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## **Abstract**

A blockchain-based e-voting website allows users to vote electronically on a decentralized and secure platform. The e-voting website can provide a dependable and trustworthy voting system that protects the integrity and privacy of the voting process by using the features of blockchain, such as immutability, transparency, and security.

Users can register and verify their identity via a secure authentication mechanism on this e-voting website. They may visit the portal after registering to examine a list of candidates and vote. The votes are tamper-proof recorded on the blockchain, ensuring that the election results are accurate and cannot be changed.

In general, the incorporation of blockchain technology into an e-voting platform has a variety of advantages, including improved security, transparency, and efficiency. It offers a trustworthy and dependable platform for holding elections and has the power to completely alter how elections are held in the future.

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## CHAPTER 1: INTRODUCTION

### 1.1 PROJECT DESCRIPTION

The right to vote is a constitutional right given to every citizen of any democratic country and Citizens, as stakeholders of the state, elect their respective representative via elections (ROJAS, 2005). Voting is still being conducted through paper ballots, regardless of the numerous technological advancements in today's society making elections inefficient as well as outdated (Javier Díaz-Santiso, 2021).

Even though democracies have started to use electronic voting for national scale elections, there are still no ideal, dependable, and efficient electronic voting system for people since the election requires one or more authorities for both authentication and protecting voters' privacy, and it is also difficult for voters to believe in the public authority that, it will always follow the rules or never be breached (Wei-Jr Lai, 2021).

The blockchain is globally divided and fully decentralized, meaning it has no supervisor or someone that can be blamed or rewarded (Söze, 2017). The Blockchain is made up of multiple irreplaceable blocks, i.e., a chain system (whenever a new block is established and included to blockchain, it replicates itself on its system, which remains on the internet, then simply syncs the same information on all the nodes operating in blockchain) representing a single source of truth (Söze, 2017). These features qualify blockchain to host major events like elections in its network.

### 1.2 CURRENT SCENARIO

- Paper ballot voting requires cumbersome manual work, a huge budget, and a substantial amount time and manpower for the overall election process (Simkhada, 2012). For example, the Election Commission prints around 20 million ballot papers, for which the country spends around NPR 110 million only on paper supply (Rijal, 2022).
- The existing system cannot guarantee prevention from unlawful manipulation of the data before or after casting a vote (Javier Díaz-Santiso, 2021). For example, some people seized the polling stations, tore up the remaining ballot papers, and ran away with the ballot boxes in two polling stations in Rautahat (Rijal, 2022).

- Due to the complexity of the balloting system every election many votes are disqualified because of various human errors.
- It also affects voter engagement. In the context of Nepal, about 4 million Nepalese could not vote simply because they were in a foreign country during election (Rijal, 2022).
- The voting sometimes gets halted and does not proceed as planned due to various natural disasters and human interferences (Javier Díaz-Santiso, 2021). For example, in the previous election, 79 polling centers were halted, and voting was postponed in 28 municipalities of 16 districts due to various reasons (Rijal, 2022).

### 1.3 PROBLEM DOMAIN

- Election fraud: Traditional ballot systems are vulnerable to election fraud, which can occur in various ways, such as ballot stuffing, fake voting, and tampering with ballot boxes. These activities can compromise the integrity of the electoral process and undermine public trust in the election results (ROJAS, 2005).
- Long lines and waiting times: Traditional ballot systems often involve long lines and waiting times at polling stations, which can discourage people from voting, especially those with disabilities, the elderly, and those with limited mobility (ROJAS, 2005).
- Limited accessibility: Traditional ballot systems may not be accessible to people with disabilities, making it difficult or impossible for them to cast their votes independently and privately (ROJAS, 2005).
- Human error: Traditional ballot systems are prone to human error, which can lead to invalid ballots or miscounts (ROJAS, 2005).
- Cost and logistics: Traditional ballot systems can be expensive and time-consuming to set up and maintain, especially in large or remote areas. This can pose a significant logistical challenge for election officials (ROJAS, 2005).
- Lack of transparency: Traditional ballot systems may lack transparency in the counting and tabulation of votes, making it difficult to ensure the accuracy and integrity of the results (ROJAS, 2005).

- Voter intimidation: Traditional ballot systems can be susceptible to voter intimidation, where voters may feel pressured to vote a certain way, or they may be targeted by physical or verbal harassment or violence at polling stations.

## 1.4 PROJECT AS A SOLUTION

- E-voting is a faster and more economy efficient and can be the best alternative in countries like Nepal where the infrastructure is poor and the population highly dispersed (Simkhada, 2012).
- The use of blockchain network covers up the security problems occurring in a regular centralized e-voting system (Javier Díaz-Santiso, 2021).
- The proposed project increases the accessibility for the voters and simultaneously decreasing voter fraud (Javier Díaz-Santiso, 2021).
- The chances of voting being halted drops to negligible as the blockchain network would be unaffected even after failure of one or more nodes (Cabanac G, 2022).
- The e-voting system could provide sufficient transparency while not raising any privacy issues (Cabanac G, 2022).
- Through the proper use of smart contracts each ballot could be counted anonymously, correctly, and efficiently (Javier Díaz-Santiso, 2021).

## 1.5 AIM AND OBJECTIVES

### 1.5.1 AIM

- The aim of this project is to create an electronic voting system that provides decentralization as well as immutability and improves the current voting systems in terms of performance and reliability.

### 1.5.2 OBJECTIVES

The objectives for the completion of the proposed project are:

- To learn more about HTML, CSS and JavaScript and be able to create a user-friendly website for e-voting system.
- To dive deeper into the study of blockchain network and its functionalities.
- To become familiar with truffle (coding environment for blockchain).

- To learn more about Web3.js libraries and its alternatives.
- To understand and become capable of implementing smart contracts as per the requirements of the project.

## 1.6 STRUCTURE OF THE REPORT

### 1.6.1 BACKGROUND

The background section is intended to set the context for the information that follows. It comprises a quick introduction of the issue at hand, as well as any important background information required for the reader to grasp the context of the report. The background section may also include a description of any research or data that has been gathered and processed, as well as a summary of any major results or conclusions made from this study.

### 1.6.2 DEVELOPMENT

The development part of a report is intended to present and explain the project's significant results or development in greater depth. It may contain descriptions of any study or data gathered, as well as any analysis or interpretation of this data. In general, the development section is intended to give a more in-depth study of the project's progress as well as a deeper grasp of the issue under discussion.

### 1.6.3 TESTING AND ANALYSIS

An analysis of progress entails reviewing the progress achieved toward the project's goals and objectives. This may entail evaluating any completed milestones, examining any data or metrics gathered, and assessing any obstacles or issues that have developed throughout the course of the project.

### 1.6.4 CONCLUSION

The report's conclusion provides a comprehensive overview of the topics discussed earlier, including an analysis of the potential legal, social, and ethical challenges that could arise from the use of a smart mirror. It also explores potential enhancements or updates that could be made to the smart mirror in the future.

## CHAPTER 2: BACKGROUND

### 2.1 ABOUT THE END USERS

#### 2.1.1 CLIENT

- **Name of the Client:**

Shurachith Cooperative (Rajan Ghimire)

- **Client's Description:**

Shurachith Cooperative, a renowned co-operative formed in 2067 B.S., is the client for this final year project (FYP). The firm has a good reputation in the sector and a dedicated customer base. Shurachith Cooperative, based in Hetauda, provides standard banking services such as checking and savings accounts, as well as loans.

As part of the FYP, Mr. Rajan Ghimire representative of the Shurachith Cooperative's management will review and make suggestions as well as collaborate to create an e-voting website using blockchain technology and is willing to cooperate with the concepts and satisfy the requirements that have been specified.

- **Client's Requirements**

- i. The website should be easy-to-use and have user-friendly UI.
- ii. The project should be secure.
- iii. The project should maintain vote and voter's privacy i.e., voters should be able to cast their ballots in private, without fear of reprisal or coercion.
- iv. The project should maintain transparency and fairness i.e., voting process should be transparent, impartial, and free from undue influence.
- v. The project should be auditable and be accurate i.e., the results of the election should be able to be verified and audited to ensure the accuracy and integrity of the process.

- **Client's Approval Letter**

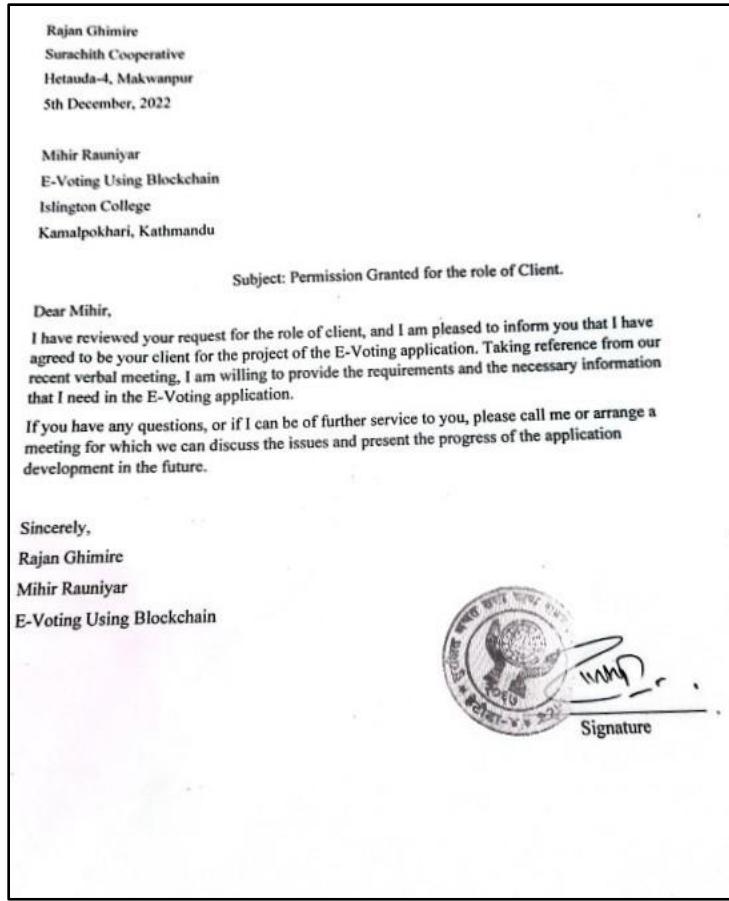


Figure 1: Client's Approval Letter

### 2.1.2 END USERS

End users of an e-voting system using blockchain could be the citizens of the country or people of an organization where the system is implemented. This system has the potential to make voting more accessible, convenient, and secure for voters. Blockchain technology provides a tamper-proof and transparent record of transactions, which can increase public trust in the electoral process and ensure the accuracy and integrity of the results. However, concerns about accessibility and inclusivity remain as not all voters may have access to the necessary technology or internet connectivity to participate in the system. Moreover, voters may need to be educated on how to use the e-voting system effectively and securely, as well as how to verify the accuracy of the results.

## 2.2 UNDERSTANDING THE SOLUTION

### 2.2.1 Project Elaboration

The Ethereum blockchain voting website is a web-based application that utilizes Ethereum's decentralized, open-source blockchain platform to enable secure and transparent voting in elections. This website uses a range of technologies and features to enable this functionality, including:

**Smart contracts:** Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. The voting website would use smart contracts to automate the voting process, including the counting and reporting of votes.

**User interface:** The voting website would have a user interface that allows voters to cast their ballots electronically, and provides them with real-time updates on the voting process.

Lastly, this website is a complex and sophisticated application that leverages the power of blockchain technology to enable secure and transparent voting. It is designed to be user-friendly and easy to use, while also providing the necessary security and transparency to ensure the integrity of the voting process.

### 2.2.2 Features Description and Working

#### i. Login:

The login feature allows authorized users, such as election officials or registered voters, to access the e-voting system. This feature requires correct username and password to enter the system.

#### ii. Add Candidate:

The add candidate feature allows election officials/ admin to add candidates to the e-voting system. Candidates' information i.e., their name would be recorded in a tamper-proof and transparent manner in the blockchain.

#### iii. Voter Authentication:

The voter authentication feature ensures that only eligible voters can participate in the election. This feature involves the admin to authenticate the eth address of the voter.

iv. Voting:

The voting feature allows registered voters to cast their vote in the election. The system records the vote in a tamper-proof and transparent manner, ensuring the accuracy and integrity of the voting process.

v. Start/End Election:

The start/end election feature allows election officials/ admin to open and close the voting process in the system. This feature ensures that the voting process starts and ends at a desired time and that no votes are cast outside of the designated voting period.

vi. Monitor Votes:

The monitor/ analytics feature allows admin to monitor the voting process in real-time. It can track the number of votes cast and ensure that the system is working properly.

## 2.3 SIMILAR PROJECTS

### 2.3.1 PROJECT 1: Candida18/ Online-Voting-System

**Author/s:** Candida Noronha

**Project Description:** The term “ONLINE VOTING SYSTEM” refers to an online voting method. Authorized voters can use this technology to vote online instead of visiting to a polling place. A database is kept in which all the names of voters with comprehensive information are preserved.

Front-End: HTML, CSS, JAVASCRIPT and Bootstrap

Back-End: PHP

Database: My SQL

GitHub Link: <https://github.com/Candida18/Online-Voting-System>

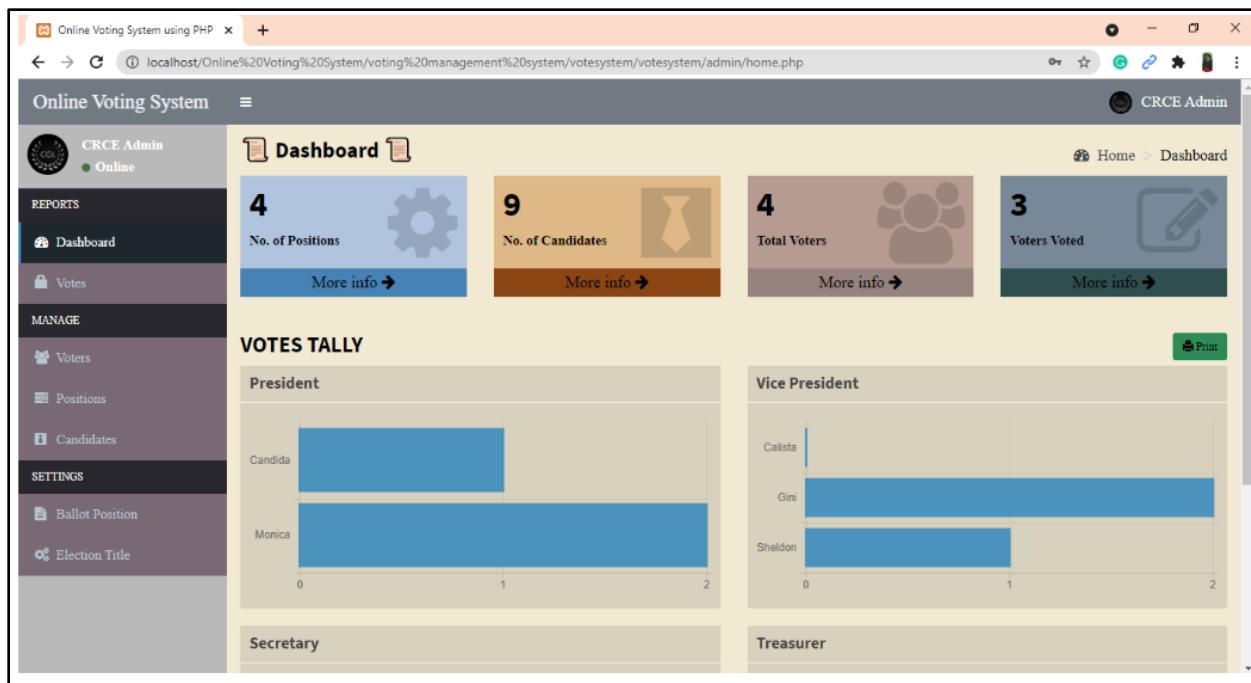


Figure 2: Project 1 (Noronha, 2021)

### 2.3.2 PROJECT 2: vidhikhatwani / Polling-System-Java-Application

**Author/s:** Vidhi Khatwani

**Project Description:** The Online Polling System is a Java program with essential GUI and database attributes that dictate the software needs for this project. This project is intended for low-volume voting procedures such as college elections or feedback forms. We will give an online facility for voting on various questions provided by the administrator/organizer in this project.

GitHub Link: <https://github.com/vidhikhatwani/Polling-System-Java-Application>

**APPLICATION OUTPUTS:**

Welcome page/  
sign in page:

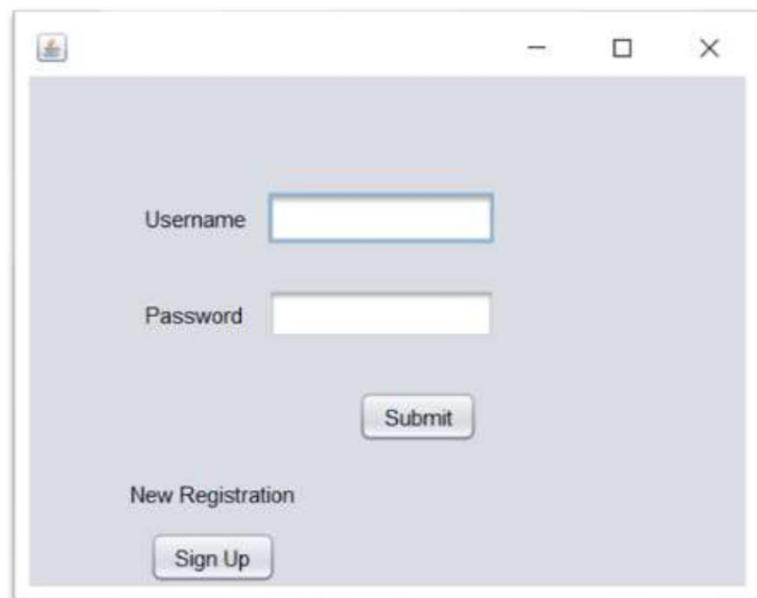


Figure 3: Project 2 (Khatwani, 2022)

**2.3.3 PROJECT 3: shah-deep / Online-Voting-System**

**Author/s:** Deep Shah

**Project Description:** It's a desktop program built in Python that makes use of socket technology. It benefits from synchronous multithreading. Python socket programming might be used to build a system in which voters can connect to a server through the internet, cast their ballots, and have their votes recorded and tabulated in real-time. E-voting in Python utilizing socket programming is a simple and efficient way for voters to cast their ballots electronically without having to physically visit a polling location.

GitHub Link: <https://github.com/shah-deep/Online-Voting-System>

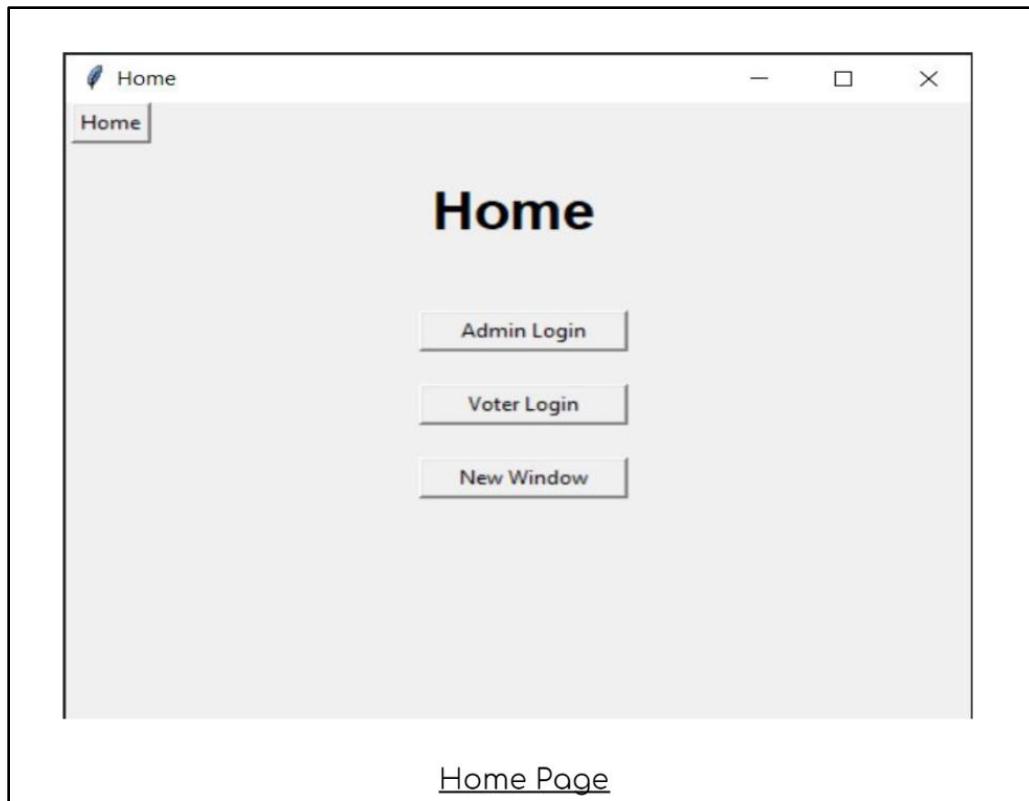


Figure 4: Project 3 (Shah, 2022)

## 2.4 COMPARISONS

### 2.4.1 COMPARISON TABLE

S.N.	Features	Project 1	Project 2	Project 3	This Project
1	Uses Blockchain	X	X	X	✓
2	Provides Authenticity	✓	✓	✓	✓
3	Provides Verifiability	✓	✓	X	✓
4	Is Widely Accessible	✓	✓	X	✓
5	Is Secure	X	X	X	✓
6	Is Scalable	✓	✓	X	✓
7	Maintains Vote Privacy	X	X	✓	✓

Table 1: Comparison Table

## 2.4.2 CRITICAL EVALUATION

When compared to other systems, this project offers several advantages. The other projects are prone to several vulnerabilities and lack of features. In contrast, this system offers several unique features, such as transparency, security, and immutability of records.

Overall, this system offers more as well as important features that make it more secure, transparent, efficient, and accessible than the other projects. This project's implementation of e-voting using blockchain can help ensure fair and transparent electoral processes, increase public trust in the voting system, and encourage more participation in the democratic process.

## CHAPTER 3: DEVELOPMENT

### 3.1 CONSIDERED METHODOLOGIES

- Waterfall Methodology

The fundamental life cycle model for software development is the waterfall model. It is crucial since the conventional waterfall model serves as the foundation for all other software development life cycle models. The life cycle is divided into many segments according to the traditional waterfall paradigm. This model takes into account the possibility of starting a phase after the preceding phase has ended. That is, the input for the following phase will be the output of the previous one. As a result, the development process may be viewed as a waterfall's sequential flow. The phases do not overlap in this instance (Geeks for Geeks, 2022).

