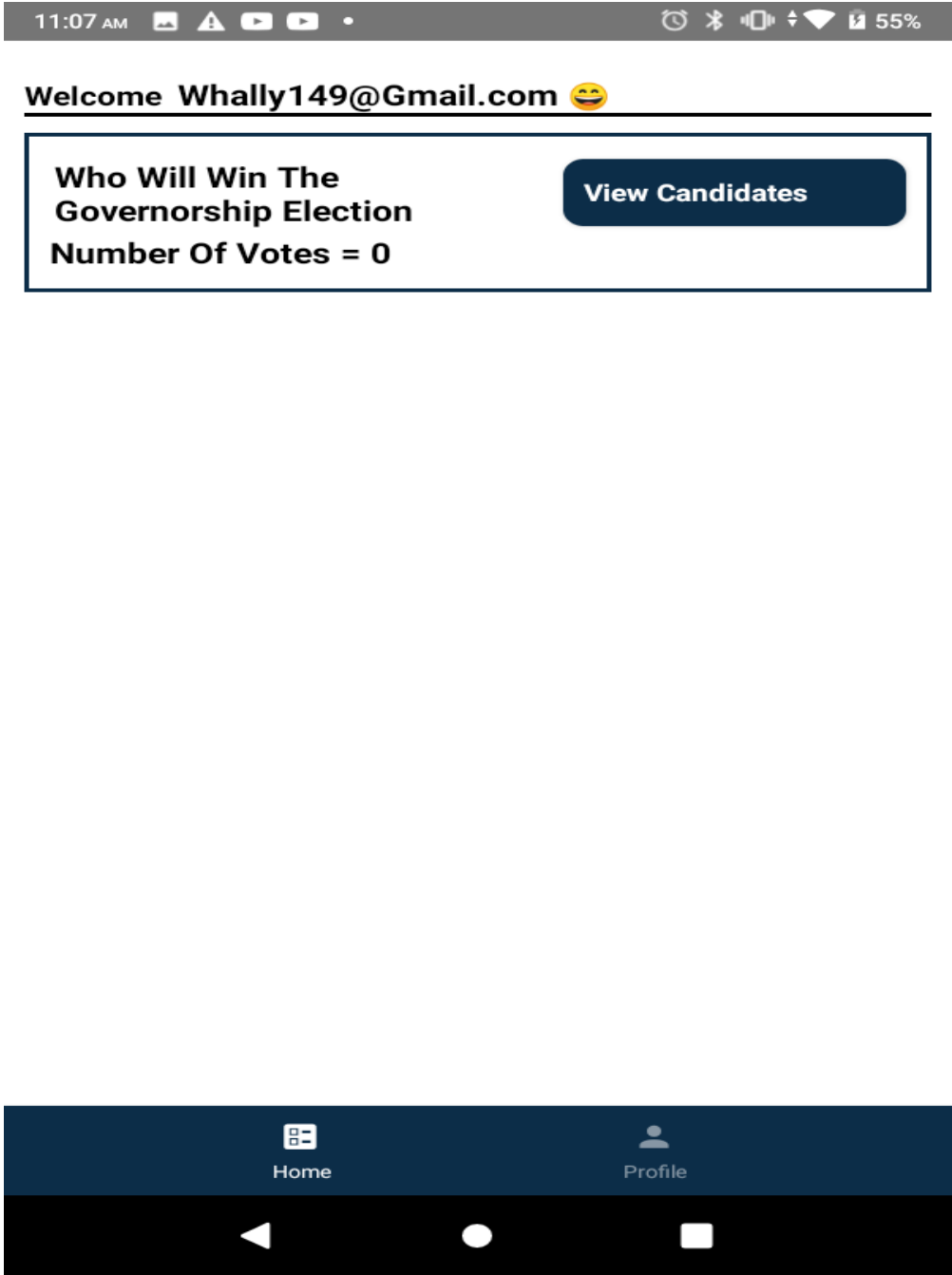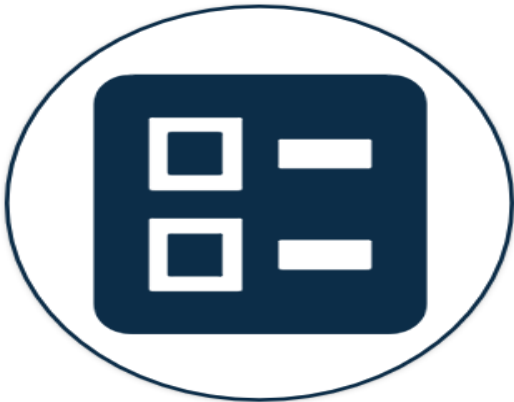
Fig 4.1 Mobile app home page
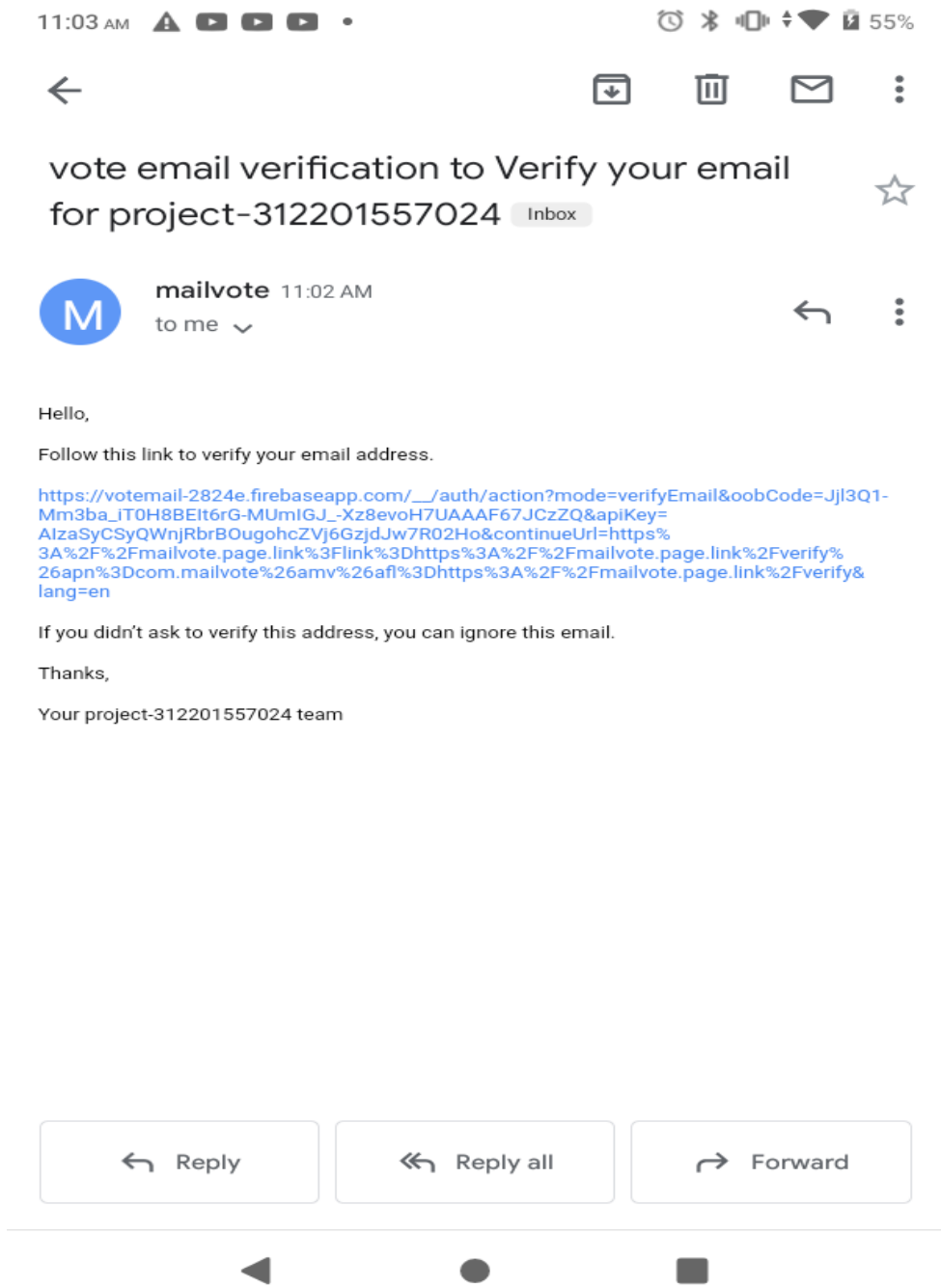
Fig 4.2 Voters verification screen