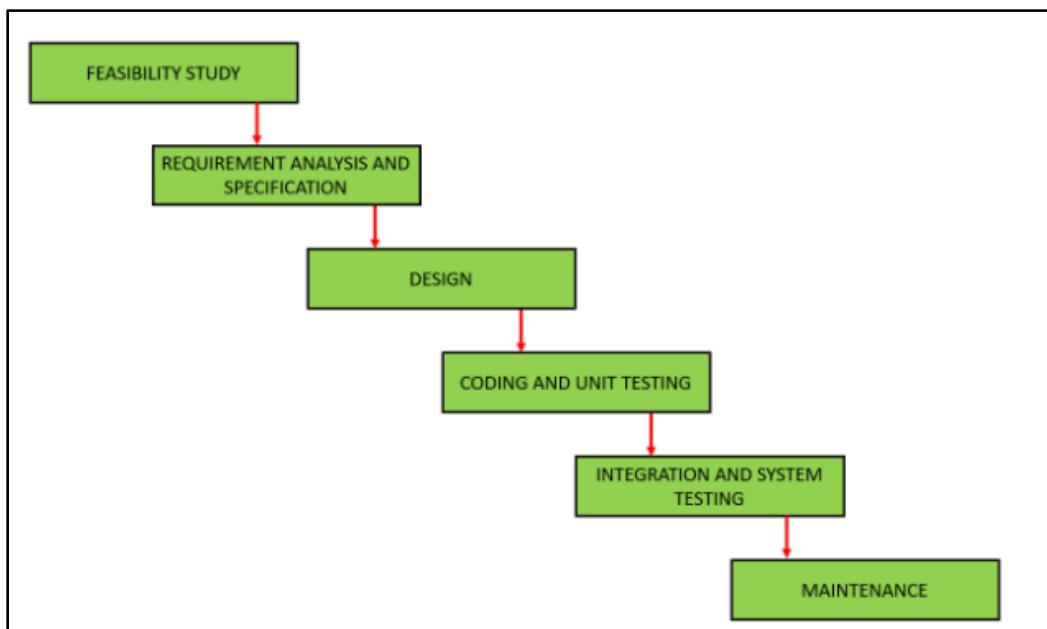


Figure 5: Waterfall Methodology (Geeks for Geeks, 2022)

- Agile Methodology

It is a process in which the need and its solution emerge via the collaborative activity of teams and the client. The activity is divided into numerous phrases, and continual

improvement and iteration are accomplished by communicating with stakeholders. Sprints are the names given to the divided portions (Young, 2013).

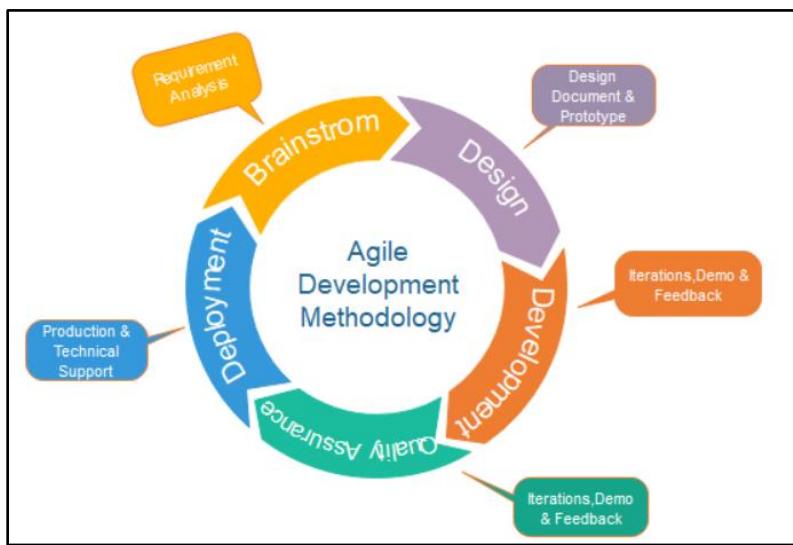


Figure 6: Agile Methodology (JavatPoint, 2022)

### 3.2 SELECTED METHODOLOGY

The methodology chosen for the development and completion of this project is Prototype Methodology. It is explained below:

- **Prototype Methodology**

When users do not know the specific project needs ahead of time, the prototyping model is employed. In this approach, a prototype of the eventual product is created, tested, and improved based on consumer input until a final acceptable prototype is reached, which serves as the foundation for building the final product (Young, 2013).

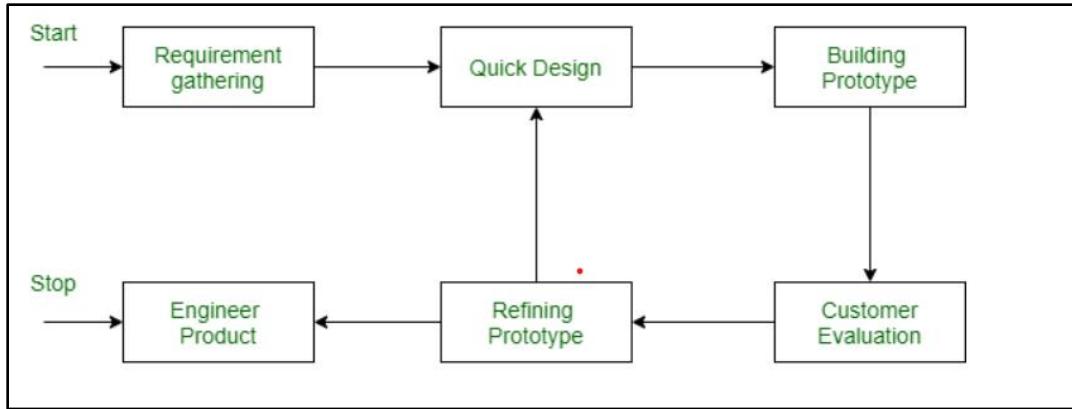


Figure 7: Prototype Methodology (Geeks for Geeks, 2022)

The advantage and disadvantages of Prototype methodology are:

**Advantage:** Allows designers and developers to test out new ideas and concepts fast and cheaply: Because prototypes are often simpler and less comprehensive than finished products, they may be manufactured and tested more rapidly and inexpensively than completely completed products. As a result, prototype technique is a versatile and effective tool for exploring many design possibilities and gathering feedback.

**Disadvantages:** Creating prototypes may be time-consuming, especially if numerous prototypes are required to properly test and perfect the concept. This may necessitate a large expenditure of time and resources, which may be detrimental to some initiatives.

### 3.3 PHASES OF PROTOTYPE METHODOLOGY

The phases of the prototype methodology for the development of this project are explained below:

#### 3.3.1 Planning and scoping

This step entail establishing the e-voting system's aims and objectives, as well as outlining any particular needs or restrictions that must be considered.

### **3.3.2 Design and development (Front-End)**

The design of the e-voting system is created and polished during this phase. This includes building wireframes, front-end codes, testing alternative design elements, and getting client input.

### **3.3.3 Design and development (Smart Contract)**

During this phase, the code for the e-voting system's smart contracts is written. This step also includes experimenting with various coding styles and selecting the best efficient code for the smart contract.

### **3.3.4 Testing**

The prototype e-voting system is tested in this step to confirm that it is functional, secure, and user-friendly. This includes client's and developer's tests as well as evaluating the system's technical backbone.

### **3.3.5 Refinement**

The prototype e-voting system is refined and enhanced as needed based on the results of testing. This may include changing the design, adding new features, or correcting any flaws or difficulties discovered during testing.

### **3.3.6 Deployment**

The e-voting system is ready for use in an election after it has been improved and tested. This may include establishing the technological infrastructure required to support the system, as well as any voter registration and voting processes that may be required.

## **3.4 SURVEY RESULTS**

### **3.4.1 PRE-SURVEY RESULTS**

A survey was conducted to gather insights about the attitudes and behaviours of voters regarding e-voting using blockchain technology. The survey was conducted online and included 26 responses from different cities across the country.

The results of the survey showed that the majority of respondents (73.1%) at least heard of the blockchain technology and (26.9%) understood its potential benefits. The main

motivations for using e-voting with blockchain cited by respondents included increased security, transparency, and the potential for faster and more efficient vote counting.

However, the survey also revealed that there were some concerns about the use of e-voting with blockchain. The main concerns cited by respondents included the potential for technical failures, a lack of trust in the about the proper implementation of electronic voting systems, and a preference for traditional in-person voting.

Lastly, the survey results suggest that while there is strong interest in the potential of e-voting with blockchain, there are also some reservations about its adoption. Further research could be conducted to address these concerns and to explore ways to increase trust and confidence in the security and integrity of e-voting systems using blockchain technology.

For More Details, Click [Here](#)

### **3.4.2 POST-SURVEY RESULTS**

After the completion of the development, a survey i.e., post-survey was conducted to gather the thoughts of the people after using the system. The survey was hosted through google forms and it gathered 15 responses (client not included) from people who used the system.

The results of the survey showed that the majority of respondents i.e., 93.3% found the application user-friendly, 86.7% found the instructions clear and easy to understand, and all the people i.e., 100% were able to cast their vote without any difficulties.

Also, all the people find it important that votes are recorded immutably in blockchain i.e., Very High – 53.3%, High – 40%, Medium – 6.7%. The same can be seen in the case of personal information being secure although 6.7% people are uncertain majority people i.e., 53.3% are very confident. There are no complains about its speed and efficiency as well as the voting results being tallied accurately. However, most people think that the project has a long way to go for it to be applied in real world Elections and it cannot be denied.

In conclusion, the post-survey provided valuable feedback into both the positive and negative aspect of the project. It cannot be denied that although this project has a lot to improve on, the project has demonstrated that it has the potential to significantly improve the electoral process, and with continued development, it could become a viable option for real-world elections.

For More Details, Click [Here](#)

### 3.5 REQUIREMENT ANALYSIS

#### 3.5.1 Requirements for Development

- A laptop or a desktop computer is required to do the programming and documentation of the project.
- For Front-end Web Development: **HTML, CSS, JavaScript & Bootstrap** was used. These languages were used to develop the login page, user interface, buttons etc.
- **Solidity** language was used for making the Smart Contract. It is used for all the operations being conducted like voting, counting votes, checking eligibility etc.
- **Ganache** was used to simulate a Personal Ethereum Blockchain for developing and testing. It is used by the developer for its virtual Ethereum environment and currency given for testing.
- **MetaMask** is used for the transaction in the system.
- **Web3.js** is a library which was used to connect blockchain network and front-end website.

#### 3.5.2 Requirements for Design

- **Balsamic** was used to create wireframes for the system.
- **Draw.io** was used to make various diagrams/ designs like Use-Case Diagram, Data flow diagram, flowcharts etc.
- **Logo Creator** was used to create a logo for the system.

## 3.6 DESIGN

### 3.6.1 LOGO



Figure 8: Logo

### 3.6.2 WIREFRAMES

These are the wireframes created for the UI of the project. Although most of the parts of the UI are built using these wireframes as a base but some parts may vary due to reasons like, client's requirements, supervisor or user's feedback etc. The wireframes are shown below:

This wireframe represents admin login consisting of fields for email and password and a button for sign in.

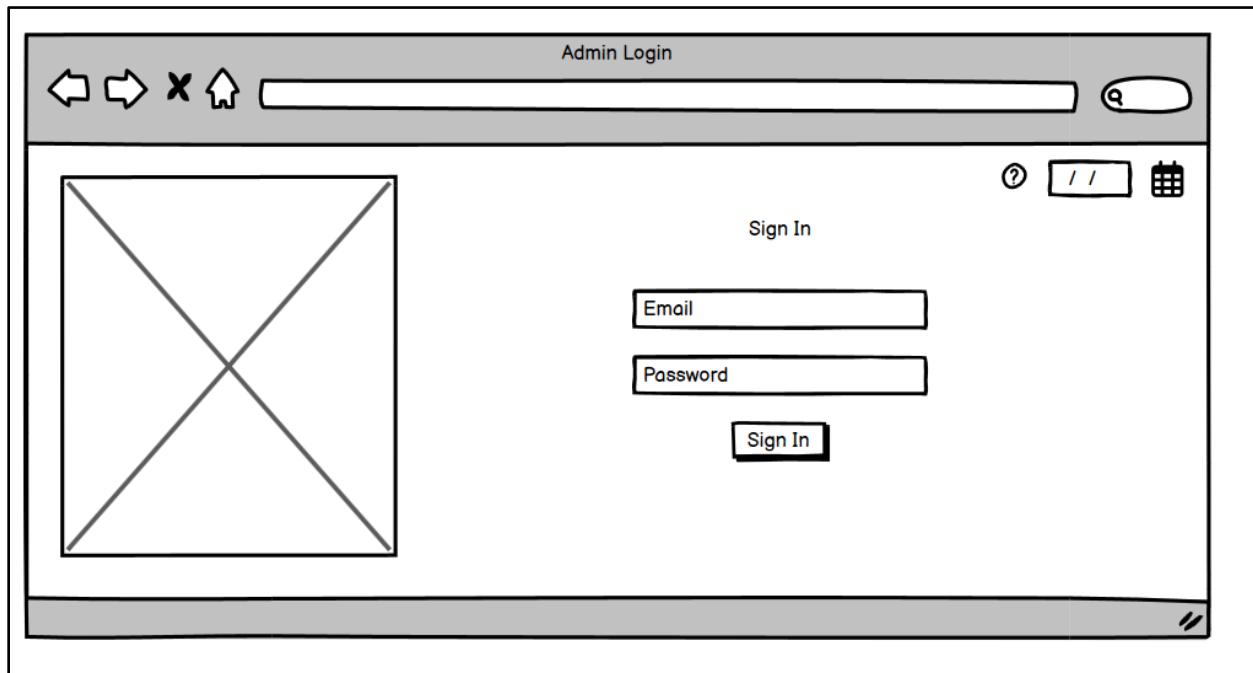


Figure 9: Wireframe- Admin Login

This wireframe represents Admin Dashboard consisting sidebar with Add candidate, Change phase, voter authentication tabs etc.

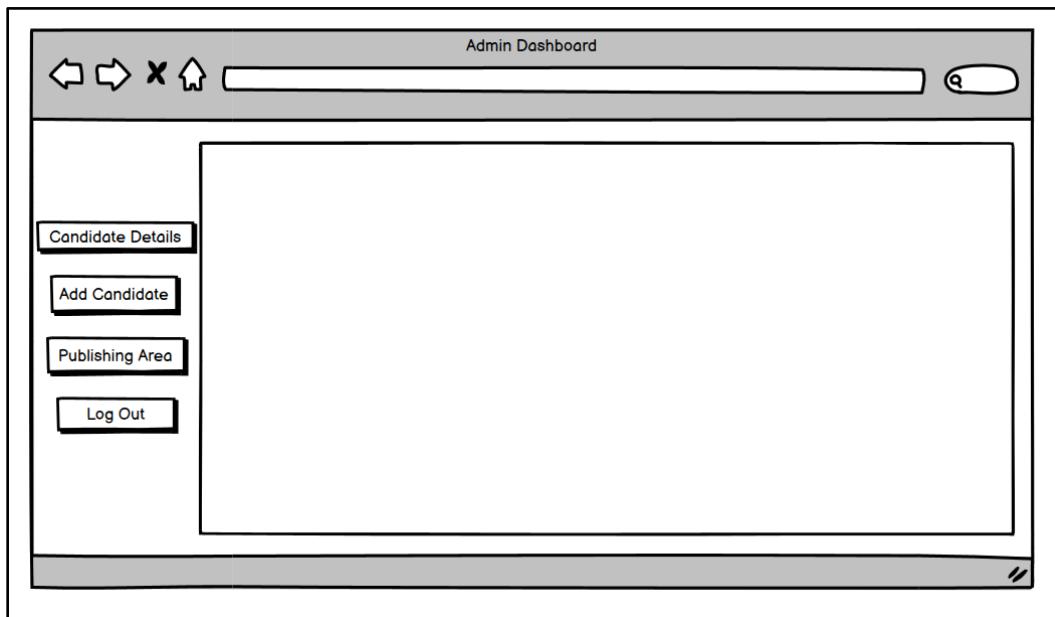
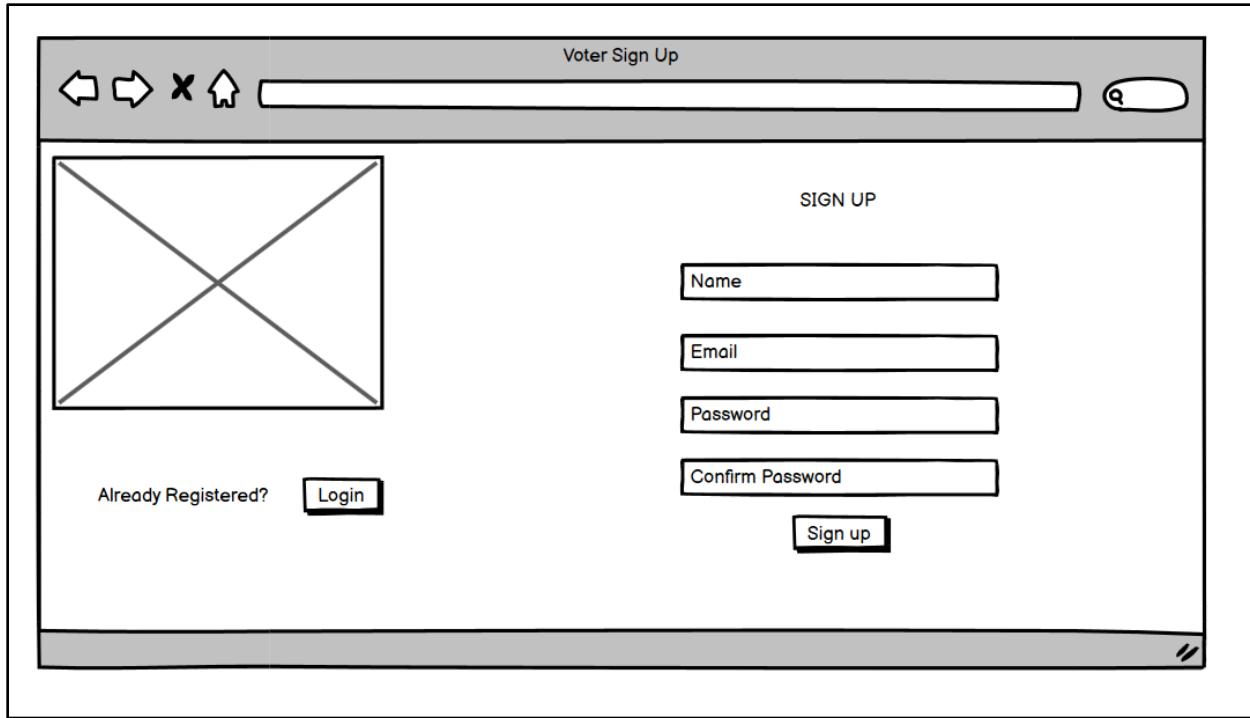


Figure 10: Wireframe- Admin Dashboard

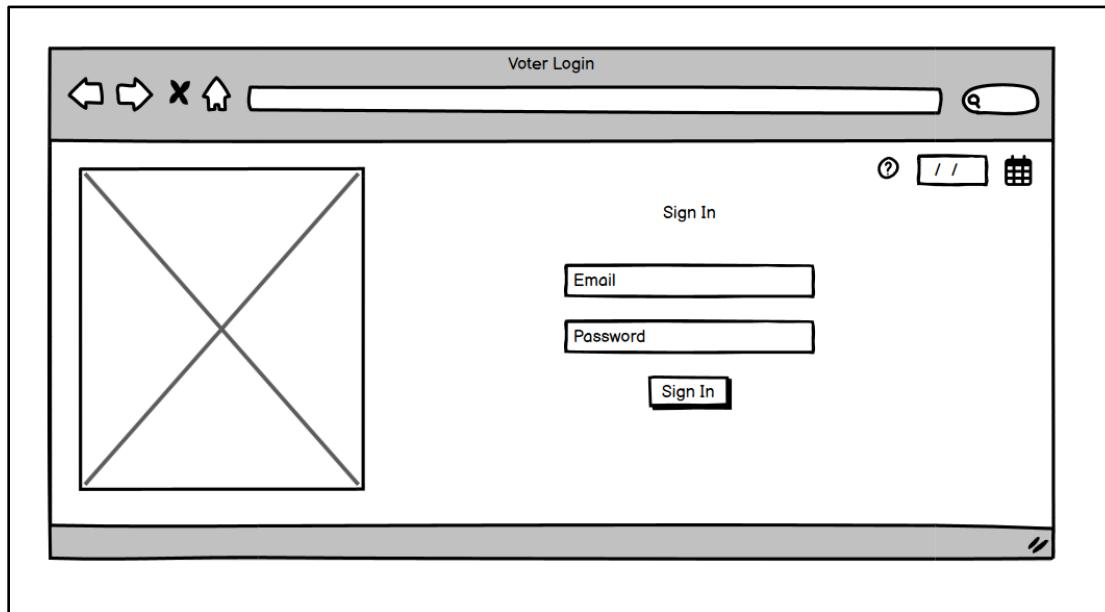
This wireframe presents voter registration consisting input fields for personal information and a signup button.



The wireframe for the Voter Sign Up page features a header bar with standard browser controls (back, forward, search, etc.). On the left side, there is a large square placeholder with a diagonal cross. To the right of this placeholder, the text "SIGN UP" is centered above four input fields: "Name", "Email", "Password", and "Confirm Password". Below these fields is a "Sign up" button. At the bottom left, there is a link "Already Registered?" and a "Login" button. The footer contains a double arrow icon.

Figure 11: Wireframe- Voter Registration

This wireframe presents voter login same as admin login it has email and password input field and button for sign in.



The wireframe for the Voter Login page is similar in structure to the sign-up page. It includes a header bar with browser controls. A large square placeholder with a diagonal cross is on the left. To the right, the text "Sign In" is centered above two input fields: "Email" and "Password". Below these is a "Sign In" button. In the top right corner, there are three small icons: a question mark, a double slash, and a grid. The footer features a double arrow icon.

Figure 12: Wireframe- Voter Login

This wireframe presents voting area/ voter's dashboard consisting of candidates' info and a vote button.

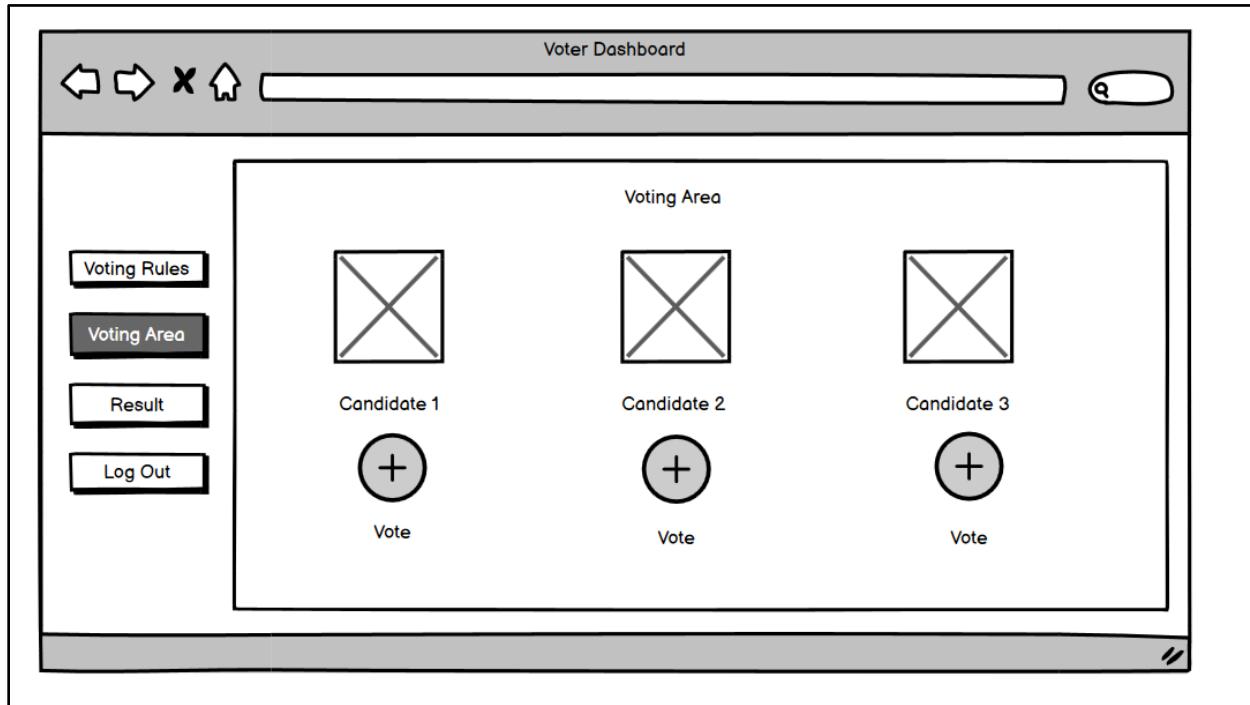


Figure 13: Wireframe- Voter Dashboard

For Other Wireframes, Click [Here](#)

### 3.6.3 USE-CASE DIAGRAM

The use-case diagram below illustrates how an actor i.e., admin/ voters interact with the system to accomplish various tasks. The tasks are explained in brief:

- Login: Voters, and admin can all log in to the system to access their respective accounts and perform their tasks.
- Add Candidate: Admin can add candidates to the system and provide their information to the voters.
- Voter Authentication: The admin authenticates voters to ensure that they are eligible to cast a vote.

- Voting: Voters can cast their vote through the system, which records their choice in the blockchain.
- Change Phase: Admin can start and end the election process through the system.
- Monitor Votes: Admin can monitor the progress of the election and view the results as they come in.

An important point to take note of is that all the functions requires Eth transaction to execute and interact with smart contract.

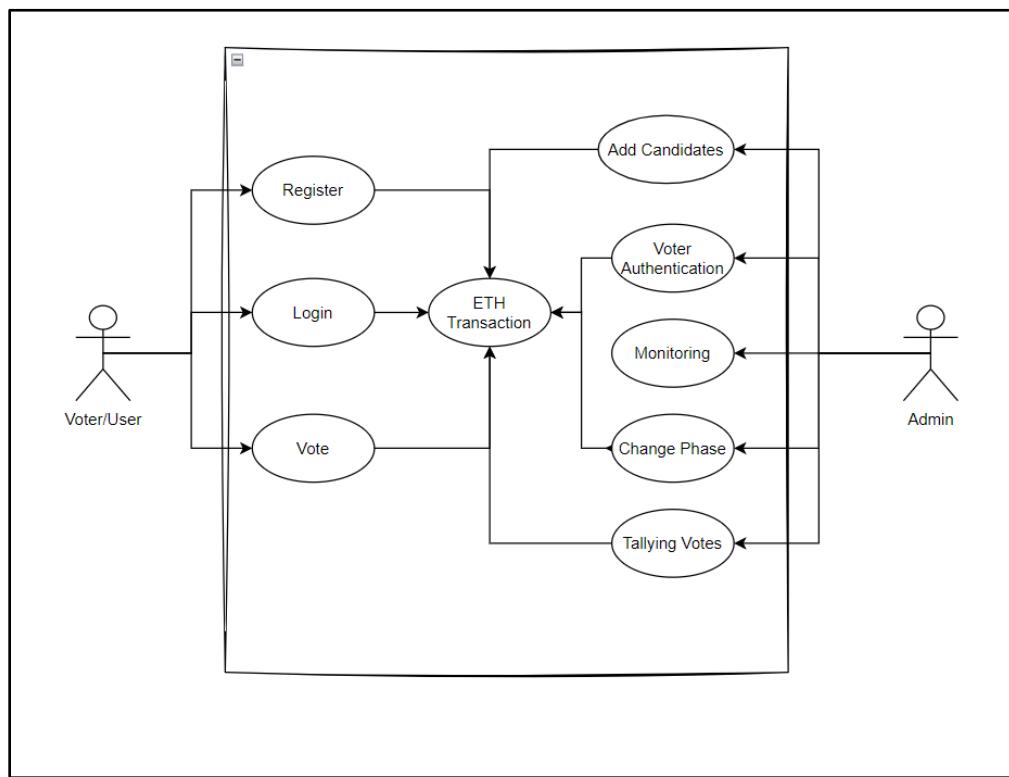


Figure 14: Use-Case Diagram

### 3.6.4 DATAFLOW DIAGRAMS

The figure below shows the dataflow for registration of voters. The voter's personal info. is stored in smart contract after the transaction is successful.

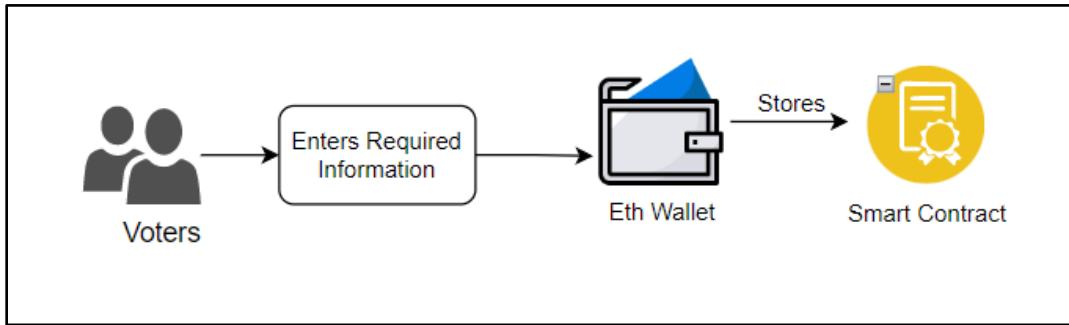


Figure 15: Dataflow- Voter Reg.

This figure presents the dataflow of voter's login which consists of voters entering login credentials and confirming transaction, then the credentials are verified from smart contract and voter's account is opened.

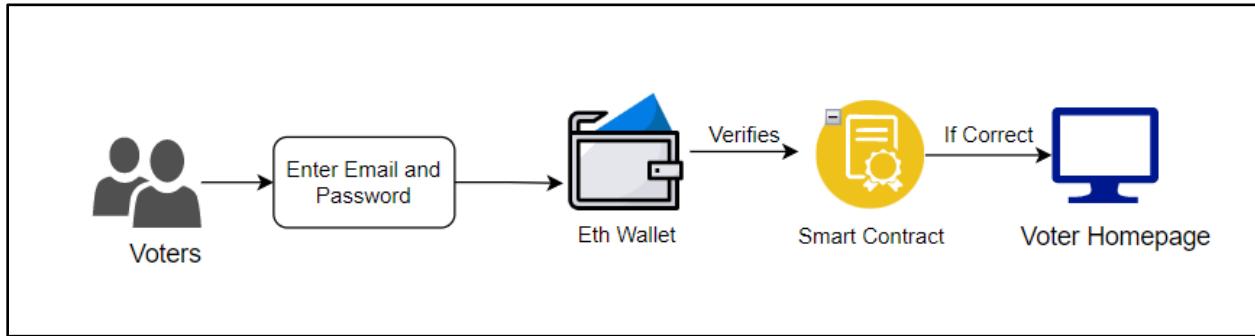


Figure 16: Dataflow- Voter Login

This dataflow diagram presents the admin's login process which consists of admin entering login credentials and if it matches with the credentials from App.js it gives access to admin's account.

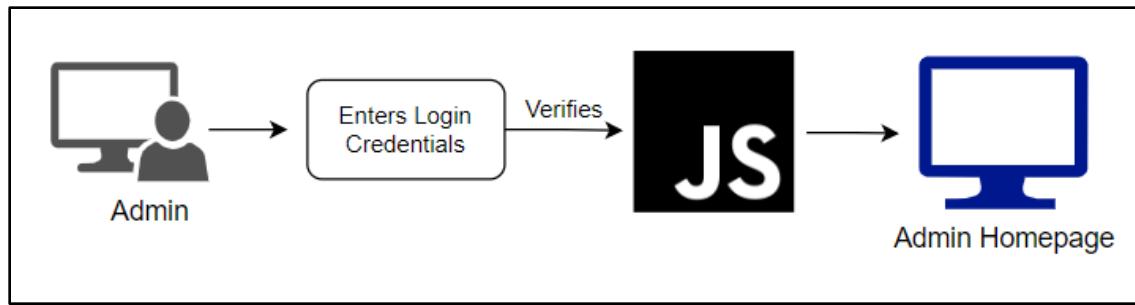


Figure 17: Dataflow- Admin

This dataflow diagram presents the flow of all the functions that can be performed by the admin which consists of add candidate, voter authentication, changing election phases, monitoring votes and publishing results.

All of the functions require transaction from wallet and the verification from the smart contract.

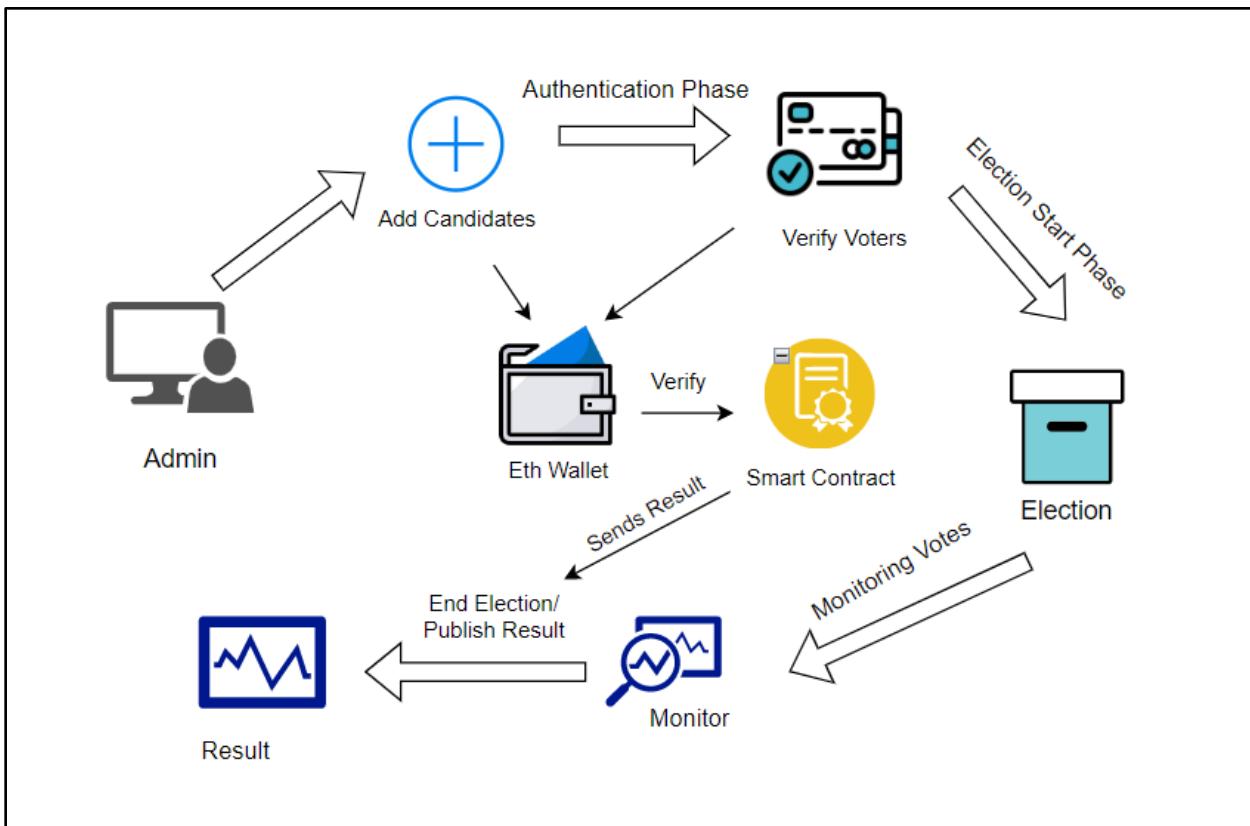


Figure 18: Dataflow- Admin's Functions

This dataflow presents the flow of all the functions that a voter can perform in this system which consists of voting the candidate and confirming the transaction and storing it to smart contract.

The stored votes are then published when the admin ends the election.

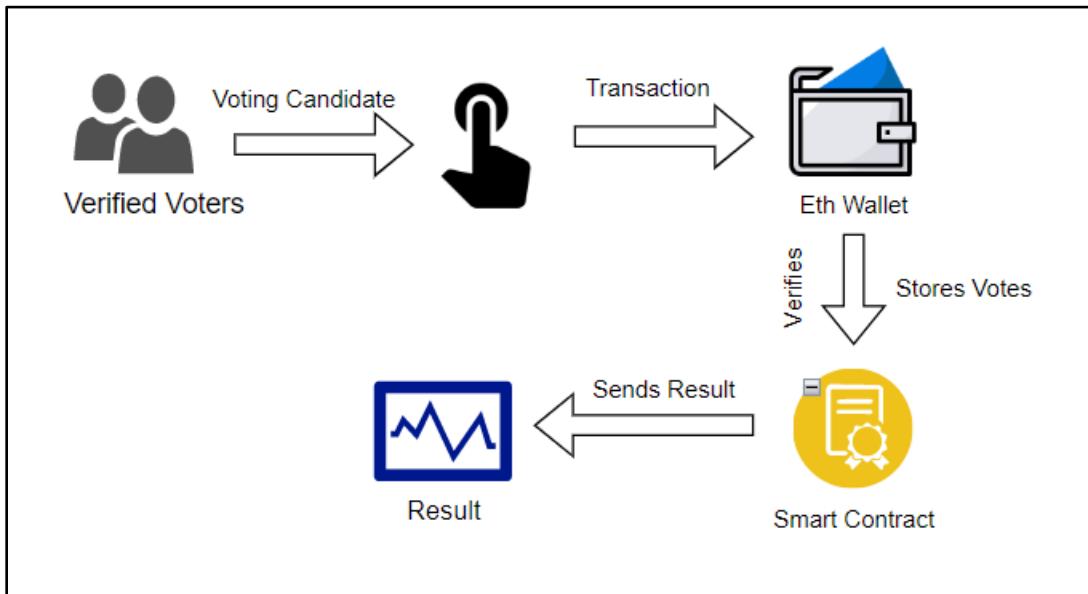


Figure 19: Dataflow- Voter's Function

### 3.6.5 FLOWCHARTS

#### - Admin Flowcharts

This flowchart describes the process of admin login.

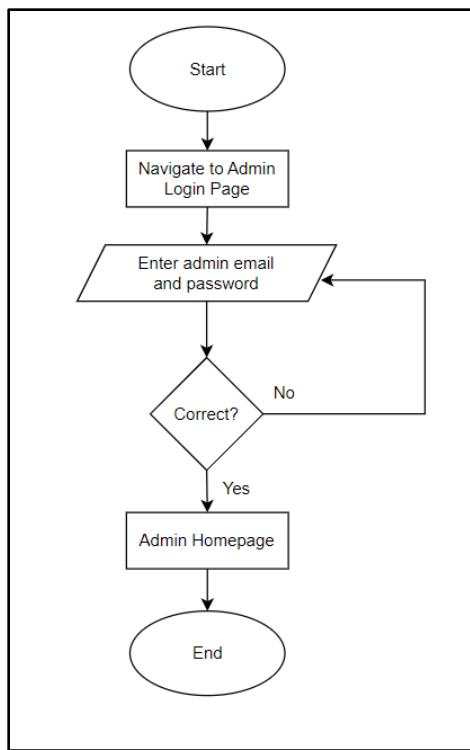


Figure 20: Flowchart- Admin Login

This flowchart describes the process of add candidates' function.

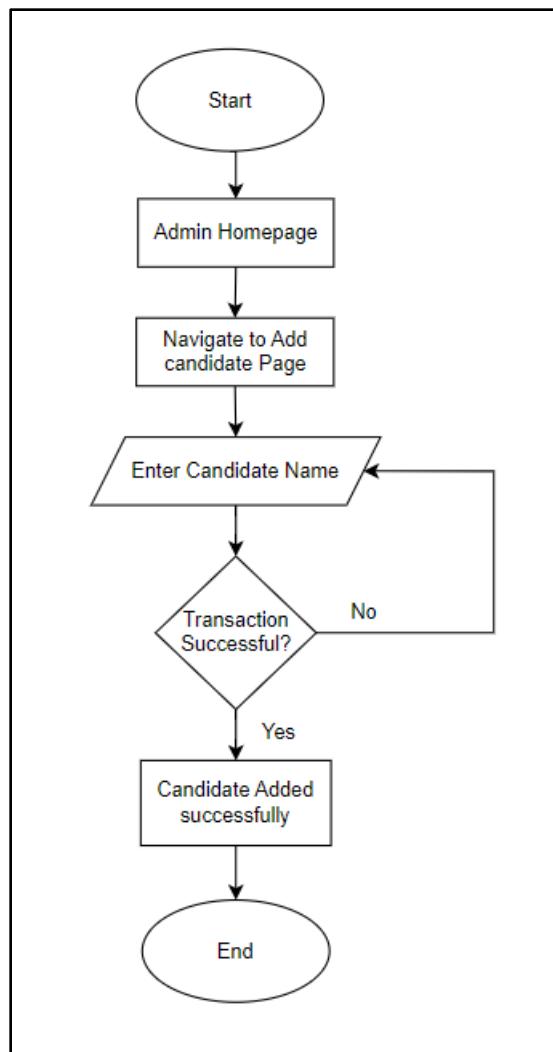


Figure 21: Flowchart- Add Candidate

The flowchart below explains the process of voter authentication.

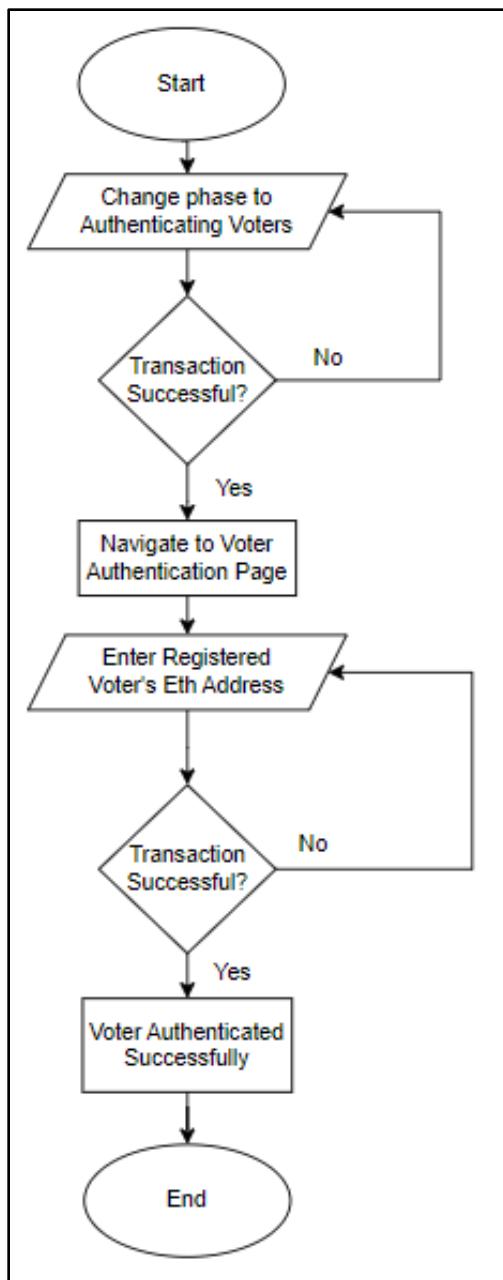


Figure 22: Flowchart- Voter Authentication

This flowchart describes the change phase function of the admin.

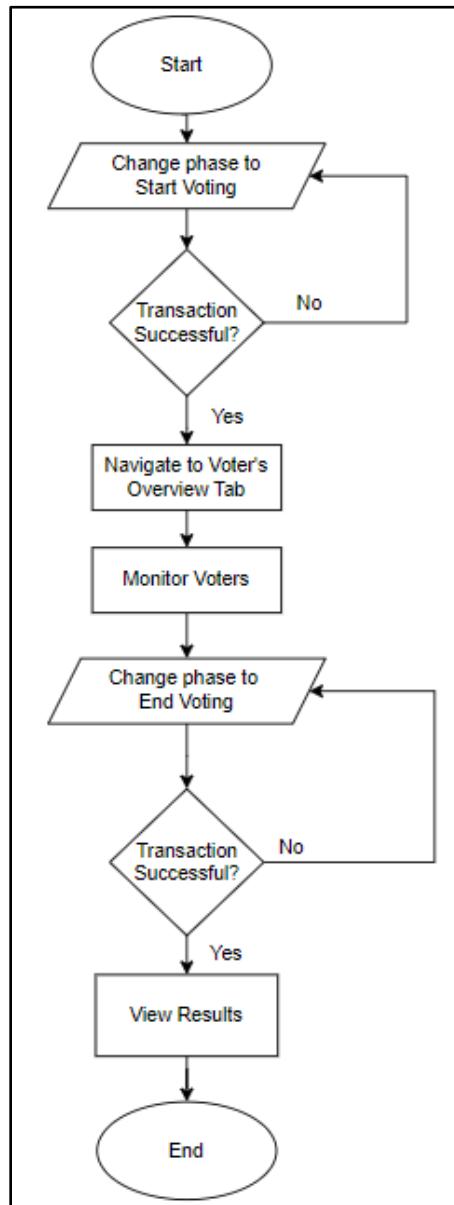


Figure 23: Flowchart- Start/End Election

### - Voter's Flowchart

This flowchart describes the registering and login feature of voters.

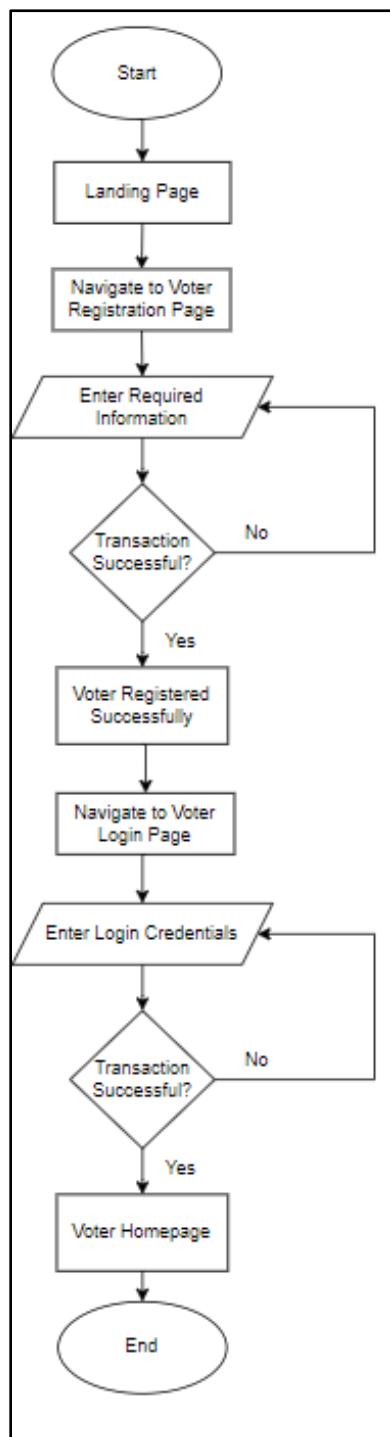


Figure 24: Flowchart- Voter Reg. and Login

This flowchart describes the process of voter's voting function.