Fig 4.3: Email verification page one

Fig 4.4 Email verification page two
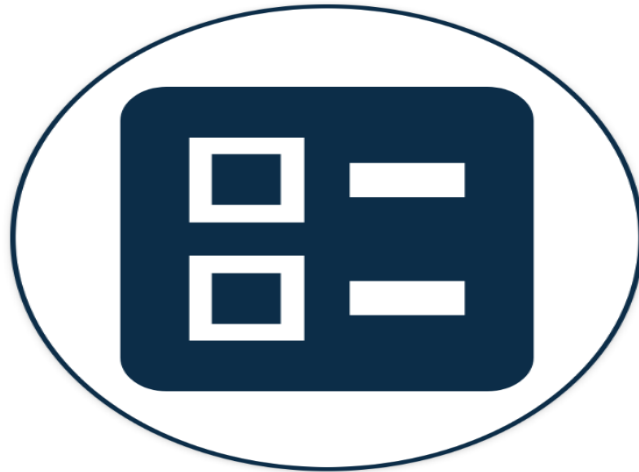
Fig 4.5 Sign-in page

Fig 4.6 Sign-up page

4.4.7 Voter profile page

Fig 4.7 Voter profile page

Fig 4.8 Voting page for selecting a preferred candidate

Fig 4.9 Cast vote screen

Fig 4.10: Voting success screen

Fig 4.11 Admin firebase dashboard

Fig 4.12 Admin voter authentication method

Fig 4.13 Firestore database

4.5.4 Firestore storage
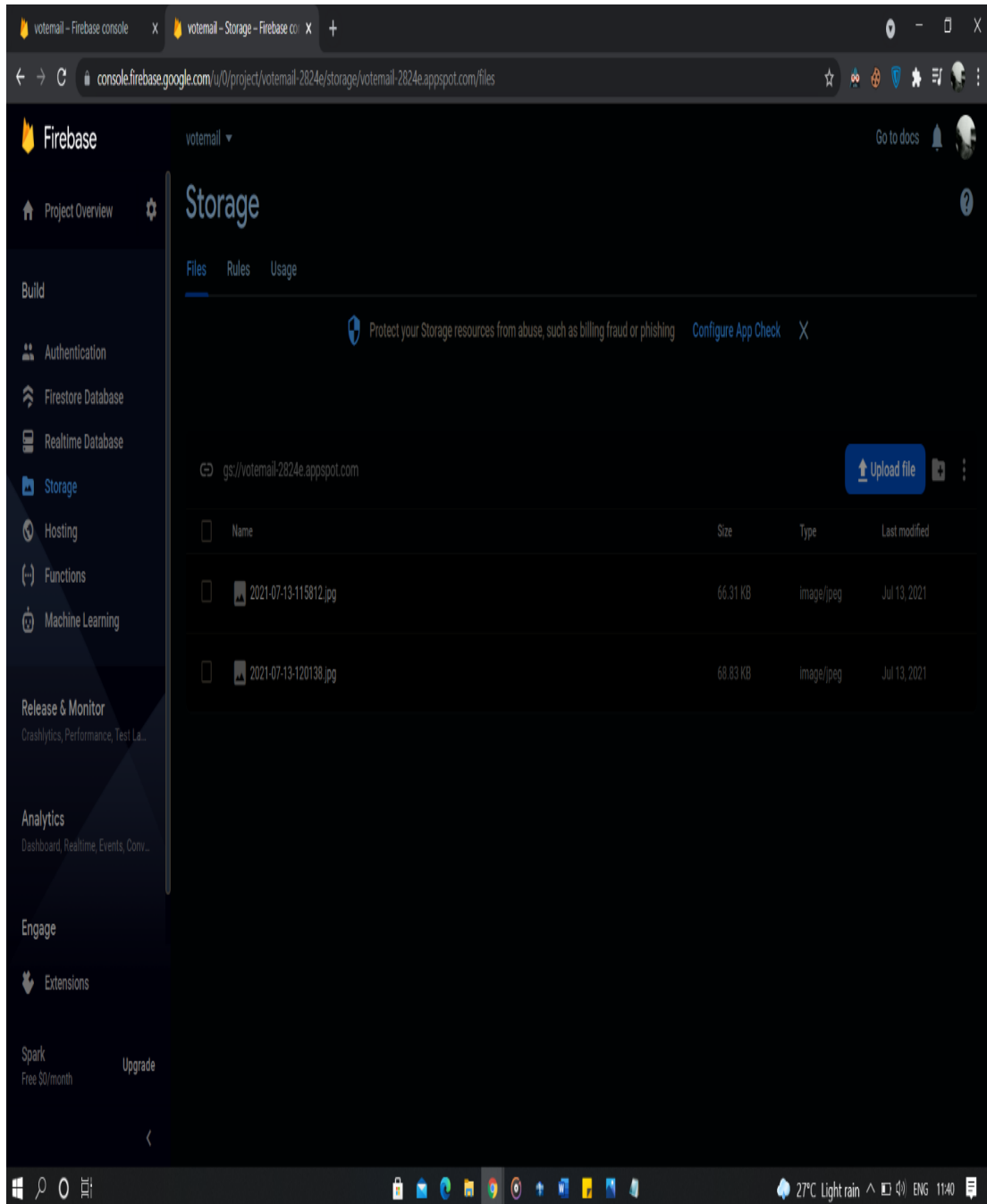