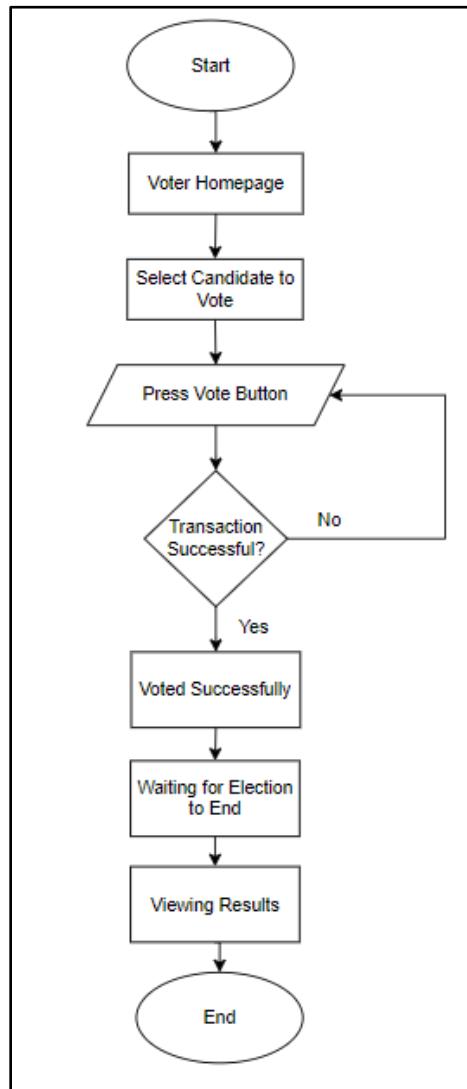


Figure 25: Flowchart- Vote Function

### 3.7 IMPLEMENTATION

Following the Prototype methodology, this project was developed according to the duration shown as in the Gantt Chart in appendix section. The folder management for the project is shown below:

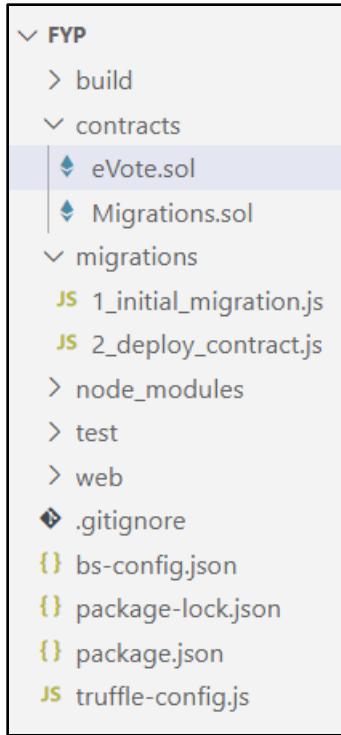


Figure 26: Folder Management

### 3.7.1 Smart Contract

The figure below shows a custom data type i.e., struct which is used to group related variables together into a single unit like in Voter struct, there are various variable with different data type but is related to Voter.

```

contract eVote {
    struct Voter {
        bool hasVoted;
        uint vote;
        bool isRegistered;
        bool isLoggedIn;
        bool allowedToVote;
    }
    struct VoterDetails{
        string email;
        string pass;
        string identityno;
    }
    struct Candidate {
        uint id;
        bytes32 name;
        uint totalVotes;
    }

    address chairman;
}

```

Figure 27: Code- Struct

The code below shows the mappings to store information about voters, their details, registered voters, and candidates. It has variables to keep track of the total number of voters and candidates, as well as the number of users who have voted. The contract also has Boolean variables to control the voting process, such as authorizing users, starting and finishing the vote, and allowing candidates to register.

```

mapping(address => Voter) public voters;
mapping(address => VoterDetails) voterdetails;
mapping(uint => address) public voterList; //addresses of registered voters
mapping(uint => Candidate) public candidates;

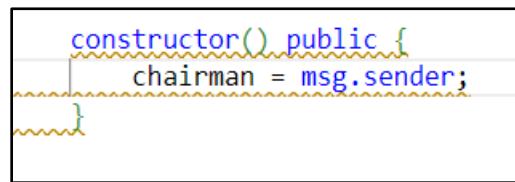
uint public totalVoters = 0;
uint public votedUsers = 0;
uint public totalCandidates = 0;

bool public registerCands = true;
bool public authorizeUsers;
bool public startVote;
bool public finishedVote;
bool public voteOngoing;

```

Figure 28: Code- Mapping

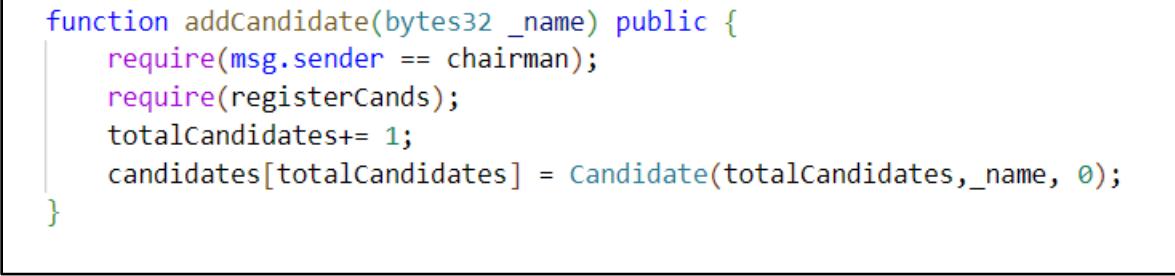
This constructor function is called when the contract is deployed and initializes the "chairman" variable to the address of the contract deployer (the "msg.sender"). The "chairman" is the owner of the contract and has admin privileges. Since there is no msg.sender currently it is marked as red.



```
constructor() public {
    chairman = msg.sender;
}
```

Figure 29: Code- Deployer

It checks that the caller is the chairman and candidate registration is open, then increments the total number of candidates and creates a new candidate with a unique ID, name, and zero votes.



```
function addCandidate(bytes32 _name) public {
    require(msg.sender == chairman);
    require(registerCands);
    totalCandidates+= 1;
    candidates[totalCandidates] = Candidate(totalCandidates, _name, 0);
}
```

Figure 30: Code- Add Candidate

It checks that the caller of the function is the chairman and that voter authorization is enabled, then sets the "allowedToVote" flag to true for the specified voter. Finally, it returns the value of the "allowedToVote" flag for the voter.

```

function voterAuth(string memory _voter) public returns (bool) {
    require(msg.sender == chairman);
    require(authorizeUsers);
    address _voter_addr = parseAddr(_voter);
    if(voters[_voter_addr].isRegistered){
        voters[_voter_addr].allowedToVote = true;
    }
    return voters[_voter_addr].allowedToVote;
}

```

Figure 31: Code- Voter Authentication

It checks that the caller is not already registered, then increments the total number of voters and adds the caller to the list of registered voters. It sets the voter's registration status to true and saves their details, then returns true.

```

function registerVoter(string memory _email,string memory _password,string memory _idno) public returns (bool) {
    require(!voters[msg.sender].isRegistered);
    totalVoters+= 1;
    voterList[totalVoters] = msg.sender;
    voters[msg.sender].isRegistered = true;
    voterdetails[msg.sender] = VoterDetails(_email,_password,_idno);
    return true;
}

```

Figure 32: Code- Register Voter

This function allows a registered voter to log in by checking if the entered email and password match the ones saved in the voterdetails mapping. If the details match, the isLoggedIn flag is set to true for the voter.

```

function loginVoter(string memory _email, string memory _password) public returns (bool)
{
    require(voters[msg.sender].isRegistered);
    require (
        keccak256(abi.encodePacked(voterdetails[msg.sender].email)) ==
        keccak256(abi.encodePacked(_email)) &&
        keccak256(abi.encodePacked(voterdetails[msg.sender].pass)) ==
        keccak256(abi.encodePacked(_password))
    );
    voters[msg.sender].isLoggedIn = true;
}

```

Figure 33: Code- Login Voter

This is the logout function.

```

function logout() public {
    require(voters[msg.sender].isLoggedIn);
    voters[msg.sender].isLoggedIn = false;
}

```

Figure 34: Code- Logout

This function is used to authorize voters. It can only be called by the chairman and sets the authorizeUsers flag to true and registerCands flag to false.

```

function authorizingUsers() public {
    require(msg.sender == chairman);
    authorizeUsers = true;
    registerCands = false;
}

```

Figure 35: Code- Authorize User

The startVoting() function starts the voting process and sets the startVote and voteOngoing variables to true, while stopVoting() function stops the voting process and

sets finishedVote and voteOngoing variables to true. An event votedEvent is also defined with an indexed \_voteIndex parameter.

```

function startVoting() public {
    require(msg.sender == chairman);
    startVote = true;
    voteOngoing = true;
    authorizeUsers = false;
}

function stopVoting() public {
    require(msg.sender == chairman);
    finishedVote = true;
    voteOngoing = false;
}

event votedEvent (
    uint indexed _voteIndex
);

```

Figure 36: Code- Change Phase

The vote function allows registered voters to vote for a candidate if voting has started, the voter hasn't voted before, is allowed to vote, and the candidate index is valid. It updates the vote count for the candidate and marks the voter as having voted. It also emits a votedEvent to indicate that a vote has been cast.

```

function vote(uint _voteIndex) public {
    require(startVote && !finishedVote);
    require(!voters[msg.sender].hasVoted);
    require(voters[msg.sender].allowedToVote);
    require(_voteIndex > 0 && _voteIndex <= totalCandidates);

    voters[msg.sender].vote = _voteIndex;
    voters[msg.sender].hasVoted = true;
    candidates[_voteIndex].totalVotes += 1;
    votedUsers += 1;
    emit votedEvent(_voteIndex);
}

```

Figure 37: Code- Vote Function

### 3.7.2 Development Network

This is a configuration for the development network on Ethereum. It sets the host to "127.0.0.1", the port to 7545, and the network ID to "\*". It is saved as truffle-config.js in the development folder.

```
development: {  
  host: "127.0.0.1",      // Localhost (default: none)  
  port: 7545,            // Standard Ethereum port (default: none)  
  network_id: "*",       // Any network (default: none)  
}
```

Figure 38: Truffle-Config.js

The truffle-config.js is then the location is added in the workspace.

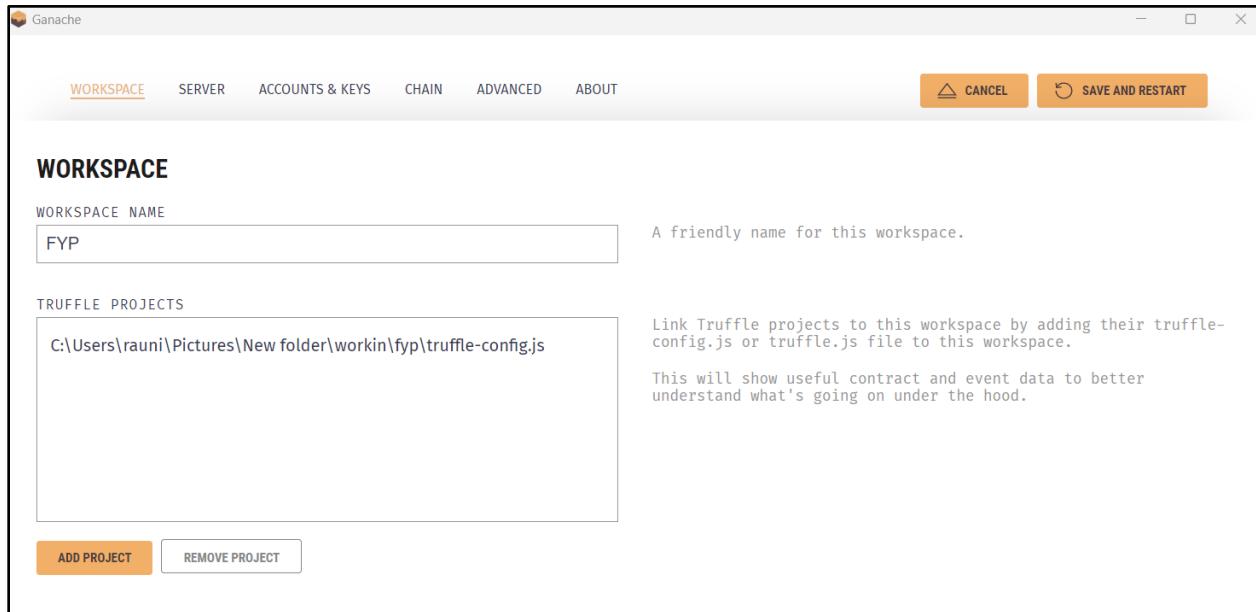


Figure 39: Ganache- Workspace

And, the Ganache server is configured same as in truffle-config.js.

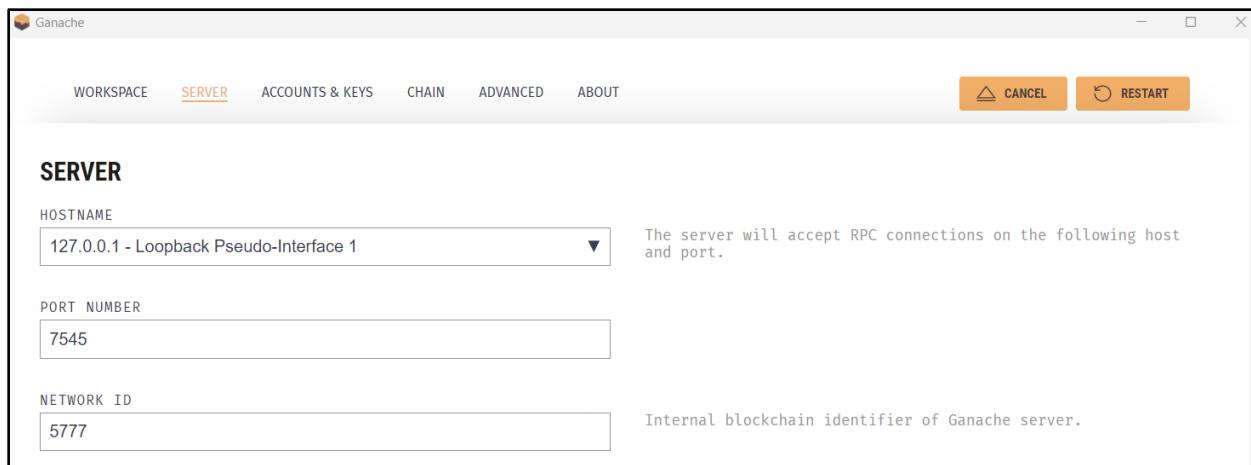


Figure 40: Ganache- Server

The Local Network is also configured in the MetaMask to sync with truffle-config and Ganache.

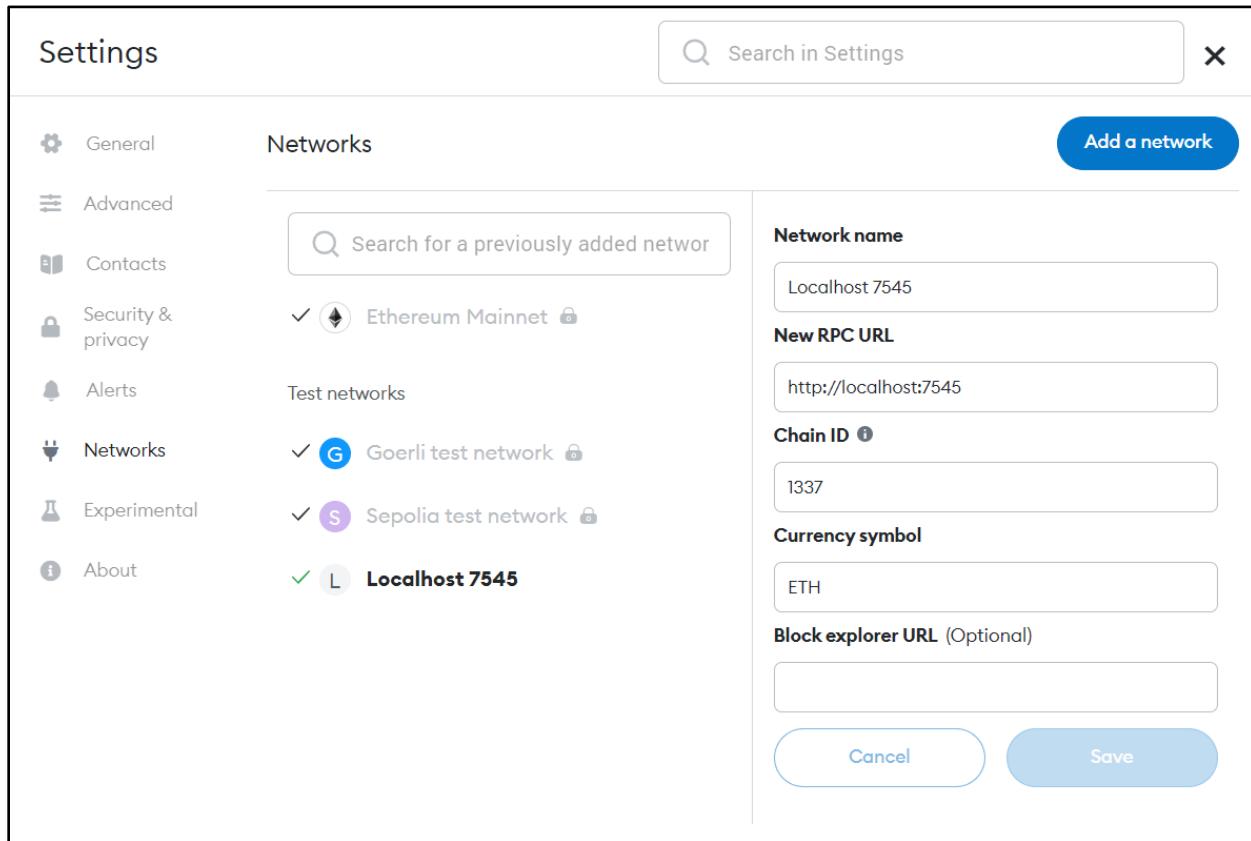


Figure 41: MetaMask- Local Network

### 3.7.3 App.js

This function is used to authenticate an admin by checking their email and password. If the email and password match the hardcoded values of "admin@admin.com" and "admin", respectively, then the admin is redirected to the admin page (admin.html). If the credentials are incorrect, an alert message is displayed.

```
function adminLogin(email,pass) {
    var $address = $(email);
    var emailaddress = $address.val();
    var $passw = $(pass);
    var pass_val = $passw.val();
    console.log(emailaddress);
    console.log(pass_val);

    if(emailaddress == "admin@admin.com" && pass_val=="admin"){
        window.location.replace("http://localhost:3000/admin.html");
    }else{
        alert("Wrong Credentials!");
    }
};
```

Figure 42: JS- admin login

This code initializes the web3Provider, contracts, account, and hasVoted variables. The init function calls initWeb3, which checks if web3 is defined and sets the web3Provider accordingly. If web3 is not defined, it sets the web3Provider to <http://localhost:7545>. Lastly, it calls initContract.

```

web3Provider: null,
contracts: {},
account: '0x0',
hasVoted: false,

init: function() {
  return App.initWeb3();
},

initWeb3: function() {
  if (typeof web3 !== 'undefined') {
    App.web3Provider = web3.currentProvider;
    web3 = new Web3(web3.currentProvider);
  } else {
    App.web3Provider = new Web3.providers.HttpProvider('http://localhost:7545');
    web3 = new Web3(App.web3Provider);
  }
  return App.initContract();
},

```

Figure 43: Web.js

This function initializes the contract by fetching the eVote.json file, setting the provider and listening for events. It also redirects to different pages depending on the current URL.

```

initContract: function() {
  $.getJSON("evote.json", function(evote) {
    App.contracts.evote = TruffleContract(evote);
    App.contracts.eVote.setProvider(App.web3Provider);
    App.listenForEvents();
    App.setNames();
    App.checkLogin();
  }).then(function(redirectWeb){
    if(window.location.href == "http://localhost:3000/votingpoll.html" || window.location.href == "http://localhost:3000/results.html"){
      return App.render();
    }

    if(window.location.href == "http://localhost:3000/authentication.html"){
      return App.listVoters();
    }

    if(window.location.href == "http://localhost:3000/managevoting.html") {
      return App.manageVoting();
    }

    if(window.location.href == "http://localhost:3000/statisticaloverview.html") {
      return App.showStatistics();
    }
  });
},

```

Figure 44: JS- Page Route

The function checks if a voter is logged in and shows/hides appropriate buttons. It retrieves the contract instance and voter details using the current account. If not logged in, it shows login/register/voter-in buttons and hides voter-out/results. If logged in, it shows voter-out/results and hides login/register/voter-in.

```
checkLogin: function() {
  var evoteInstance;
  App.contracts.eVote.deployed().then(function(instance) {
    evoteInstance = instance;
    return evoteInstance.voters(App.account);
  }).then(function(voter) {
    var isLoggedIn = voter[3];
    if(!isLoggedIn){
      $('#voterin').show();
      $('#adminlogin').show();
      $('#voterreg').show();
      $('#voterout').hide();
      $('#results').hide();
    } else{
      $('#voterout').show();
      $('#results').show();
      $('#voterin').hide();
      $('#voterreg').hide();
      $('#adminlogin').hide();
    }
  })
},
}
```

Figure 45: JS- Check Login

This function takes a voter's address as input, calls the voterAuth function of the deployed contract to authenticate the address, and logs the result to the console.

```
authenticate : function(address) {
  var $addrs = $(address);
  var address_val = $addrs.val();
  App.contracts.eVote.deployed().then(function(instance) {
    return instance.voterAuth(address_val, { from: App.account } );
  }).then(function(result) {
    console.log(address_val + " is authenticated.");
  });
},
}
```

Figure 46: JS- Authenticate

This function manages the various stages of the voting process by showing/hiding appropriate buttons. It retrieves the instance of the deployed contract and checks the status of the voting process using different functions. It then shows/hides buttons based on the stage of the voting process.

```
manageVoting : function(){
    $('#regcands').hide();
    $('#authusers').hide();
    $('#stop').hide();
    $('#completedeletion').hide();
    var evoteInstance;
    var completed;
    App.contracts.eVote.deployed().then(function(instance) {
        evoteInstance = instance;
        return evoteInstance.registerCands();
    }).then(function(regcands){
        if(regcands){
            $('#regcands').show();
        }
        return evoteInstance.authorizeUsers();
    }).then(function(authusers){
        if(authusers){
            $('#regcands').hide();
            $('#authusers').show();
        }
        return evoteInstance.startVote();
    }).then(function(start){
        if(start){
            $('#authusers').hide();
            $('#stop').show();
        }
        return evoteInstance.finishedVote();
    }).then(function(done){
        if(done){
            $('#stop').hide();
            $('#completedeletion').show();
        }
    });
};
```

Figure 47: JS- Manage Voting

This function retrieves the total number of candidates and their details from the deployed contract, determines the winner, and displays the candidate results. It also checks if the user is logged in and allowed to vote, and shows appropriate messages based on that. Finally, it checks if the voting is ongoing and displays the appropriate message.

```

App.contracts.eVote.deployed().then(function(instance) {
    evoteInstance = instance;
    return evoteInstance.totalCandidates();
}).then(function(totalCandidates) {
    candidatesResults = $("#candidatesResults");
    candidatesResults.text('');
    var winnerVoteCount = 0;
    var winnerName;
    for (var i = 1; i <= totalCandidates; i++) {
        evoteInstance.candidates(i).then(function(candidate) {
            var id = candidate[0];
            var name = candidate[1];
            var voteCount = candidate[2];
            if (voteCount.toNumber()>winnerVoteCount){
                winnerVoteCount = voteCount.toNumber();
                winnerName = "Winner is " + web3.utils.toAscii(name);
            } else if(winnerVoteCount==voteCount.toNumber() && winnerName!= web3.utils.toAscii(name) ){
                winnerName = " No winner. Votes were equal. New election will be organized, see you soon.";
            }
            $('#winner').html(winnerName);

            candidateTemplate = "<tr><th>" + id + "</th><td>" + web3.utils.toAscii(name) + "</td><td>" + voteCount + "</td></tr>";
            candidatesResults.append(candidateTemplate);
        });
    }
    return evoteInstance.voters(App.account);
});

```

Figure 48: JS- Vote

The showStatistics function uses the eVote contract instance to retrieve the total number of voters and the number of voters who have already voted. It then calculates the number of unvoted voters and displays the data in a pie chart using the jqplot library.

```

showStatistics: function(){
    App.contracts.eVote.deployed().then(function(instance) {
        var evoteInstance;
        var allVoters;
        var votedTotal;
        var unvotedTotal;
        evoteInstance = instance;
        return evoteInstance.totalVoters();
    }).then(function(totalVoters) {
        allVoters = totalVoters.toNumber();
        return evoteInstance.votedUsers();
    }).then(function(votedUsers) {
        votedTotal = votedUsers.toNumber();
        console.log('voted total ' + votedTotal);
        unvotedTotal = allVoters - votedTotal;
        console.log('unvoted total ' + unvotedTotal);
        $.jqplot('chartdiv', [[[ 'voted',votedTotal],[ 'unvoted',unvotedTotal]]], {
            seriesDefaults:{ renderer:$jqplot.PieRenderer, rendererOptions: {
                showDataLabels: true
            }},
            legend:{ show: true }
        });
    });
}

```

Figure 49: JS- Pie Chart

### 3.7.4 Front-End

This is the landing page of the project.

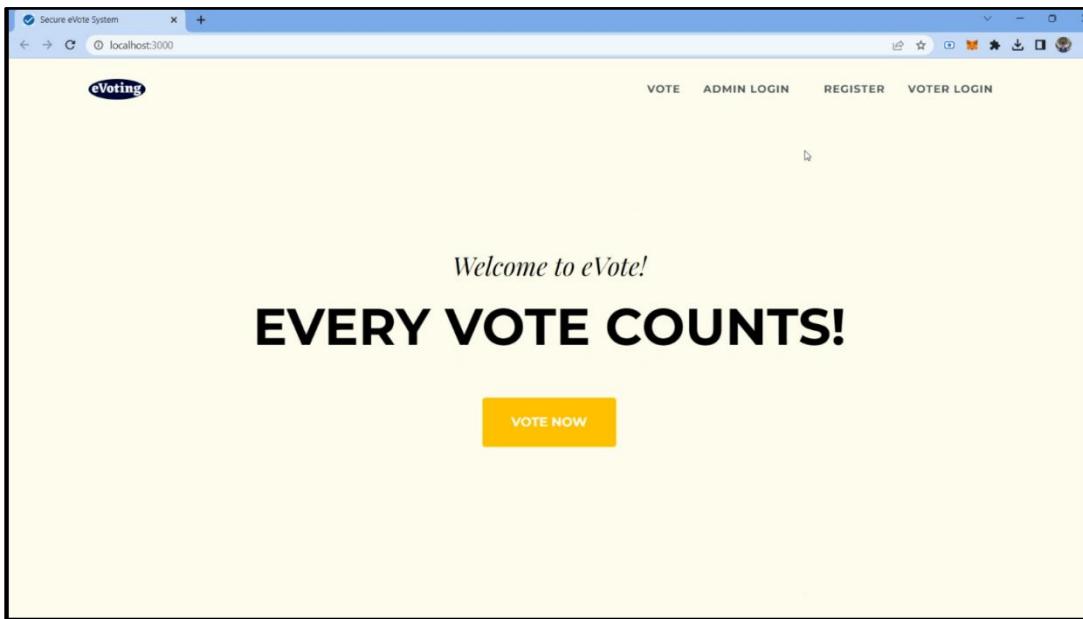


Figure 50: Landing Page

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
    <meta name="description" content="" />
    <meta name="author" content="" />
    <title>Secure eVote System</title>

    <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
    <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
    <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css" />
    <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css" />
    <link rel="stylesheet" href="css/styles.css"/>
    <style>
      @import url('https://fonts.googleapis.com/css2?family=Playfair+Display:ital@1&display=swap');
    </style>
  </head>
  <body id="page-top" style="background-color: #f5f5f5;">
    <!-- Navigation-->
    <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
      <div class="container">
        <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" height="80px" width="80px" alt="eVoting logo" data-bbox="448 188 551 291"/>
          <span>eVoting</span>
        </div>
        <button class="navbar-toggler" type="button" data-toggle="collapse" data-target="#navbarResponsive" aria-controls="navbarResponsive" aria-expanded="false" aria-label="Toggle navigation">
          <span class="navbar-toggler-icon"></span>
        </button>
        <div class="collapse navbar-collapse" id="navbarResponsive">
          <ul class="navbar-nav ml-auto">
            <li class="nav-item">
              <a class="nav-link" href="#">VOTE
            </li>
            <li class="nav-item">
              <a class="nav-link" href="#">ADMIN LOGIN
            </li>
            <li class="nav-item">
              <a class="nav-link" href="#">REGISTER
            </li>
            <li class="nav-item">
              <a class="nav-link" href="#">VOTER LOGIN
            </li>
          </ul>
        </div>
      </div>
    </nav>
    <div class="header-content" style="background-color: #f5f5f5; min-height: 100vh; position: relative; background-image: url('https://www.evote.com/images/election-background.jpg'); background-size: cover; background-position: center; background-repeat: no-repeat; color: white; font-family: 'Playfair Display', serif; font-weight: bold; font-size: 1.5em; padding: 10px; text-align: center; margin: 0 auto; width: fit-content; max-width: 1000px; border-radius: 10px; padding-bottom: 10px; border-bottom: 1px solid black; border-left: 1px solid black; border-right: 1px solid black; border-bottom-left-radius: 10px; border-bottom-right-radius: 10px; z-index: 1000; position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%);">
      <div style="background-color: #f5f5f5; padding: 10px; border-radius: 10px; border: 1px solid black; border-left: none; border-right: none; width: fit-content; margin: 0 auto; text-align: center; border-bottom: 1px solid black; border-bottom-left-radius: 10px; border-bottom-right-radius: 10px; z-index: 1000; position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%);">
        <h1 style="margin: 0; font-size: 1.5em; color: white; font-weight: bold;">Welcome to eVote!
        <h2 style="margin: 0; font-size: 1.5em; color: white; font-weight: bold;">EVERY VOTE COUNTS!
        <div style="background-color: #ffcc00; width: fit-content; margin: 10px auto; border-radius: 5px; padding: 5px; text-align: center; border: 1px solid black; border-left: none; border-right: none; border-bottom: 1px solid black; border-bottom-left-radius: 5px; border-bottom-right-radius: 5px; z-index: 1000; position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%);">
          <button style="background-color: #ffcc00; border: none; color: black; padding: 5px 10px; border-radius: 5px; font-weight: bold;">VOTE NOW
        </div>
      </div>
    </div>
  </body>
</html>
```

Figure 51: Code- Landing Page

This is admin.html page.



Figure 52: Admin Dashboard

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
    <meta name="description" content="" />
    <meta name="author" content="" />
    <title>Secure eVote - Admin Webpage</title>

    <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />

    <link href="css/adminstyle.css" rel="stylesheet" />
  </head>
  <body style="background-color: #f0f0f0;">
    <div class="d-flex" id="wrapper">
      <!-- Sidebar -->
      <div class="border-end bg-white" id="sidebar-wrapper">
        <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>
        <div class="list-group list-group-flush">
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="userauth" href="authentication.html">User Authentication</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="statisticallove" href="statisticallove.html">Statistical Love</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="addcnid" href="addcandidate.html">Add Candidate</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="phasechange" href="manageting.html">Phase Change</a>
        </div>
      </div>
      <!-- Page content wrapper -->
      <div id="page-content-wrapper">
        <!-- Top navigation -->
        <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">
          <div class="container-fluid">
```

Figure 53: Code- Admin Dashboard

For other front-end images, Click [Here](#).

## CHAPTER 4: TESTING AND ANALYSIS

### 4.1 TEST PLAN

#### 4.1.1 UNIT TESTING, TEST PLAN

- Standard Unit Testing Plan

Test Case	Objectives
1	To verify the admin can log in to the system.
2	To verify the admin can add the first candidate.
3	To verify a voter can register in the system.
4	To verify the voter can log in to the system.
5	To verify that a voter cannot register using an already existing account.
6	To verify the admin can change the phase to validate voters.
7	To verify the admin can validate a voter.
8	To verify the admin cannot validate an unregistered user in the system.
9	To verify the admin can change the phase to start voting.
10	To verify a validated voter can cast their vote and only once.
11	To verify the admin can accurately tally the results.
12	To verify the voting analytics shown is accurate.

Table 2: Standard Unit Testing Plan

- Blockchain-Specific Unit Testing Plan

Test Case	Objectives
1	To verify the front-end syncs with Ganache.
2	To verify the MetaMask syncs with front-end and ganache.
3	To verify that the deployer has the admin rights of the system.
4	To verify no function can be executed without the Ethereum address.
5	To verify system's security in case of compromised login credentials.
6	To verify voter's security in case of compromised login credentials.
7	To verify the transparency of votes.

Table 3: Blockchain-Specific Unit Testing Plan

#### 4.1.2 SYSTEM TESTING, TEST PLAN

Test Case	Objectives
1	To verify the system can launch properly.
2	To verify the admin can login and add candidates.
3	To verify voter can register and login.
4	To verify the admin can authenticate voters and start election.
5	To verify the voter can vote to their desired candidate but only once.
6	To verify the admin can end election, tally votes accurately and verify votes without hampering voter's privacy to ballot.

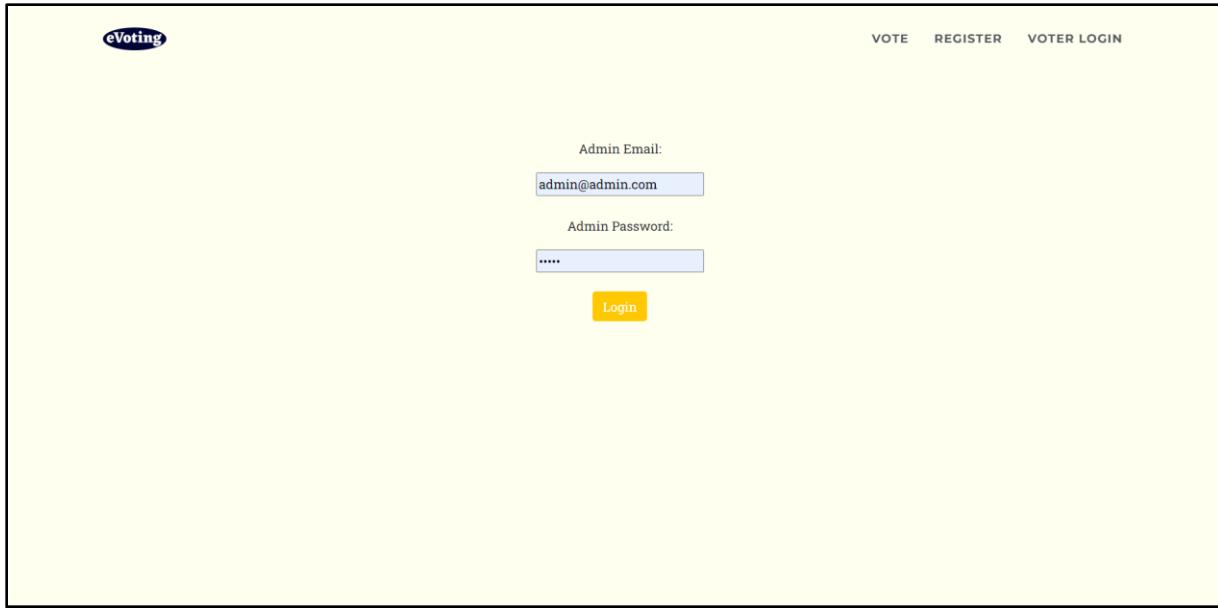
Table 4: System Testing, Test Plan

## 4.2 UNIT TESTING

### 4.2.1 STANDARD UNIT TESTS

Test No	1
Objective	To verify the admin can log in to the system.
Action	Entering Correct email and password of admin. <b>Username:</b> admin@admin.com <b>Password:</b> admin
Expected result	The admin would login successfully.
Actual result	The admin successfully logged in to system.
Conclusion	The test was successful.

Table 5: Test Case 1



The image shows a web-based login interface for an admin account. At the top left is a logo labeled "eVoting". Along the top right are three buttons: "VOTE", "REGISTER", and "VOTER LOGIN". Below these, there are two input fields: one for "Admin Email" containing "admin@admin.com" and another for "Admin Password" containing ".....". A yellow "Login" button is positioned below the password field.

Figure 54: Entering Login Credentials of Admin



The image displays the "Welcome to the Admin Webpage!" screen. On the left, a sidebar lists navigation options: "Admin Webpage", "User Authentication", "Voters overview", "Add Candidate", and "Administrative voting". On the right, the main content area features the title "Welcome to the Admin Webpage!" and a descriptive message: "Admin can add candidate, authenticate voters, start voting, and tally results." In the top right corner of the main area, there is a link labeled "Home".

Figure 55: Logging in to Admin Account

Test No	2
Objective	To verify the admin can add the first candidate.
Action	Selecting Add Candidate tab, Entering the name of the candidate, press add button and confirming MetaMask transaction. <b>Name:</b> Mihir
Expected result	The candidate would be successfully added.
Actual result	The transaction was completed and candidate was added successfully.
Conclusion	The test was successful.

Table 6: Test Case 2

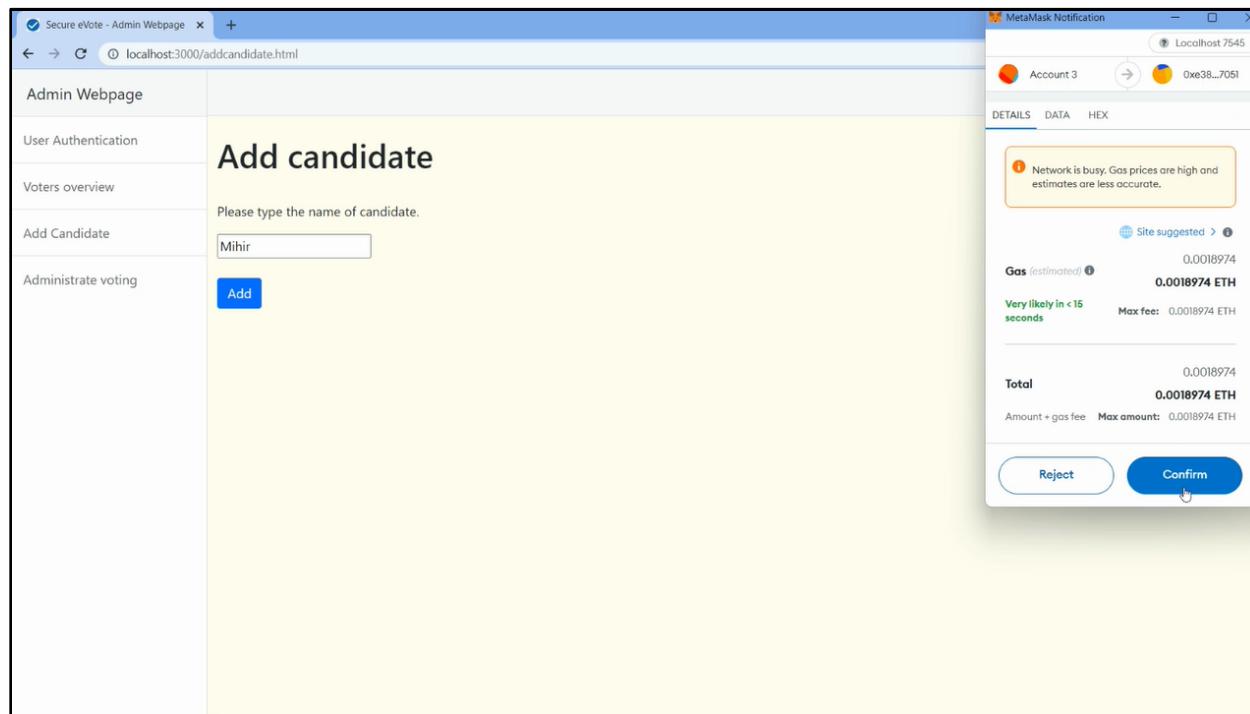


Figure 56: Entering Name of Candidate

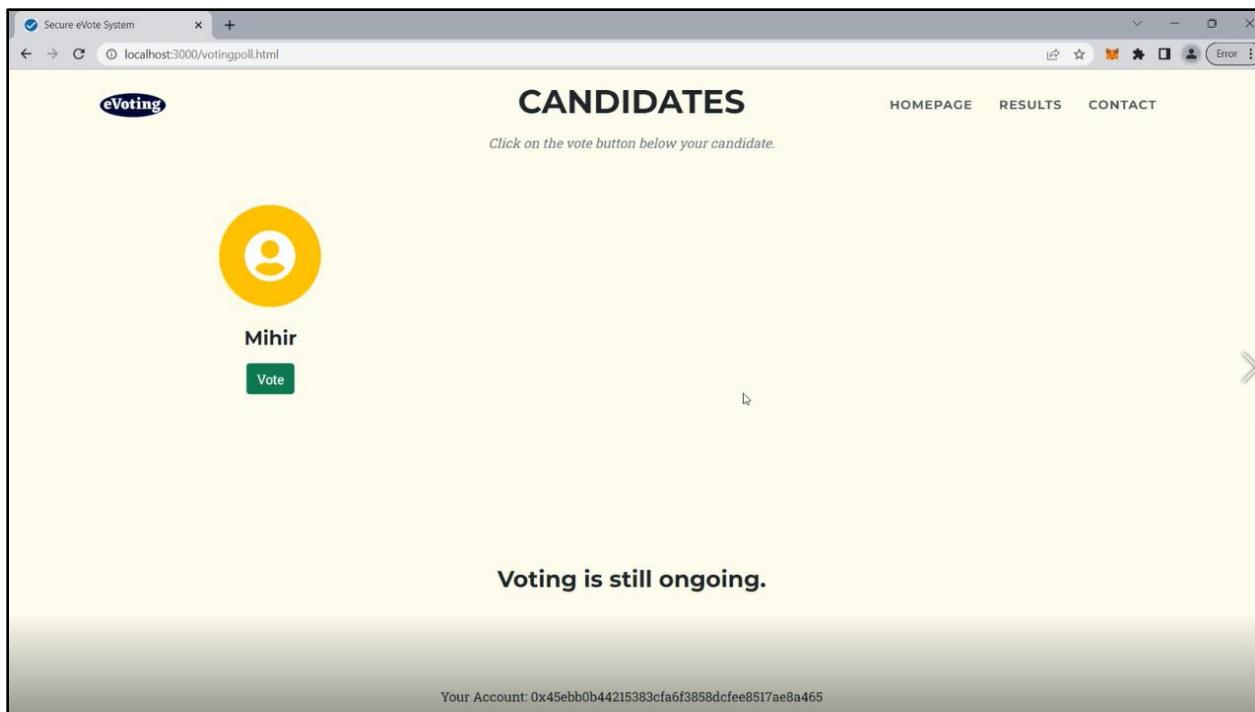


Figure 57: Candidate Added

Test No	3
Objective	To verify a voter can register in the system.
Action	<p>Filling up all the fields in the registration page, clicking register and confirming the transaction.</p> <p><b>Name:</b> abc  <b>Email:</b> <a href="mailto:abc@abc.com">abc@abc.com</a>  <b>Identity Number:</b> 123  <b>Password:</b> 123  <b>Confirm Password:</b> 123</p>
Expected result	The voter would be successfully registered.
Actual result	The transaction was completed and voter was registered successfully.
Conclusion	The test was successful.

Table 7: Test Case 3

The screenshot shows a web browser window titled "Secure eVote System" at the URL "localhost:3000/voter\_registration.html". The page has a header with the "eVoting" logo and navigation links for "HOMEPAGE", "VOTE", "ADMIN LOGIN", and "VOTER LOGIN". The main content area contains form fields for "Name" (input: abc), "E-mail" (input: abc@abc.com), "Identity Number" (input: 123), "Password" (input: three dots), "Confirm Password" (input: three dots), and a "Register" button.

Figure 58: Inputting Personal Info. of Voter

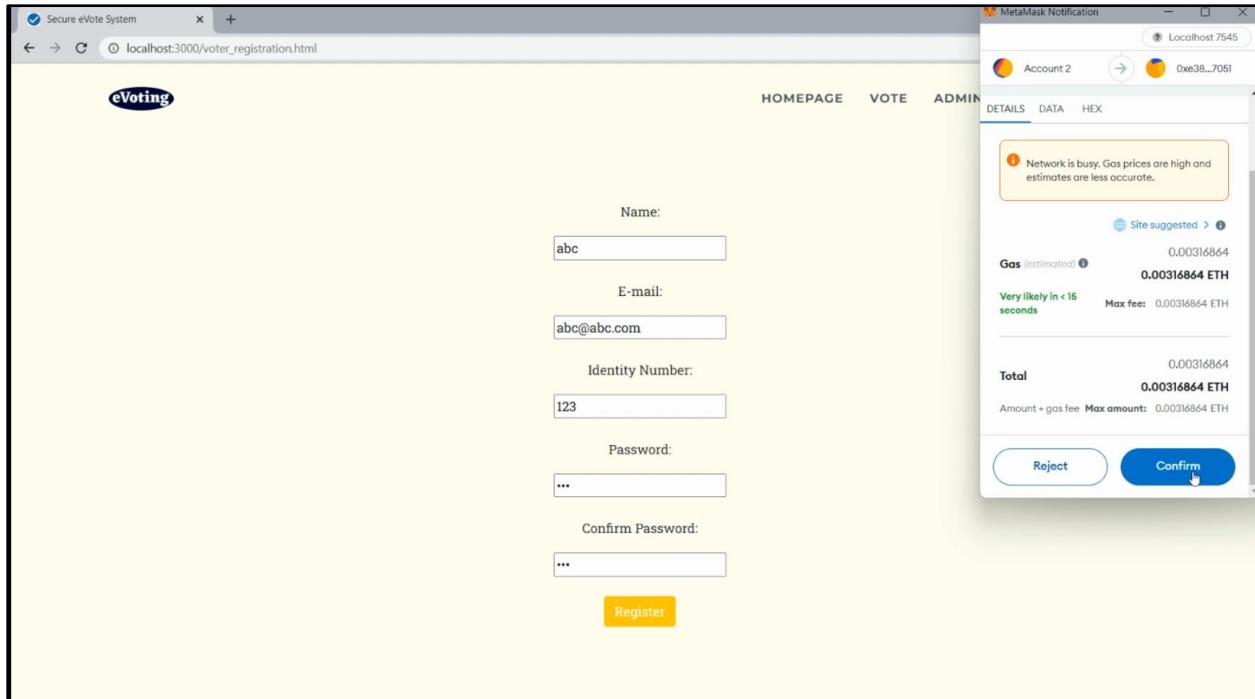


Figure 59: Confirming Transaction

Test No	4
Objective	To verify the voter can log in to the system.
Action	<p>Entering Correct email and password as registered before and confirming the transaction.</p> <p><b>Email:</b> abc@abc.com</p> <p><b>Password:</b> 123</p>
Expected result	The voter would login successfully.
Actual result	The voter successfully logged in to system.
Conclusion	The test was successful.