Fig 4.14 Firestore file storage

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1　Summary

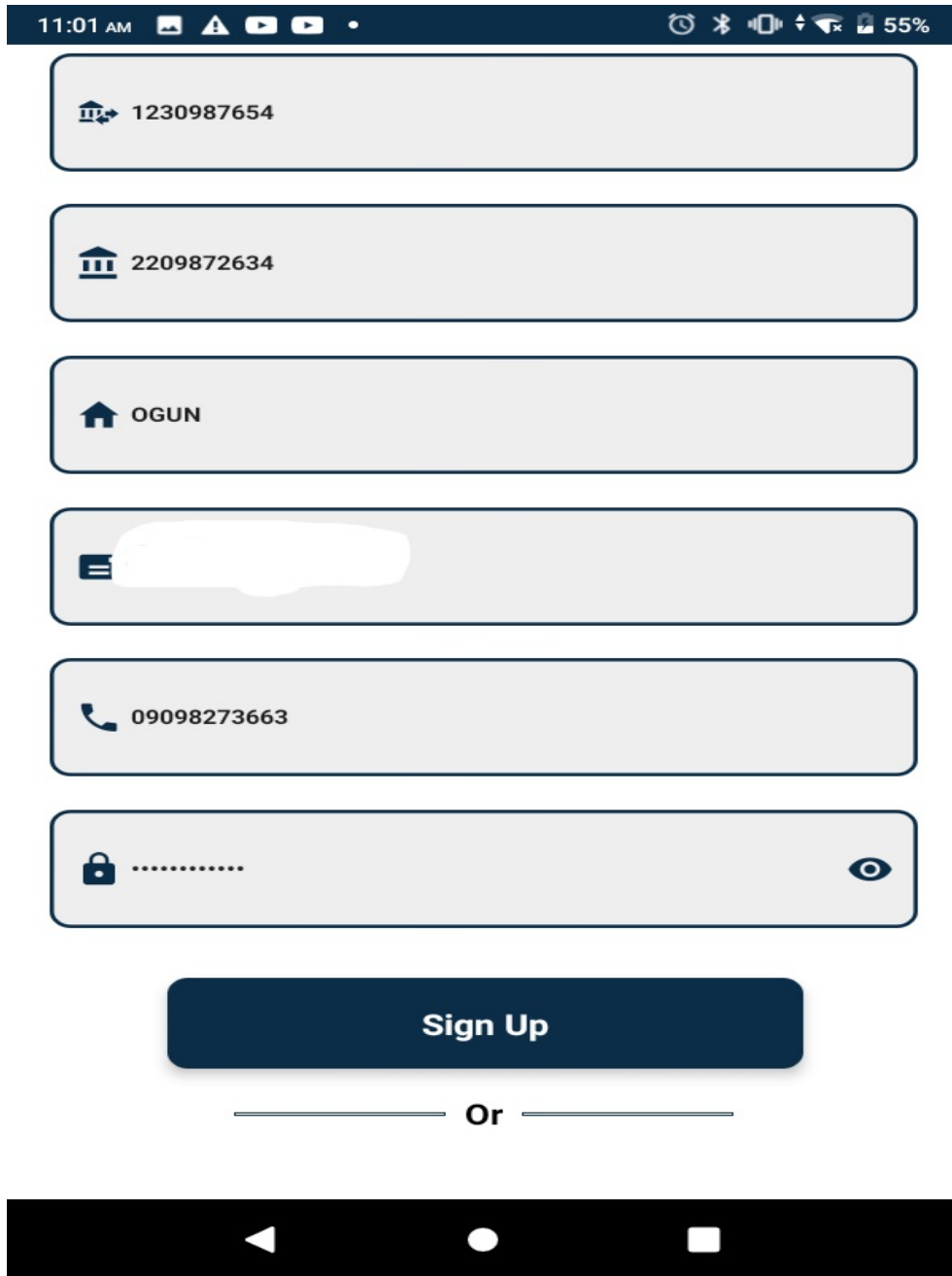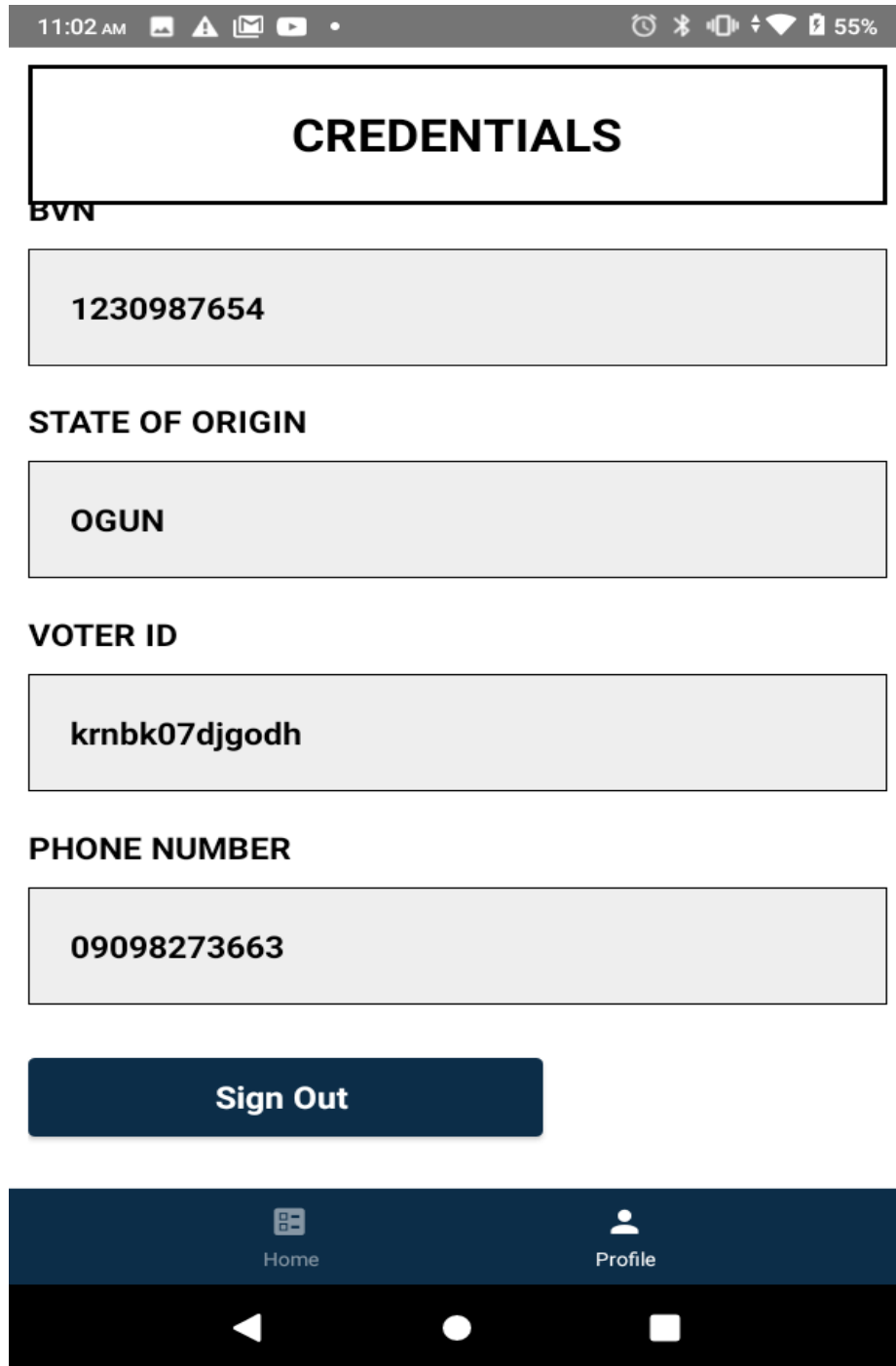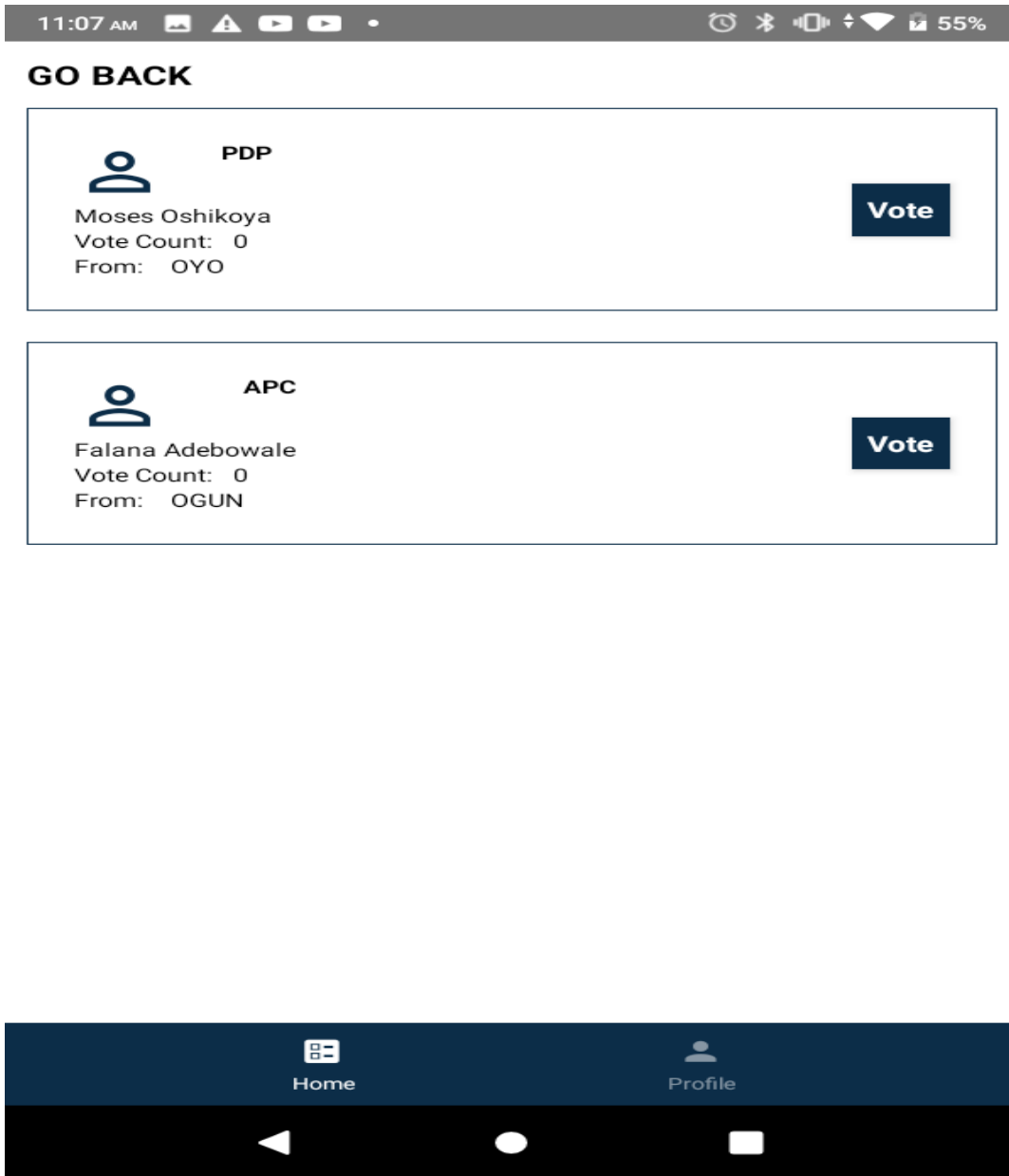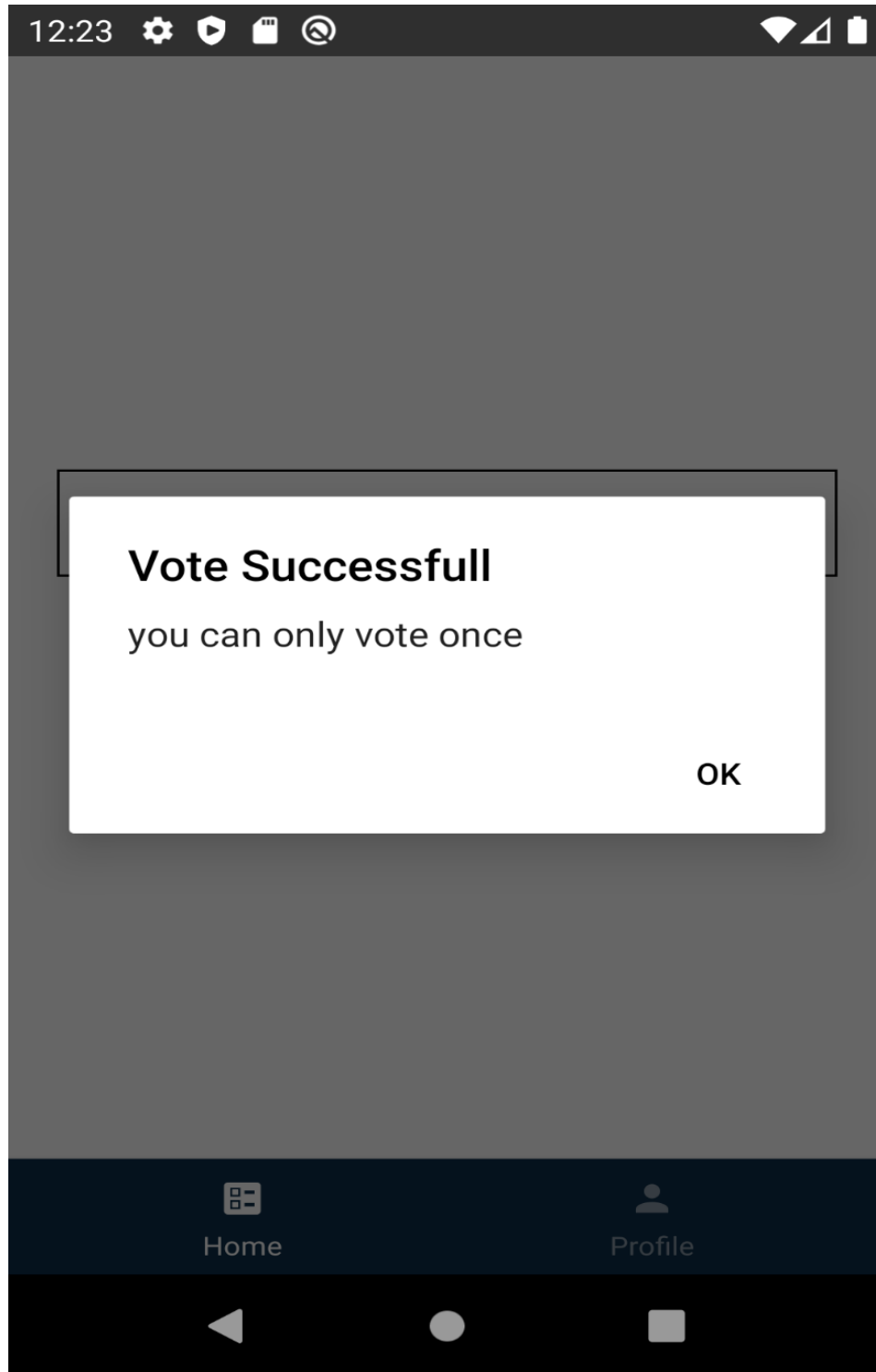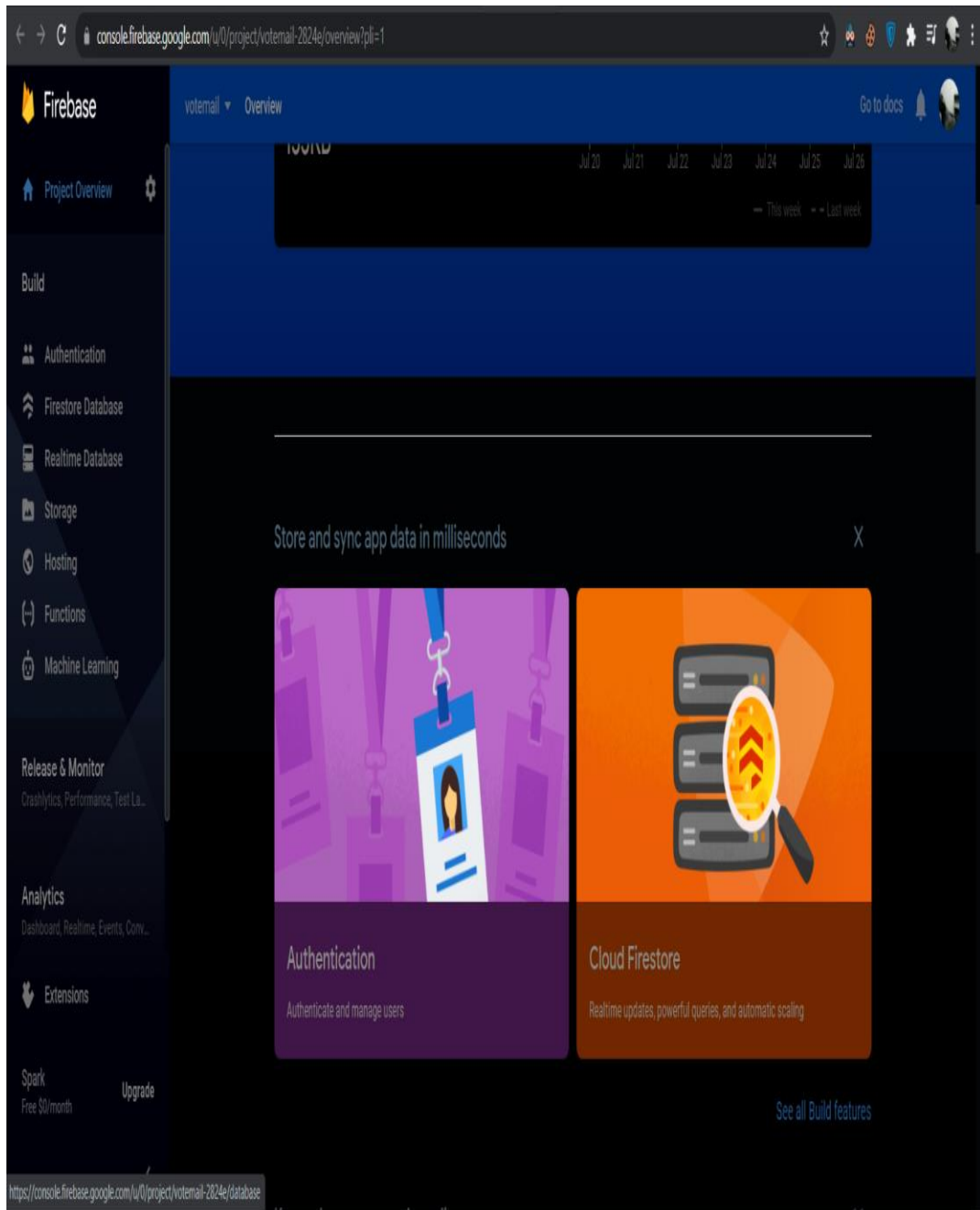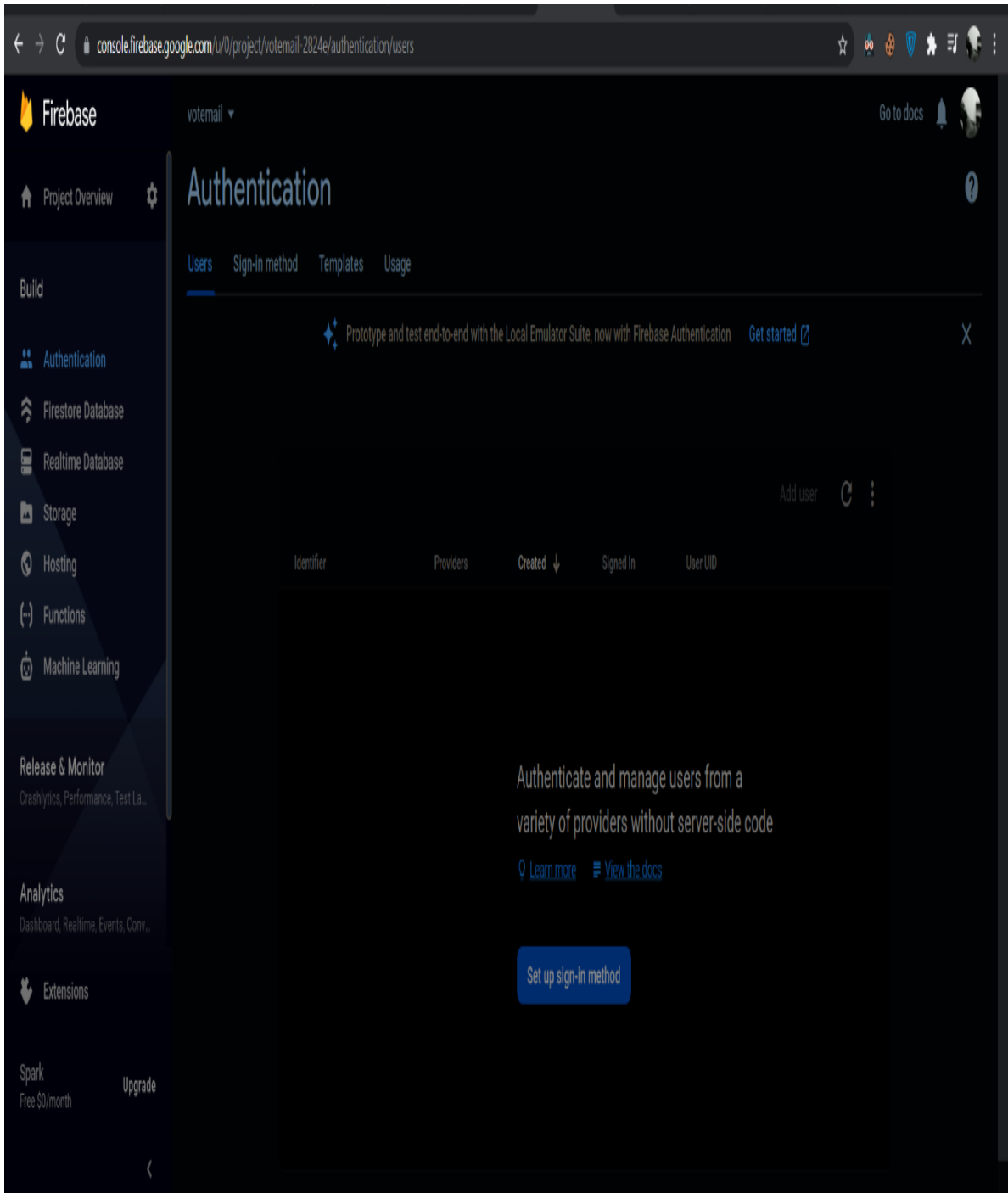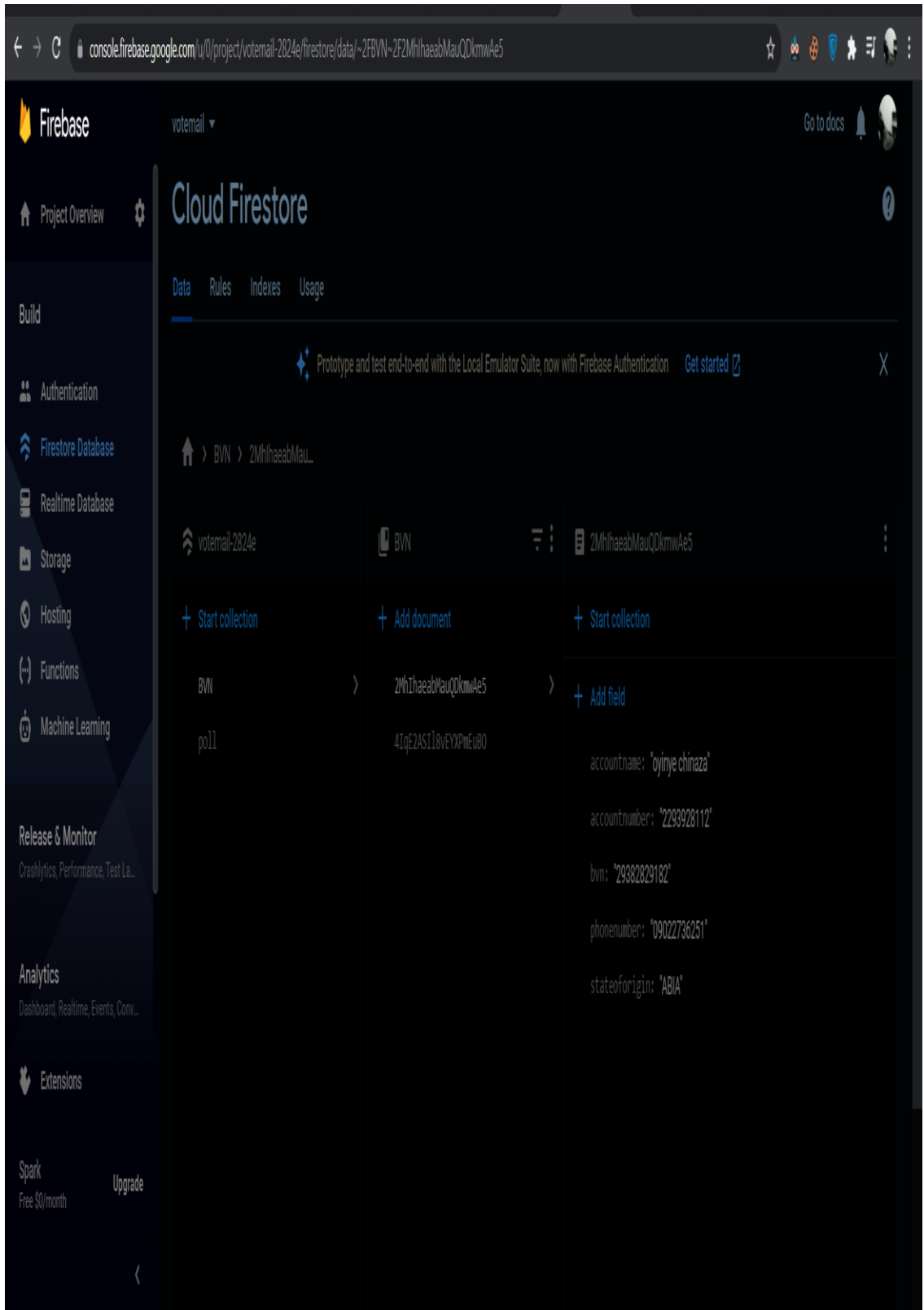This chapter has the following sections: Conclusion, Interpretation, Limitations, and Recommendation. An introduction to the voting system, as well as a description of the traditional manual ballot voting system and its drawbacks, were offered at the opening of the project chapter. A brief discussion of the research problem, research techniques, and so on was held with the project's goal and objectives in mind. The primary subjects discussed in the chapter two literature review are the role of elections in a democratic society, electronic voting methods, problems with traditional ballot systems, and the flaws of the traditional voting method. In chapter three, system analysis and design were investigated utilizing a variety of flowcharts, use cases, and sequence diagrams to explain. The basics of React Native testing with various approaches and how the apps can be tested using various frameworks. The test-automation frameworks covered here are widely accepted and used for native mobile apps, hybrid apps, the mobile web and React Native apps. The programming language used to build mobile apps is not critical because it won't have any influence on the test-automation frameworks. The hardware and software specifications have also been released. In chapter four, the implementation and screenshots of the working system were explained, as well as the justifications for using certain languages. Several screenshots were used to demonstrate the development environment, and the system was examined and concluded at the end of the chapter.