Table 8: Test Case 4

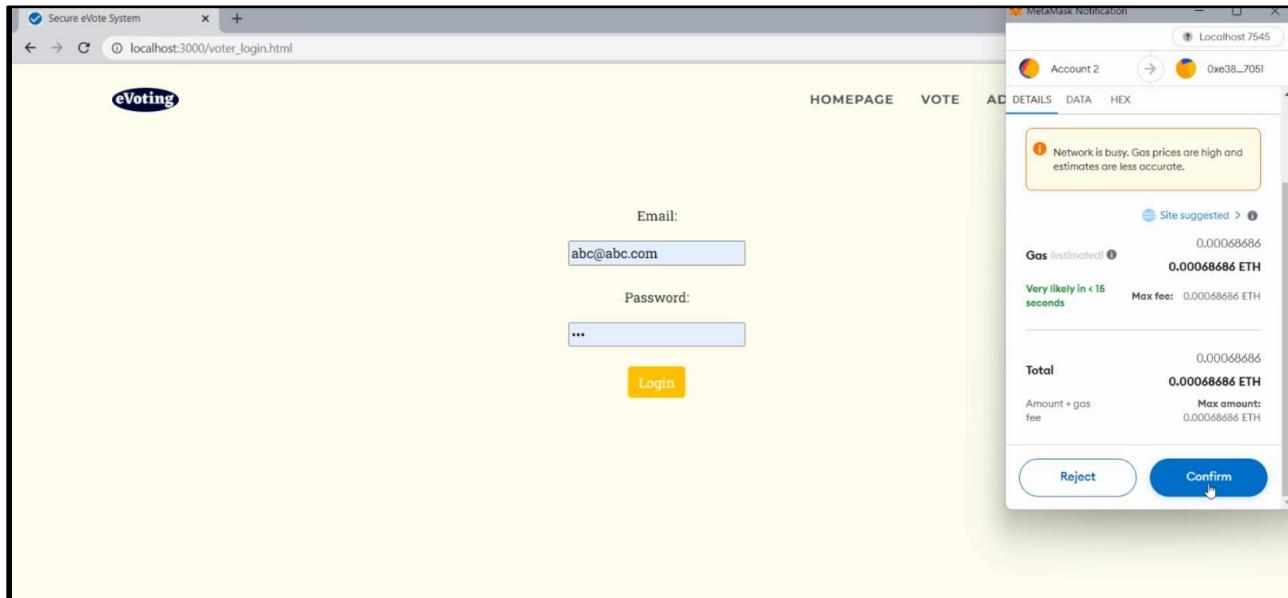


Figure 60: Entering Login Credentials of Voter

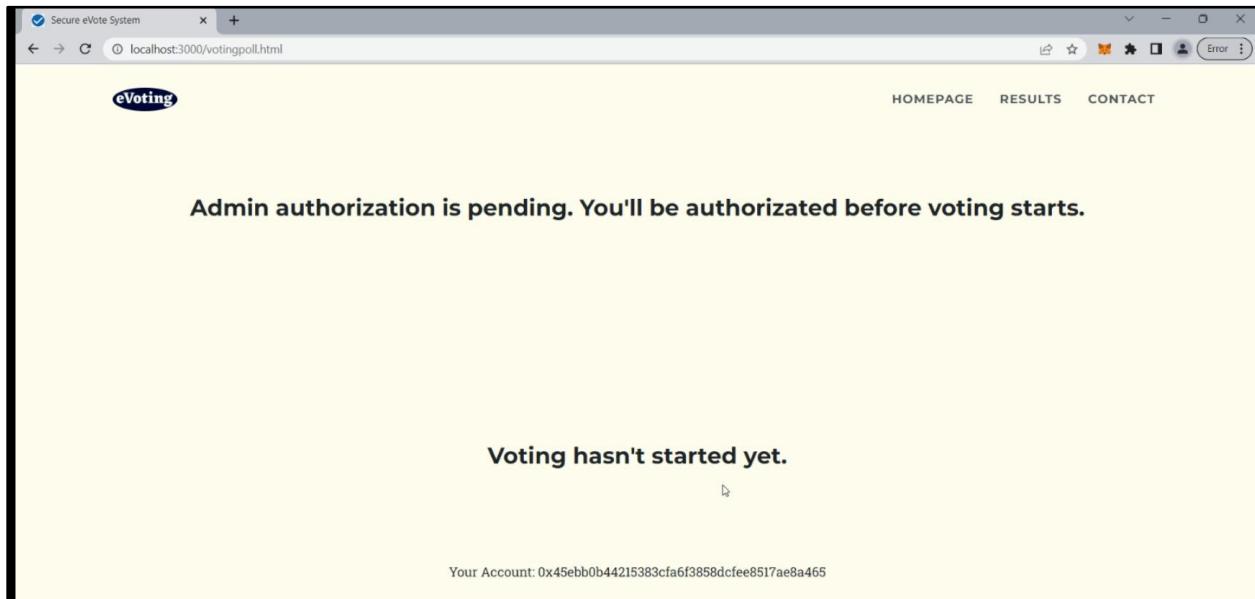


Figure 61: Voter's Account

Test No	5
Objective	To verify that a voter cannot register using an already existing account.
Action	Using the same email and MetaMask address as registered before. <b>Email:</b> abc@abc.com
Expected result	The voter cannot register twice.
Actual result	The voter could not register twice.
Conclusion	The test was successful.

Table 9: Test Case 5

Name: abc

E-mail: abc@abc.com

Identity Number: 123

Password: ...

Confirm Password: ...

**Register**

Figure 62: Re-entering the Same Credentials of Voter

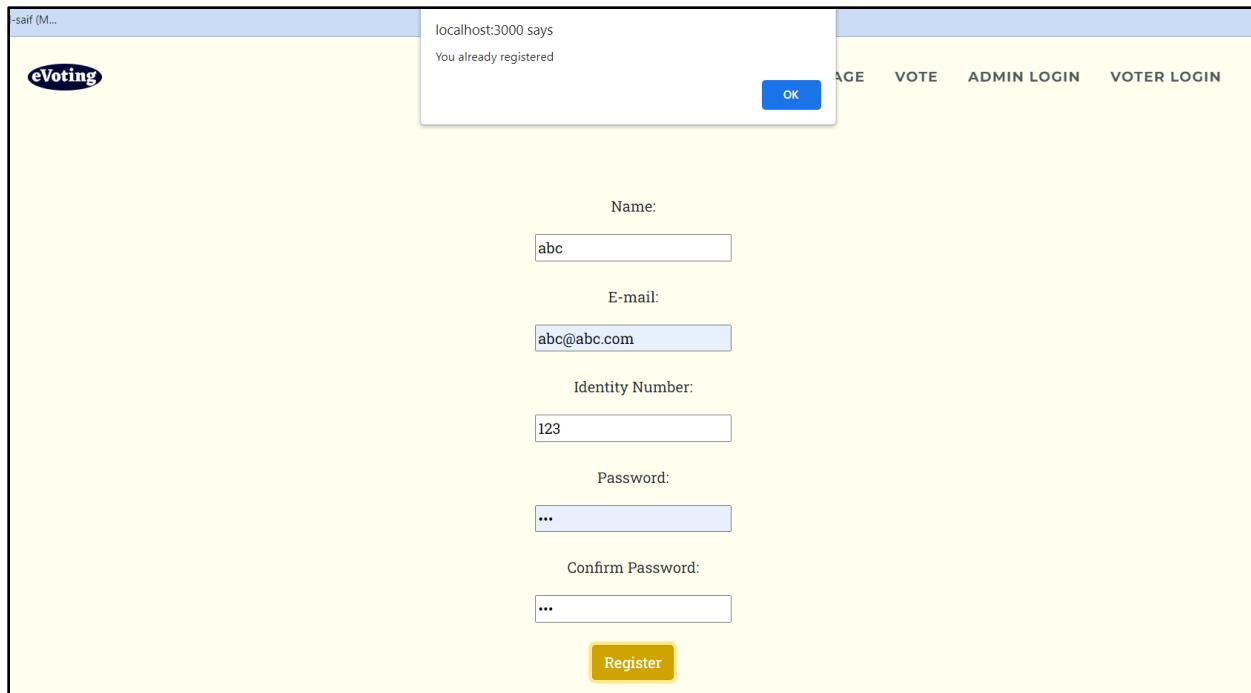


Figure 63: Error Message

Test No	6
Objective	To verify the admin can change the phase to validate voters.
Action	<p>Clicking the Administrative Voting tab and changing phase, completing transaction using admin's eth address.</p> <p><b>Eth Address:</b></p> <p>0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</p>
Expected result	The voter can change phase successfully.
Actual result	The voter changed phase successfully.
Conclusion	The test was successful.

Table 10: Test Case 6

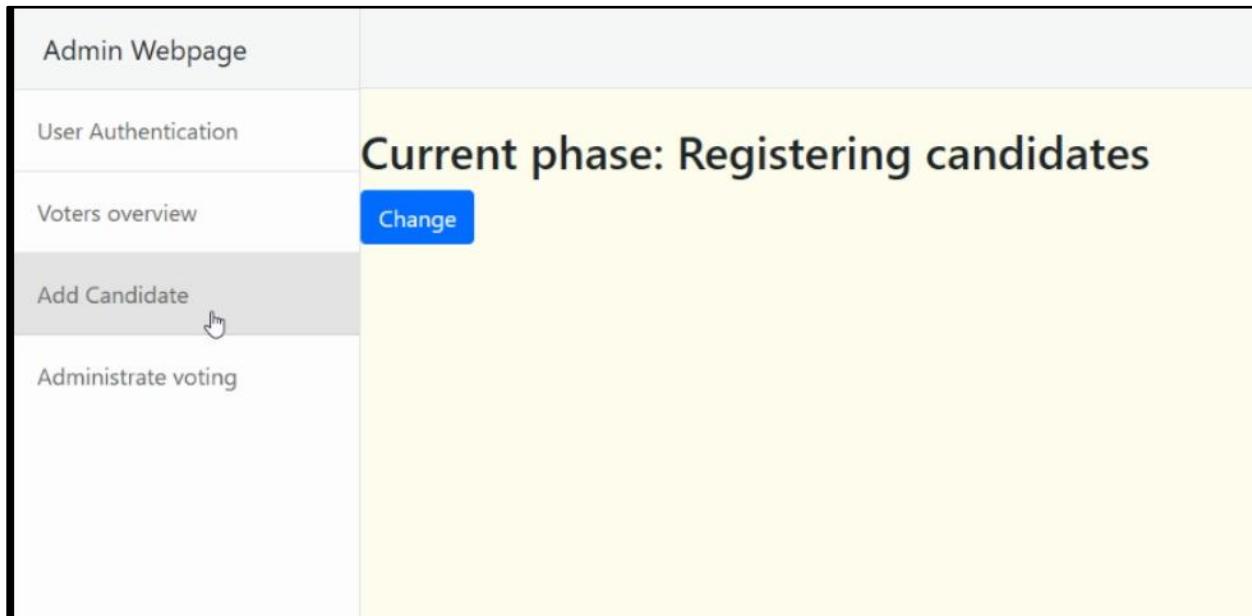


Figure 64: Changing Phase

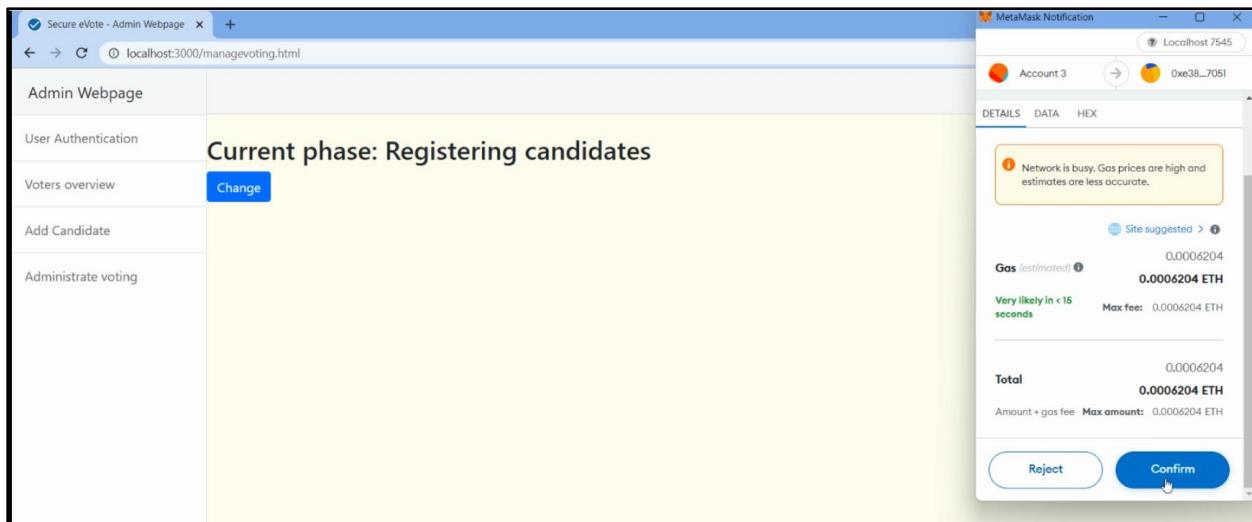
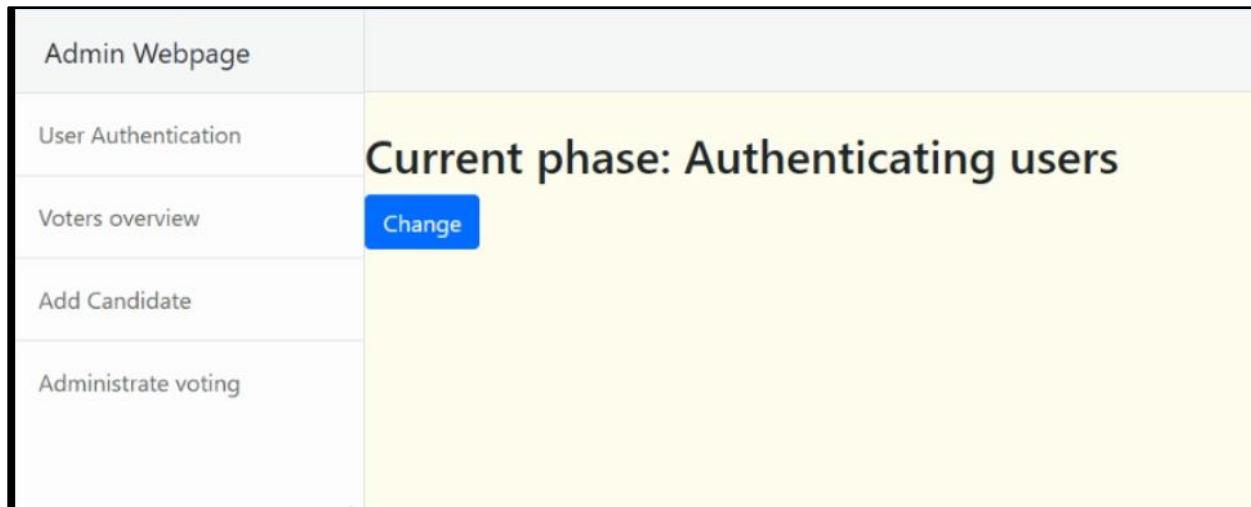


Figure 65: Changing Phase -2



*Figure 66: Authenticating Users Phase*

Test No	7
Objective	To verify the admin can validate a voter.
Action	<p>Navigating to User Authentication tab, choosing the voter's eth address from the list to verify, entering it to the field and confirming transaction.</p> <p><b>Voter's Eth Address:</b></p> <p>0x45EbB0b44215383cfa6f3858DCFee8517ae8A465</p>
Expected result	The voter can successfully validate voter's address.
Actual result	The voter successfully validated voter's address.
Conclusion	The test was successful.

*Table 11: Test Case 7*

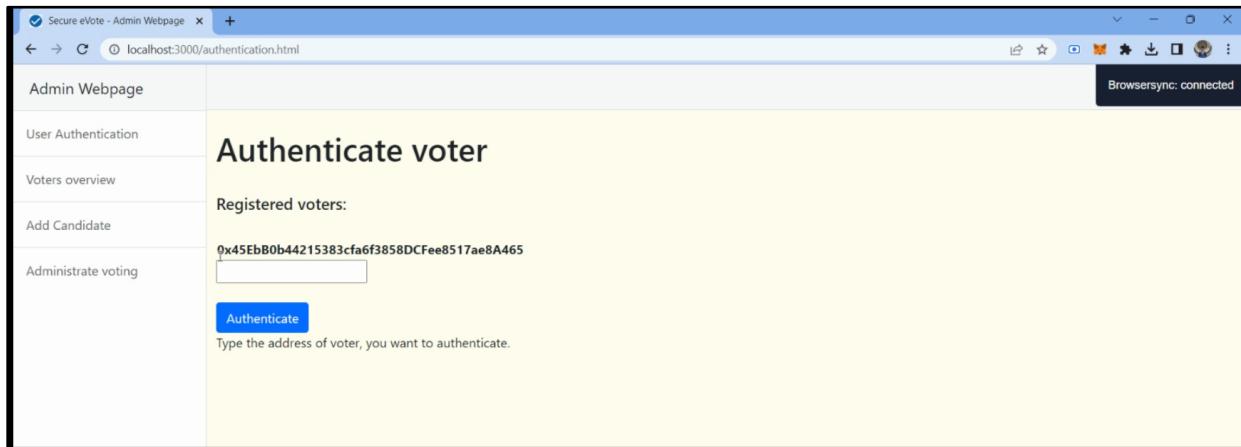


Figure 67: Authenticate Voter

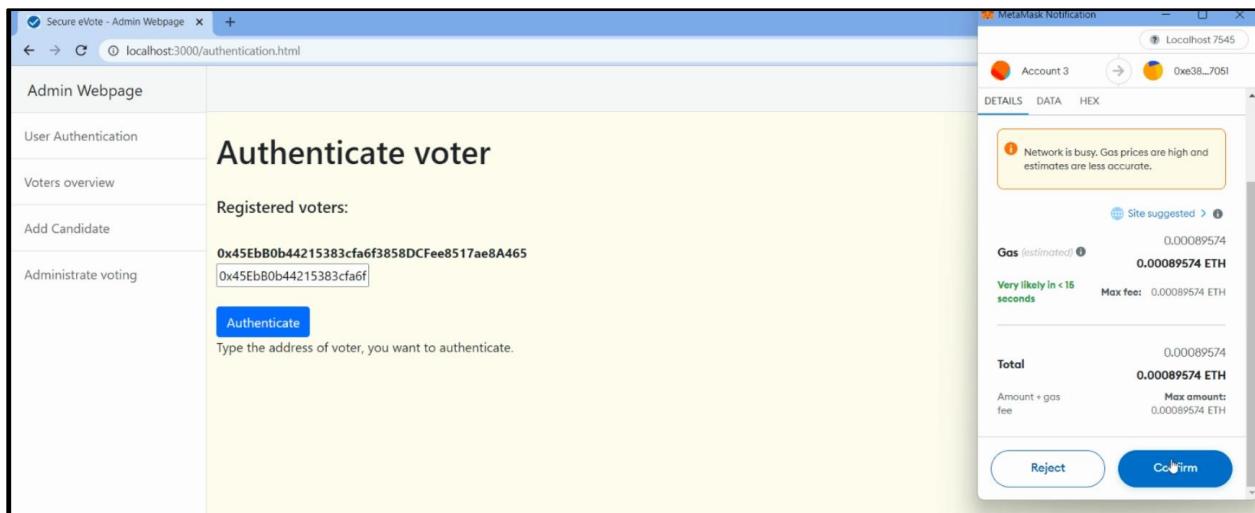


Figure 68: Entering Voter's Eth Address

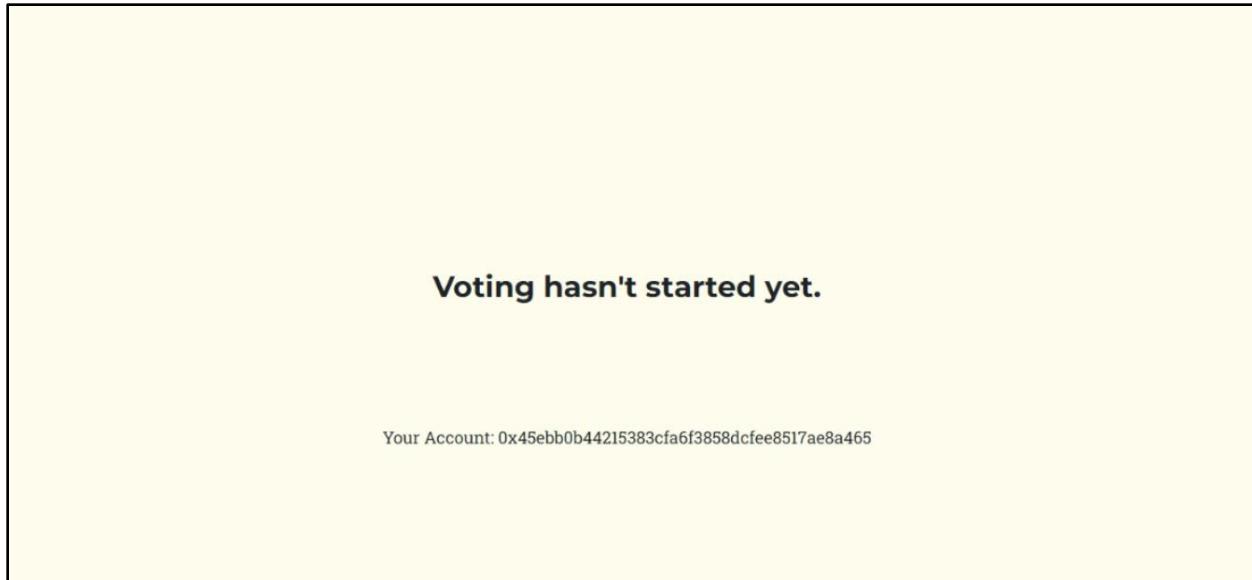


Figure 69: Voter is authenticated

Test No	8
Objective	To verify the admin cannot validate an unregistered user in the system.
Action	Entering non-registered eth address.  <b>Voter's Eth Address:</b>  0x2e2ec066518aa93004756d5eeAb35Fb649D3910a
Expected result	The admin cannot complete transaction.
Actual result	The voter could not complete transaction.
Conclusion	The test was successful.