5.2   Conclusion and Limitations

Because this is a B.Sc. project, it has limits because a mobile voting system, which is a complicated project to perform in the real world, requires a lot of resources and finances.

The following are some of the constraints encountered:

a. Time constraints: all the progress made was due to the little time duration provided to execute the project

b. Cost: The whole project execution cost roughly 250,000 naira to build and complete and constraints on resources and internet connectivity

The system's limitations are as follows:

a. This application is only available to bank customers who have a bank verification number.

b. This application is only available to registered citizens, voters can only cast their ballots using a smartphone with internet access.

5.3 Recommendations

Recommendation for the smooth and efficient running of the system: Training of Voting officials on database management and automation and training voters on operating smartphones and modern electoral practices. Future recommendations include applications in universities and higher institutions as well as organizations. I recommend further cloud

computing applications and additional authentication means like fingerprint or facial biometrics.

References

aceproject. (2021, june 5). *Types of E-Voting*. Retrieved from aceproject.org: https://aceproject.org/ace-en/focus/e-voting/types-of-e-voting/mobile_browsing/onePag

Adebayo, O. S., Ugiomoh, D. O., & AbdulMalik, M. D. (2013). The Design and Development of Real-Time E-Voting System in Nigeria with Emphasis on Security and Result Veracity. *International Journal of Computer Network and Information Security*, 5(5), 9.

Adel, K., Yasmin, G., Dima, S., & Dalya, M. (2013). M-Vote: A Reliable and Highly Secure Mobile. *researchgate.net/publication/261321411* (p. 10). software Engineering Department ALHOSN University Abu Dhabi, UAE: www.researchgate.net/publication/261321411. doi:10.1109/PICICT.2013.25

Adesuwa, O. (2015). *ONLINE VOTING SYSTEM WITH BIOMETRIC AUTHENTICATION FOR UI ELECTIONS.* UNIVERSITY OF IBADAN, NIGERIA: researchgate.net.

Asiamah, O. B., Adjei, A. A., prince, Y., & Singh, K. (2019). DESIGN OF A SIMPLE REMOTE ONLINE VOTING SYSTEM WITH TOKEN GENERATION. *International Journal of Advanced Research in Engineering and Technology*

(IJARET), *10*(6), 96-103. Retrieved from http://www.iaeme.com/IJARET/issues.asp?JType=IJARET&VType=10&IType=6

Augoye, V. (2013). *Electronic Voting: An Electronic Voting Scheme using the Secure Payment card System.* University of London Egham. Surrey TW20 0EX, United Kingdom: Information Security Group,. Retrieved from http://www.ma.rhul.ac.uk/tech

Bone, R. M. (2020, march 28). *Three key issues dominating Nigeria's election*. Retrieved from atlanticcouncil.

elections.smartmatic. (2019, September 27). *What is Electronic Voting and its Advantages?* Retrieved from elections.smartmatic: https://elections.smartmatic.com/electronic-voting-advantages/

Emad , A.-S., Rawan, K., & Izzat, A. (2016). Human-Centered System Design for Electronic Governance. In G. R. Christopher, & S. Saqib, *Human-Centered System Design for Electronic Governance* (p. 19). 701 E. Chocolate Avenue Hershey : Information Science Reference (an imprint of IGI Global).

Emeka, A. G. (2016, January). E-Voting and Credible Elections in Nigeria. *International Journal of Engineering Science Invention, 5*(1), 01-14. Retrieved from www.ijesi.org

Firas , H., & Seifedine, K. (2012, October). New System of E-Voting Using Fingerprint. *International Journal of Emerging Technology and Advanced Engineering, 2*(10), 9. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.414.585&rep=rep1&type=pdf

G. Rao et al. (2011). Three dimensional virtual environment for secured and reliable authentication. *Journal of Engineering Research and Studies*, 2(2), 68–75.

Htet, ne oo; Aye, Moe Aung. (2014). Survey of Different Electronic Voting Systems. *International Journal of Scientific and Engineering Research*, 3460-3464.

Idris, A., & Yusof, R. (2015). Adoption of E-voting System in Nigeria: A Prospect for Poverty Alleviation. *International conference of E-Commerce*, (p. 5). Northern Corridor Research Centre, College of Business Studies (NCRC), Universiti Utara Malaysia.

inecnigeria. (2019, February 1). *MyINEC Mobile App*. Retrieved from inecnigeria: https://inecnigeria.org/news-all/myinec-mobile-app/

Javaid, A. (2014, January). Electronic Voting System Security. *SSRN Electronic Journal*, 19. doi:10.2139/ssrn.2393158

Kathleen, R., & Ivy, W. (2018, November 10). *one-time password (OTP)*. Retrieved from searchsecurity.techtarget: https://searchsecurity.techtarget.com/definition/one-time-password-

OTP#:~:text=A%20one%2Dtime%20password%20(OTP,or%20reused%20across %20multiple%20accounts.

Krisheswari, K., Jagadeswari, K., & Kannan, P. (2018). SMART VOTING SYSTEM USING ANDROID. *The International Journal for Research Trends and Innovation (IJRTI)*, 2456-3315.

Lee, J. (2015, Oct 20). *Nigeria to link biometric BVN with national ID card by 2016*. Retrieved from biometricupdate: https://www.biometricupdate.com/201510/nigeria-to-link-biometric-bvn-with-national-id-card-by-2016

maxweber. (2021, June 18). *Election*. Retrieved from en.wikipedia.org: https://en.wikipedia.org/wiki/Election

Njideka , M., Umeh , I., & Chukwunonso, N. (2021). An Online Voting Platform for Nigeria's Independent National Electoral Commission. *International Journal of Advanced Trends in Computer Science and Engineering*.

Njoku, D. O., Amaefule, I. A., Ikenna, N. C., & Janefrances, J. E. (2018, May). Application of ICT and Electronic Technology in Election Management: Challenges in Rural Areas in South-Eastern Nigeria. *International Journal of Advanced Engineering, Management and Science (IJAEMS), 4*(5). Retrieved may 21, 2021, from https://dx.doi.org/10.22161/ijaems.4.5.3

Nwogu, E. (2015). Mobile, Secure E -Voting Architecture for the Nigerian Electoral System. *IOSR Journal of Dental and Medical Sciences, 17*(2), 27-36. doi:DOI: 10.9790/0661-17222736

Okpara, C. R. (2018). *DEVELOPMENT OF A MOBILE ANDROID VOTING APP FOR TERTIARY INSTITUTIONS IN NIGERIA.* Federal University of Technology, Owerri, Imo State, Nigeria.: researchgate.net.

Philanthropies, T. (2021, January 10). *mobile-voting-101*. Retrieved from mobilevoting.org: https://mobilevoting.org/mobile-voting-101/

polyas. (2020, January 10). *Ballot Box Election*. Retrieved from polyas.com: https://www.polyas.com/election-glossary/ballot-box-election

Rao, G., Patil, S., & Deep, K. (2011). Three dimensional virtual environment for secured and reliable authentication. *Journal of Engineering Research and Studies*, 2(2), 68–75.

Sylvester, I. A. (2013). *Security Analysis of Electronic Voting (E-voting) System (Nigeria).* JOS, NIGERIA: cloudfront.net.

Thakkar et al. (2016, March - April). Online Voting System (Android Application). *IOSR Journal of Computer Engineering (IOSR-JCE), 18*(2), 42-45. Retrieved June 1, 2021, from www.iosrjournals.org

Thakkar, S., Pawar, N., Sarang, N., & Prof.Vijaylaxmi, K. (2016, March - April). Online Voting System (Android Application). *IOSR Journal of Computer Engineering (IOSR-JCE), 18*(2). Retrieved may 10, 2021, from www.iosrjournals.org

WANG, J. (2014). *VOTING ON A MOBILE PLATFORM*. University of Illinois at Urbana-Champaign, Computer Science. University of Illinois at Urbana-Champaign: ideals.illinois. Retrieved from https://www.ideals.illinois.edu/bitstream/handle/2142/49589/Jicong_Wang.pdf?sequence=1

wikipedia. (2021, June 21). *Electoral system*. Retrieved from en.wikipedia.org: https://en.wikipedia.org/wiki/Electoral_system

Zsolt Szolnoki, Szolnoki, Z., & Staak, S. V. (2020, November 17). *Mobile Voting – Serving Voters, Protecting Democracy*. Retrieved from idea.int: https://www.idea.int/news-media/events/mobile-voting-serving-voters-protecting-democracy

APPENDIX

SOURCE CODE FOR DESIGNED SYSTEM

Authentication source code:

```
import {auth, db} from '../config/firebaseconnect';

export const logInUser = async (email, password) => {

 try {

   const isSignedIn = await auth.signInWithEmailAndPassword(email, password);

   if (!isSignedIn) {

     return {

       error: "Can't sign in",

     };

   }

 } catch (error) {

   if (error.code === 'auth/user-not-found') {
```

```javascript
      return 'User does not exists';

    }

    if (error.code === 'auth/wrong-password') {

      return 'Invalid credentials';

    }

    return 'Server error';

  }

};

export const verifyUser = async (bvn, email) => {

  try {

    const bvnDoc = await db.collection('bvn').doc(bvn).get();

    if (bvnDoc.exists) {

      return bvnDoc.data();

    }

    if (!bvnDoc.exists) {

      return {error: 'User does not exist'};

    }
```

```
  } catch (error) {

    return {error: 'Network Error'};

  }

};

export const signUserUpWithMailandRegUser = async (

  email,

  password,

  account_name,

  phonenumber,

  account_number,

  state_of_origin,

  bvn,

) => {

  try {

    console.log('I reached here');

    const isRegistered = await auth.createUserWithEmailAndPassword(

      email,
```

```
    password,

 );

 try {

   const sentEmail = await isRegistered.user.sendEmailVerification({

     handleCodeInApp: false,

     url: 'https://mailvote.page.link/verify',

     android: {

       packageName: 'com.mailvote',

       installApp: false,

     },

   });

   sentEmail && 'Email Sent';

 } catch (error) {

   return 'Error Sending Mail';

 }

 const currentUser = auth.currentUser.uid;

 isRegistered.user.updateProfile({
```

```
    displayName: account_name,

  });

  try {

    await db

      .collection('Users')

      .doc(currentUser)

      .set({

        email,

        password,

        account_name,

        phonenumber,

        account_number,

        state_of_origin,

        bvn,

        userId: currentUser,

        voterId:

          Date.now().toString(36) + Math.random().toString(36).substr(2, 5),
```

```
    });

  } catch (error) {

    return 'Error Saving User details';

  }

} catch (error) {

  if (error.code === 'auth/email-already-in-use') {

    return 'That email address is already in use!';

  }

  if (error.code === 'auth/invalid-email') {

    return 'That email address is invalid!';

  }

  console.log(error);

  return 'Server error';   }

};

export const getUserProfile = async () => {

 const id = auth.currentUser.uid;

 try {
```

```
    const user = await db.collection('Users').doc(id).get();

  if (user.exists) {

    return user.data();   }

 } catch (error) {

  console.log(error);

 }

};
```