Table 12: Test Case 8

Admin Webpage	<h2>Authenticate voter</h2> <p>Registered voters:</p> <input style="width: 200px; height: 20px; margin-bottom: 10px;" type="text"/> <p><b>Authenticate</b></p> <p>Type the address of voter, you want to authenticate.</p>
User Authentication Voters overview Add Candidate Administrate voting	

Figure 70: Authenticate Voter

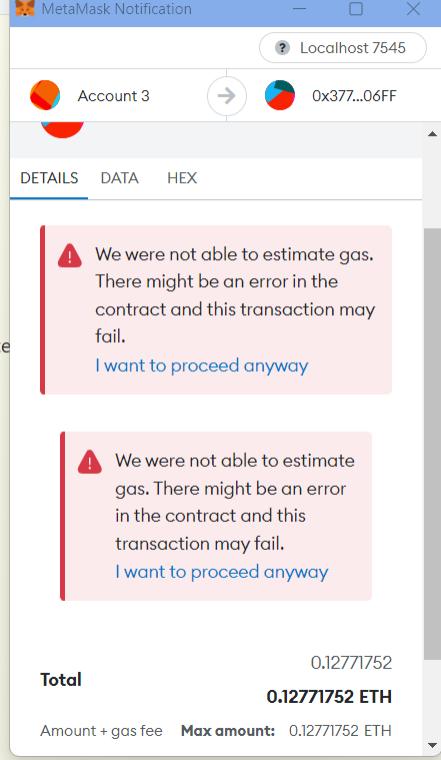
Admin Webpage	<h2>Authenticate voter</h2> <p>Registered voters:</p> <input style="width: 200px; height: 20px; margin-bottom: 10px;" type="text" value="0x2e2ec066518aa930047!"/> <p><b>Authenticate</b></p> <p>Type the address of voter, you want to authenticate</p>	 <p>We were not able to estimate gas. There might be an error in the contract and this transaction may fail. I want to proceed anyway</p> <p>We were not able to estimate gas. There might be an error in the contract and this transaction may fail. I want to proceed anyway</p> <p>Total 0.12771752 0.12771752 ETH</p> <p>Amount + gas fee Max amount: 0.12771752 ETH</p>
User Authentication Voters overview Add Candidate Administrate voting		

Figure 71: Entering Unregistered Eth Address

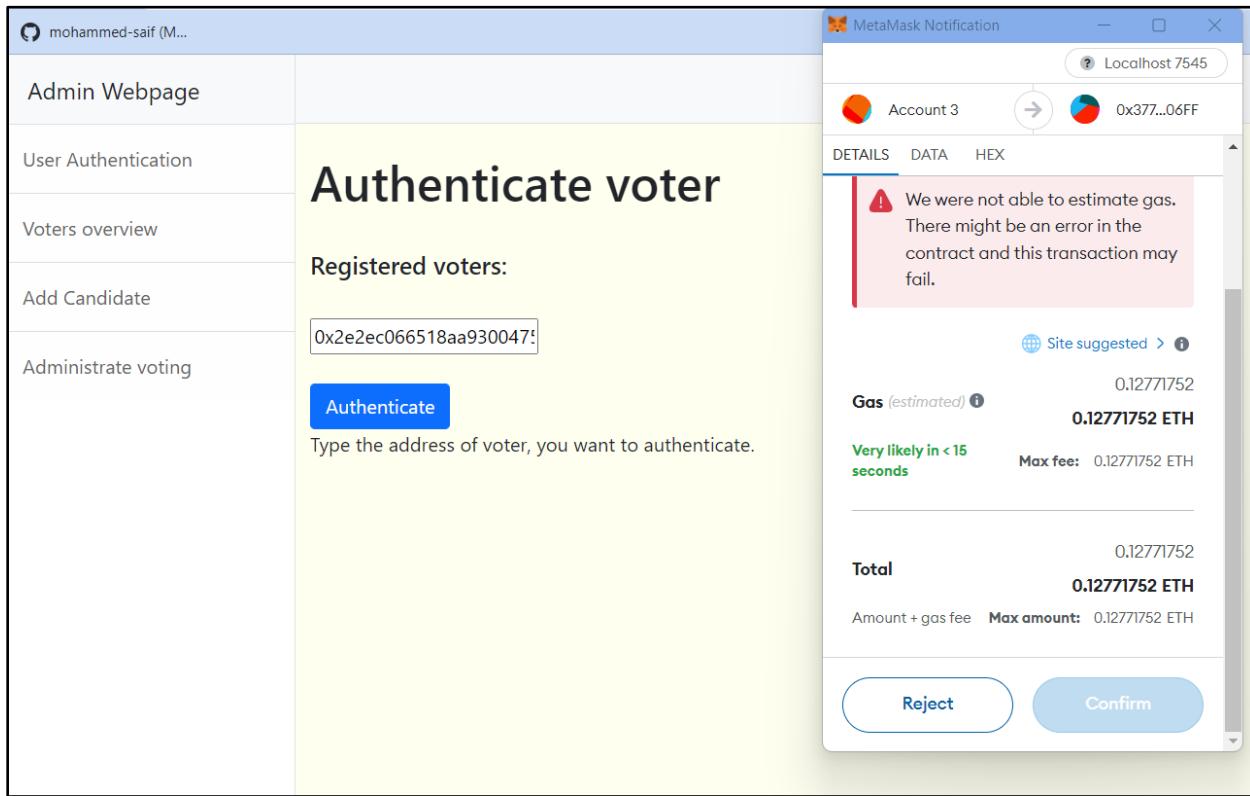


Figure 72: Proceed Anyway But Not Working

Test No	9
Objective	To verify the admin can change the phase to start voting.
Action	<p>Navigating to Administrative voting tab and changing phase to start voting.</p> <p><b>Admin's Eth Address:</b></p> <p>0x91Bc00c58C78d07EC069DECFCe6e5CBF9a41F24</p>
Expected result	The admin can successfully change phase to start voting.
Actual result	The admin completed transaction and changed phase successfully.
Conclusion	The test was successful.

Table 13: Test Case 9

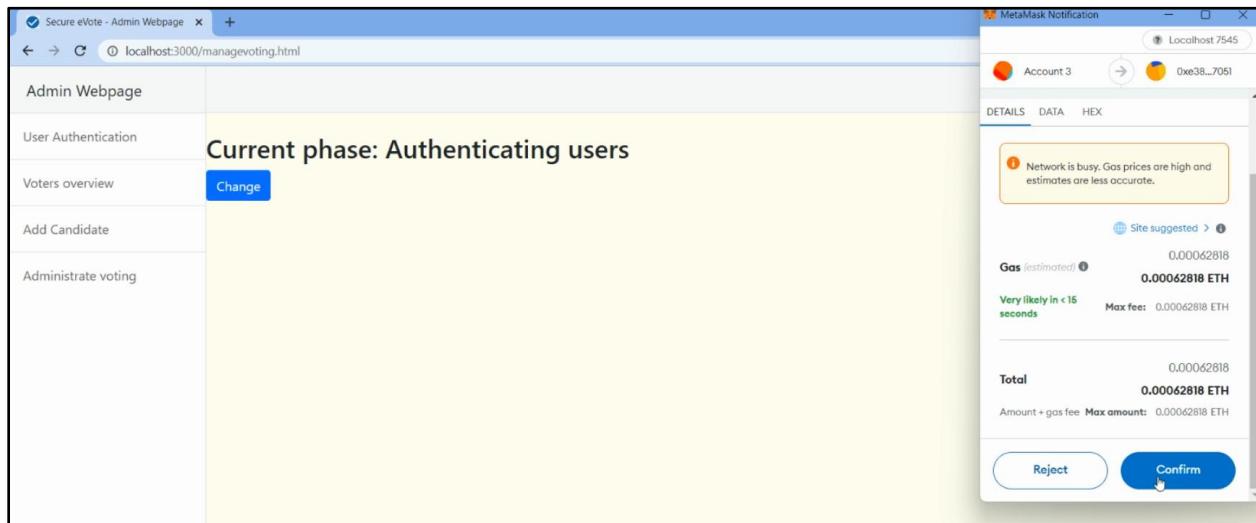


Figure 73: Changing Phase

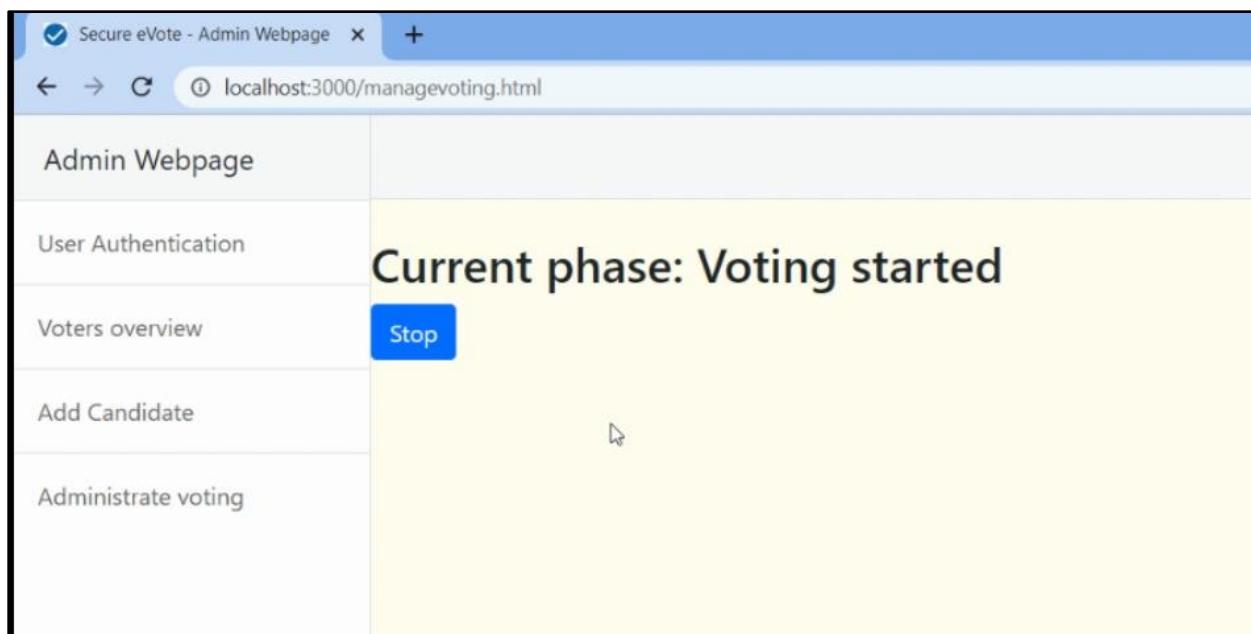


Figure 74: Voting Started

Test No	10
Objective	To verify a validated voter can cast their vote and only once.
Action	<p>Casting a vote to the candidate of their choice with their validated eth address.</p> <p><b>Voter's Eth Address:</b></p> <p>0x45EbB0b44215383cfa6f3858DCFee8517ae8A465</p>
Expected result	The voter can successfully vote but only once.
Actual result	The voter successfully voted and could not vote twice.
Conclusion	The test was successful.

Table 14: Test Case 10



Figure 75: Voting to Candidates

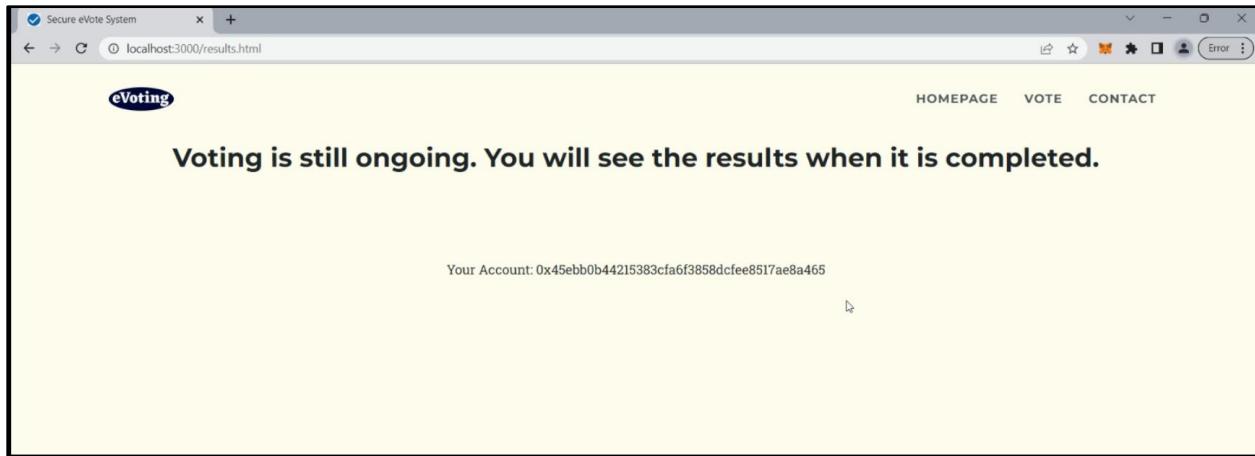


Figure 76: After Voting Once

Test No	11
Objective	To verify the admin can accurately tally the results.
Action	Navigating to Administrative voting tab and changing phase to end voting.
Expected result	The votes are tallied accurately.
Actual result	The votes were tallied accurately.
Conclusion	The test was successful.

Table 15: Test Case 11

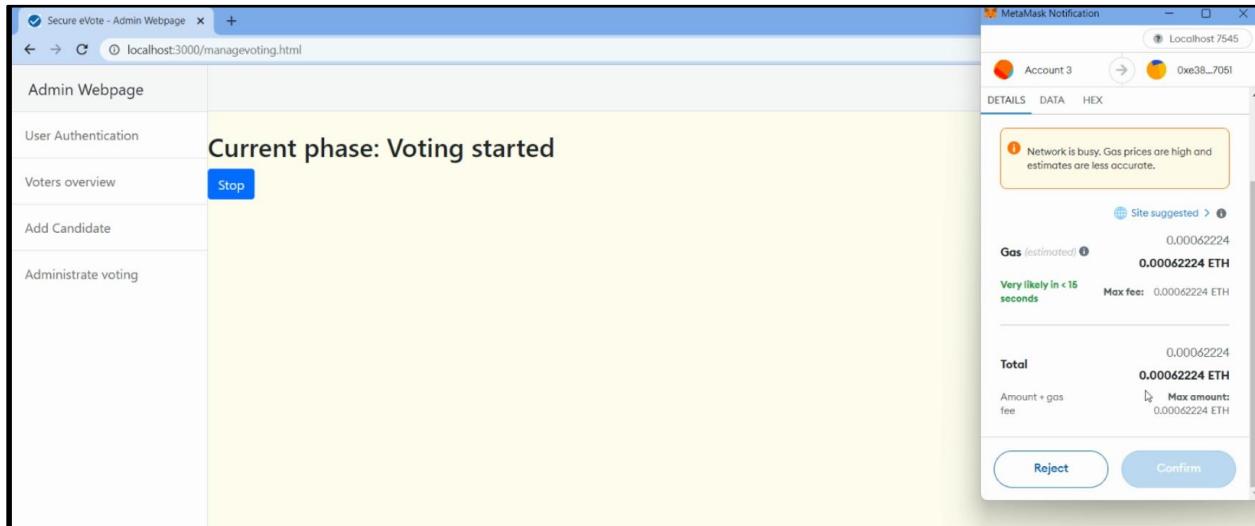


Figure 77: Ending Election

The screenshot shows a sidebar on the left with the following menu items: Admin Webpage, User Authentication, Voters overview, Add Candidate, and Administrate voting. The main content area displays a message: "Election has completed successfully. See the results [here](#)".

*Figure 78: View Results*

The screenshot shows the eVoting homepage. At the top right are links for HOMEPAGE, VOTE, and CONTACT. Below the header, there is a table with one row containing three columns. The first column contains the number 1, the second column contains the name "Mihir", and the third column contains the number 1. Below the table, the text "Winner is Mihir" is displayed.

*Figure 79: Results*

Test No	12
Objective	To verify the voting analytics shown is accurate.
Action	Navigating to Voters overview tab when, <ul style="list-style-type: none"> <li>- Before Voter has voted.</li> <li>- After Voter has voted.</li> </ul>
Expected result	The pie chart should be accurate.
Actual result	The pie chart was accurate.
Conclusion	The test was successful.

*Table 16: Test Case 12*

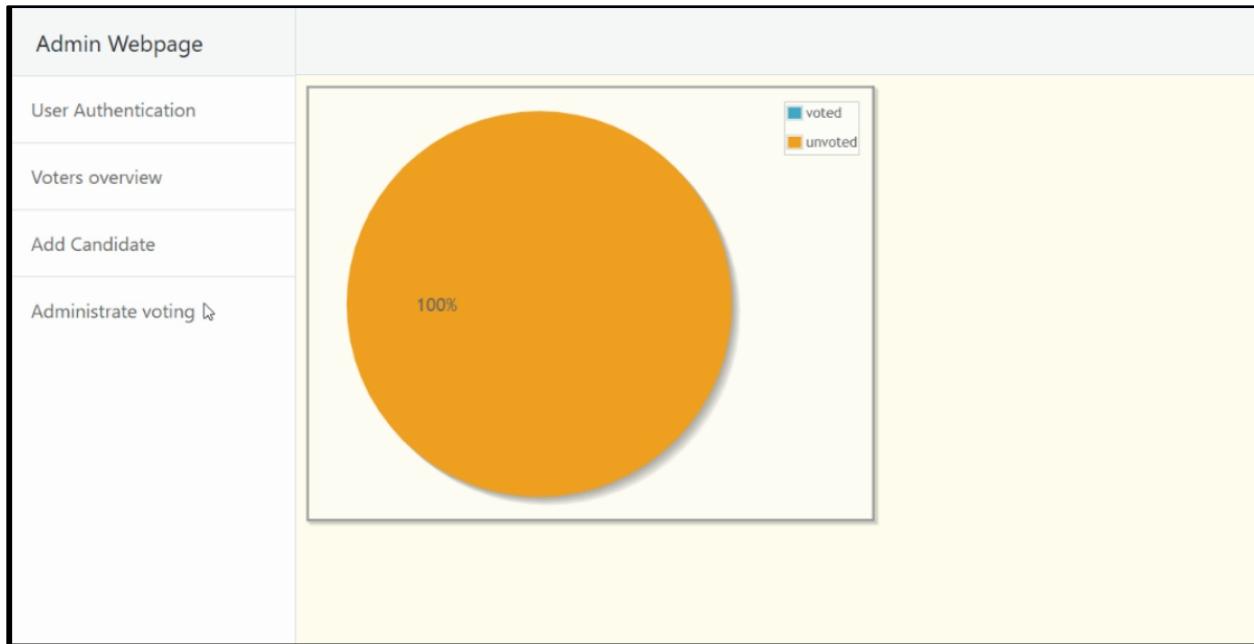


Figure 80: Analytics- Before Voting

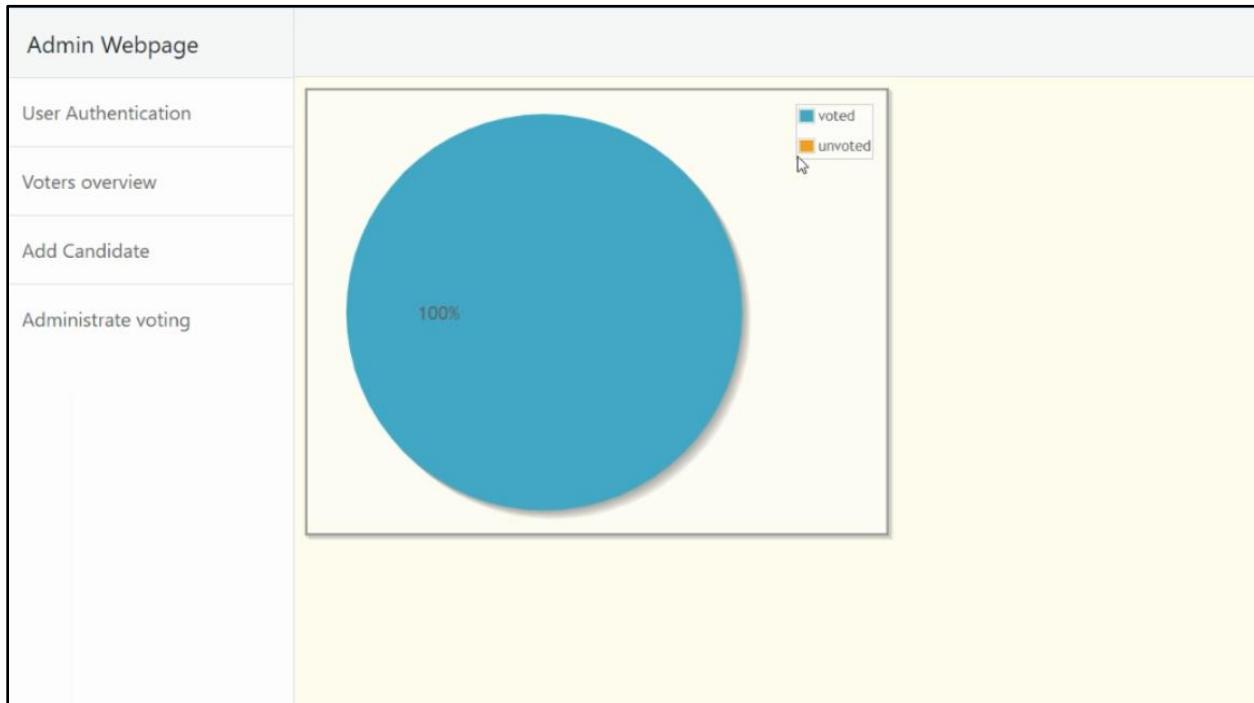


Figure 81: Analytics- After Voting

#### 4.2.2 BLOCKCHAIN-SPECIFIC UNIT TESTS

Test No	1
Objective	To verify the front-end syncs with Ganache.
Action	<p><b>Port Number</b> should match i.e., <b>7545</b></p> <p><b>Command used:</b></p> <pre>truffle migrate --reset</pre>
Expected result	The syncing should be successful.
Actual result	The syncing was successful .
Conclusion	The test was successful.

Table 17: Blockchain Test Case 1

```
development: {
  host: "127.0.0.1",      // Localhost (default: none)
  port: 7545,              // Standard Ethereum port (default: none)
  network_id: "*",         // Any network (default: none)
}
```

Figure 82; Truffle-config

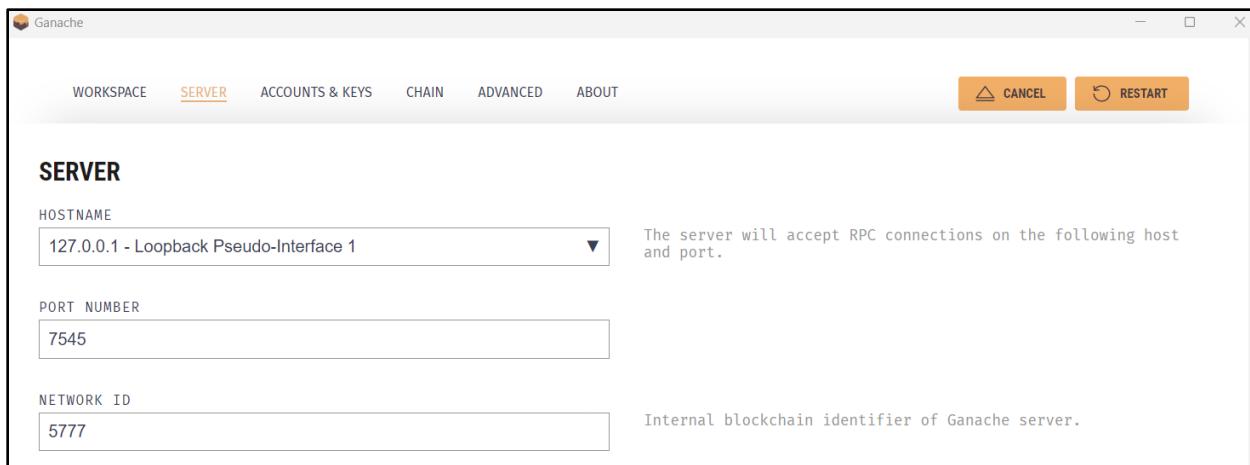


Figure 83: Ganache- Server

```
C:\Users\rauni\Pictures\New folder\Blockchain-based-E-Votting-System-main\Blockchain-based-E-Votting-System-main>truffle
migrate --reset

Compiling your contracts...
=====
> Compiling .\contracts\Migrations.sol
> Compiling .\contracts\eVote.sol
> Artifacts written to C:\Users\rauni\Pictures\New folder\Blockchain-based-E-Votting-System-main\Blockchain-based-E-Votting-System-main\build\contracts
> Compiled successfully using:
  - solc: 0.5.16+commit.9c3226ce.Emscripten clang

Starting migrations...
=====
> Network name:    'development'
> Network id:      5777
> Block gas limit: 6721975 (0x6691b7)

1_initial_migration.js
=====
```

Figure 84: Compiling Contract

```

2_deploy_contract.js
=====
Replacing 'eVote'
-----
> transaction hash: 0xc65ed050f2ad4048f435d65e763bb24c6921897c50c18777ce8d84c0bba84959
> Blocks: 0
> contract address: 0x3779e3d40D5e1999198AE2a65c46cE6aD69D06FF
> block number: 23
> block timestamp: 1681571721
> account: 0x91Bc00c58C78d07EC069DECFCe6e5CBF9a41F24
> balance: 99.975981226991685379
> gas used: 1463299 (0x165403)
> gas price: 2.559412434 gwei
> value sent: 0 ETH
> total cost: 0.003745185655259766 ETH

> Saving migration to chain.
> Saving artifacts
-----
> Total cost: 0.003745185655259766 ETH

Summary
=====
> Total deployments: 2
> Final cost: 0.004243137770045835 ETH

```

Figure 85: Compiled Contract

Test No	2
Objective	To verify the MetaMask syncs with front-end and ganache.
Action	<p>Enable test networks in MetaMask.</p> <p>Adjust Local host Network:</p> <p><b>New RPC URL:</b> http://localhost:7545</p> <p><b>Chain ID:</b> 1337</p>
Expected result	The MetaMask sync should be successful.
Actual result	The MetaMask sync with the project was successful.
Conclusion	The test was successful.

Table 18: Blockchain Test Case 2

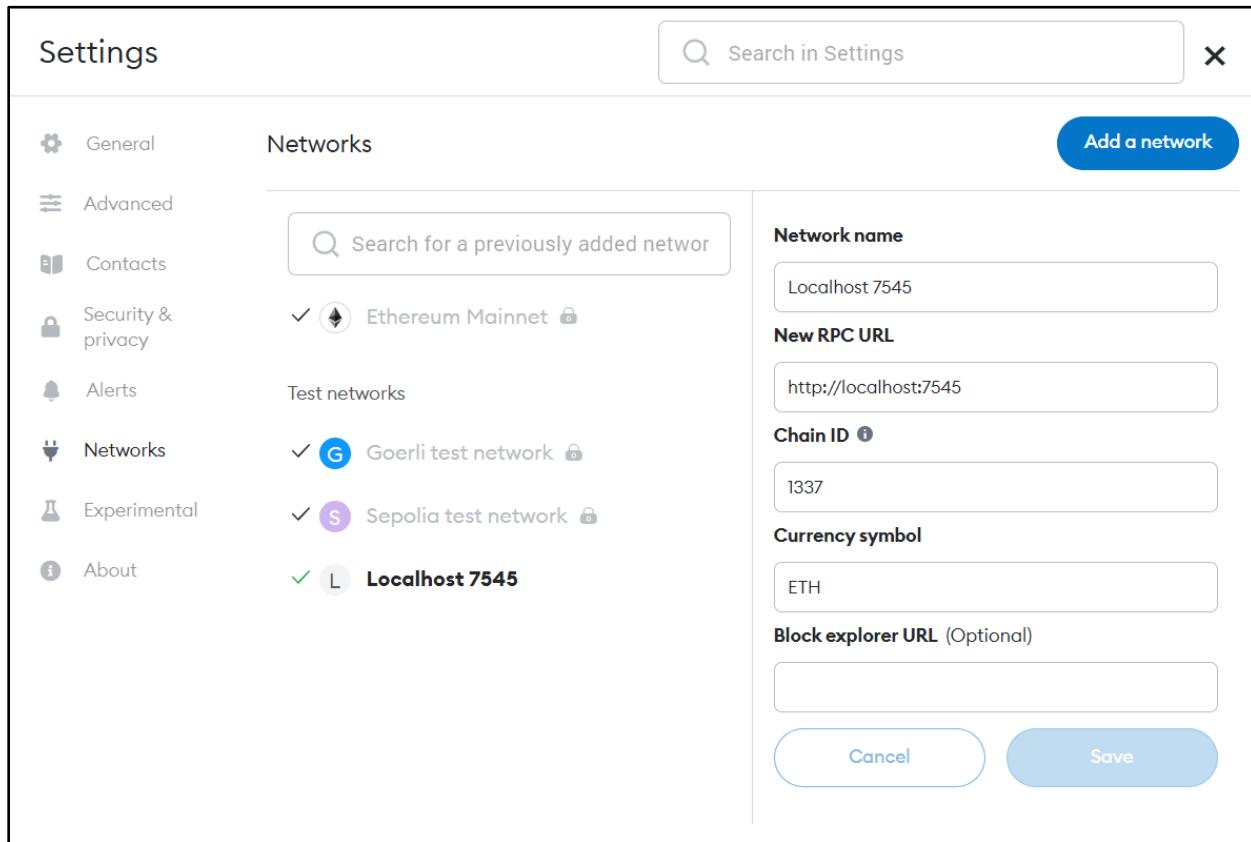


Figure 86: MetaMask- Local Network



Figure 87: Front-End Synced with MetaMask

Test No	3
Objective	To verify that the deployer has the admin rights of the system.
Action	<p>The first account on ganache is the deployer therefore admin.</p> <p><b>Eth address:</b></p> <p>0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</p> <p><b>Command Used:</b></p> <p>npm run dev</p>
Expected result	The deployer should be the admin of the system.
Actual result	The address from which project was deployed was given the admin rights.
Conclusion	The test was successful.

Table 19: Blockchain Test Case 3

The screenshot shows the Ganache application window. At the top, there's a navigation bar with icons for Accounts, Blocks, Transactions, Contracts, Events, Logs, and a search bar. Below the bar, there are several configuration fields: Current Block (32), Gas Price (2000000000), Gas Limit (6721975), Hardfork (Merge), Network ID (5777), RPC Server (HTTP://127.0.0.1:7545), and Mining Status (AUTOMINING). On the right side of the header, there are buttons for Workspace (FYP), Switch, and Settings. The main area displays a table of accounts. Each account entry includes the address, balance (in ETH), transaction count, index, and a key icon. The addresses listed are 0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24, 0x2e2ec066518aa93004756d5eeAb35Fb649D3910a, 0x45EbB0b44215383cfa6f3858DCFee8517ae8A465, 0x59f45Ba971558c1f6d5d14094DFaC346b3576705, 0x2137aE4fdAC8DE8B9EdeBBEF4E504DFbE0F0b138, 0x7131800a7c9109dC9DC67D8166f9253AB8Ae18c6, and 0x450120D71c97cD2a64d8857687998AF74fd461b4. The balances for these accounts are 99.97 ETH, 100.00 ETH, 99.99 ETH, 100.00 ETH, 100.00 ETH, 100.00 ETH, and 100.00 ETH respectively.

Figure 88: Ganache- Homepage

```

Replacing 'eVote'
-----
> transaction hash: 0xc65ed050f2ad4048f435d65e763bb24c6921897c50c18777ce8d84c0bba84959
> Blocks: 0 Seconds: 0
> contract address: 0x3779e3d40D5e1999198AE2a65c46cE6aD69D06FF
> block number: 23
> block timestamp: 1681571721
> account: 0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24
> balance: 99.975981226991685379
> gas used: 1463299 (0x165403)
> gas price: 2.559412434 gwei
> value sent: 0 ETH
> total cost: 0.003745185655259766 ETH

> Saving migration to chain.
> Saving artifacts
-----
> Total cost: 0.003745185655259766 ETH

Summary
=====
> Total deployments: 2
> Final cost: 0.004243137770045835 ETH

```

Figure 89: Deployed Address

```

:~\Users\rauni\Pictures\New folder\Blockchain-based-E-Votting-System-main\Blockchain-based-E-Votting-System-main>npm run dev

> thesis@1.0.0 dev
> lite-server

** browser-sync config **
{
  injectChanges: false,
  files: [ './**/*.{html,htm,css,js}' ],
  watchOptions: { ignored: 'node_modules' },
  server: {
    baseDir: [ './web', './build/contracts' ],
    middleware: [ [Function (anonymous)], [Function (anonymous)] ]
  }
}
[Browsersync] Access URLs:
-----
  Local: http://localhost:3000
  External: http://192.168.239.1:3000
-----
  UI: http://localhost:3001
UI External: http://localhost:3001
-----
[Browsersync] Serving files from: ./web

```

Figure 90: Deploying Project

Test No	4
Objective	To verify no function can be executed without the Ethereum address.
Action	Trying to execute the functions without Eth address.
Expected result	No function should be executed.
Actual result	No button responded and no function was executed.
Conclusion	The test was successful.

Table 20: Blockchain Test Case 4

Admin Webpage	
User Authentication	<h2>Authenticate voter</h2>
Voters overview	<b>Registered voters:</b>
Add Candidate	<input type="text"/>
Administrat voting	<b>Authenticate</b>
	Type the address of voter, you want to authenticate.

Figure 91: Authenticate Voter

Admin Webpage	
User Authentication	<h1>Add candidate</h1> <p>Please type the name of candidate.</p> <input type="text"/> <input type="button" value="Add"/>
Voters overview	
Add Candidate	
Administrat voting	

Figure 92: Add Candidate

 VOTE REGISTER VOTER LOGIN
<p>Admin Email:</p> <input type="text" value="abc@abc.com"/> <p>Admin Password:</p> <input type="password" value="..."/> <input type="button" value="Login"/>

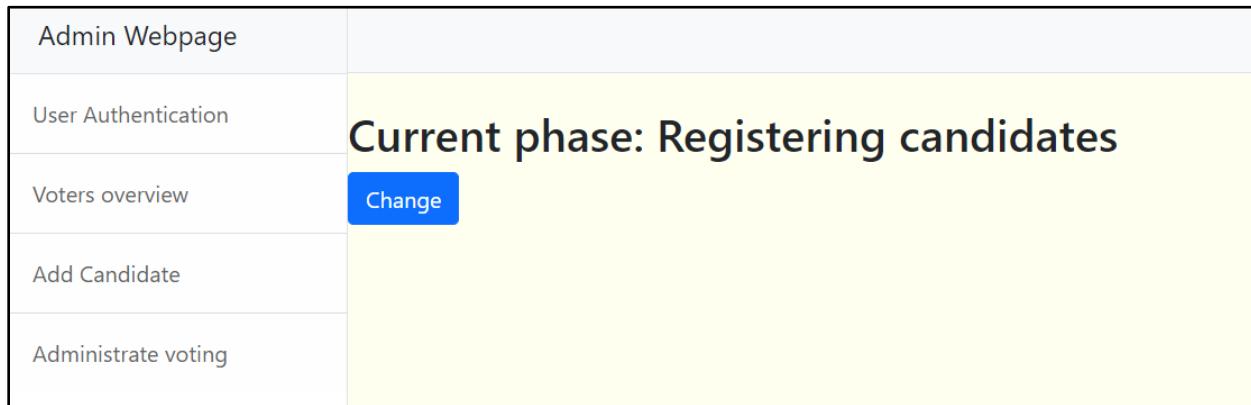
Figure 93: Voter Login

Test No	5
Objective	To verify system's security in case of compromised login credentials.
Action	In case of leaked login credentials but not Eth address, the hacker can't execute any function making system secure.
Expected result	No admin function should be executed.
Actual result	No button responded and no function was executed.
Conclusion	The test was successful.

Table 21: Blockchain Test Case 5

Admin Webpage	
User Authentication	<h2>Authenticate voter</h2> <p>Registered voters:</p> <input style="width: 200px; height: 30px; margin-bottom: 10px;" type="text"/> <p><b>Authenticate</b></p> <p>Type the address of voter, you want to authenticate.</p>
Voters overview	
Add Candidate	
Administate voting	

Figure 94: Authenticate Voter



*Figure 95: Registering Candidates*

Test No	6
Objective	To verify voter's security in case of compromised login credentials.
Action	In case of leaked login credentials but not Eth address of the voter, the hacker can't login in the voter's account.
Expected result	Hacker shouldn't be able to login.
Actual result	It wasn't possible to login in to the system without eth address.
Conclusion	The test was successful.

*Table 22: Blockchain Test Case 6*



Figure 96: Voter Login

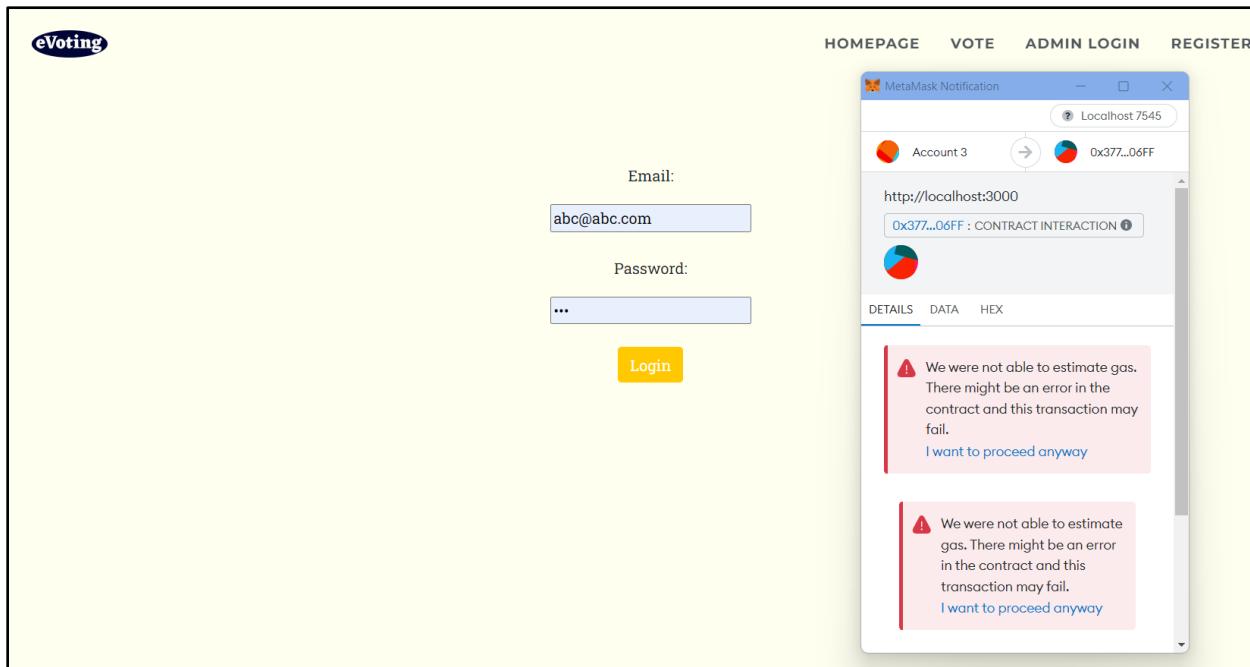


Figure 97: Error in Transaction

Test No	7
Objective	To verify the transparency of votes.
Action	Navigate to voter's overview tab and observe the pie chart for transparency of votes.
Expected result	The pie chart should provide transparency of votes
Actual result	The transparency of votes was successfully verified.
Conclusion	The test was successful.

Table 23: Blockchain Test Case 7

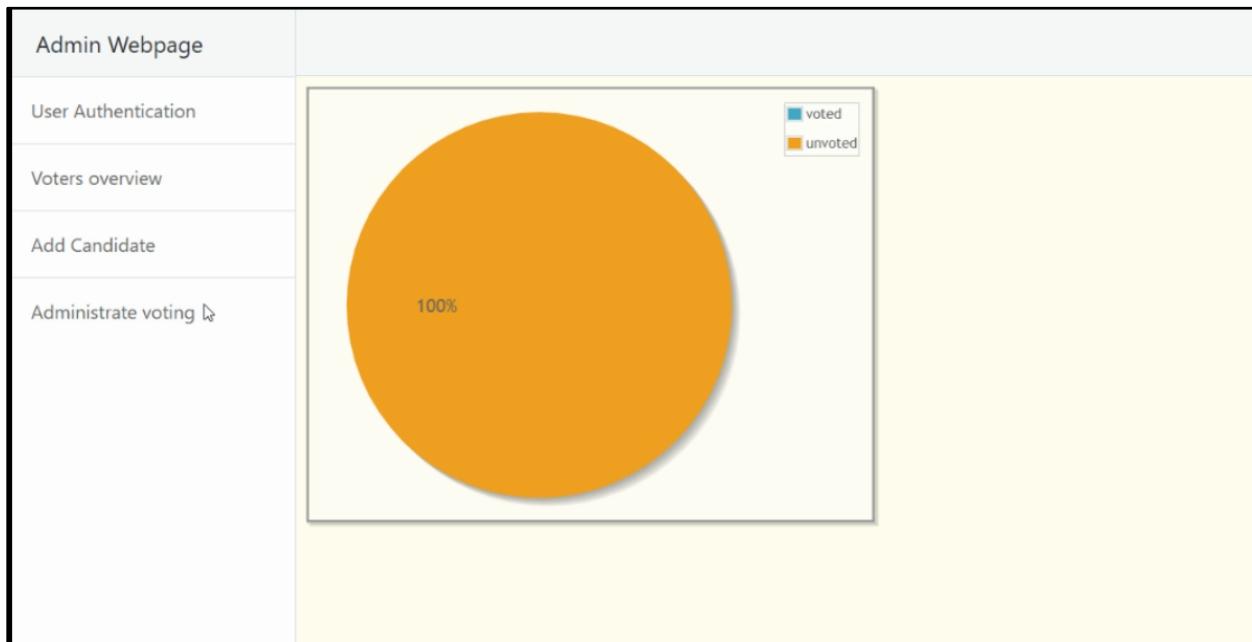


Figure 98: Analytics- Not Voted

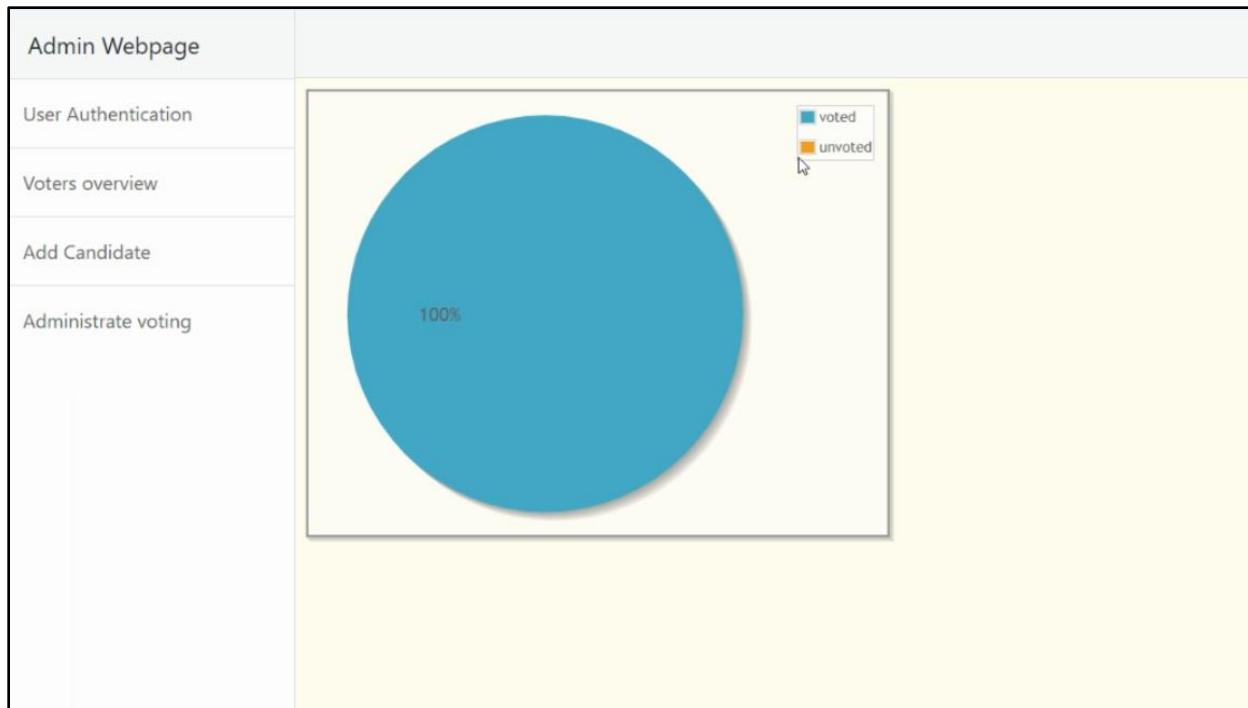


Figure 99: Analytics- Voted

### 4.3 SYSTEM TESTING

Test No	1
Objective	To verify the system can launch properly.
Action	<p>Run Ganache, compiling smart contract and launching the project.</p> <p><b>Command Used:</b></p> <pre>truffle migrate --reset npm run dev</pre>
Expected result	The project should be launched successfully.
Actual result	The project was launched successfully.
Conclusion	The test was successful.

Table 24: System Test Case 1

Accounts							Logs	
Current Block 36	Gas Price 20000000000	Gas Limit 6721975	Hardfork MERGE	Network ID 5777	RPC Server HTTP://127.0.0.1:7545	Mining Status AUTOMINING	Workspace FYP	Switch
<b>MNEMONIC</b> ⓘ							<b>HD PATH</b>	
cliff surface artefact era table farm mass supply actress cousin rug please							m44'60'0'0account_index	
ADDRESS <b>0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</b>	BALANCE <b>99.97</b> ETH						TX COUNT 28	INDEX 0
ADDRESS <b>0x2e2ec066518aa93004756d5eeAb35Fb649D3910a</b>	BALANCE <b>100.00</b> ETH						TX COUNT 0	INDEX 1
ADDRESS <b>0x45EbB0b44215383cfa6f3858DCFee8517ae8A465</b>	BALANCE <b>99.99</b> ETH						TX COUNT 8	INDEX 2
ADDRESS <b>0x59f45Ba971558c1f6d5d14094DFaC346b3576705</b>	BALANCE <b>100.00</b> ETH						TX COUNT 0	INDEX 3
ADDRESS <b>0x2137aE4fdAC8DE8B9EdeBBEF4E504DFbE0F0b138</b>	BALANCE <b>100.00</b> ETH						TX COUNT 0	INDEX 4
ADDRESS <b>0x7131800a7c9109dC9DC67D8166f9253AB8Ae18c6</b>	BALANCE <b>100.00</b> ETH						TX COUNT 0	INDEX 5
ADDRESS <b>0x450120D71c97cD2a64d8B57687998AF74fd461b4</b>	BALANCE <b>100.00</b> ETH						TX COUNT 0	INDEX 6

Figure 100: Ganache- Home

```
C:\Users\rauni\Pictures\New folder\workin\fyp>truffle migrate --reset

Compiling your contracts...
=====
> Compiling .\contracts\Migrations.sol
> Compiling .\contracts\eVote.sol
> Artifacts written to C:\Users\rauni\Pictures\New folder\workin\fyp\build\contracts
> Compiled successfully using:
  - solc: 0.5.16+commit.9c3226ce.Emscripten clang

Starting migrations...
=====
> Network name:    'development'
> Network id:      5777
> Block gas limit: 6721975 (0x6691b7)

1_initial_migration.js
=====

  Replacing 'Migrations'
  -----
  > transaction hash:  0x478d8c425046acd4cba69ef51de193d1dd5445e1a0a56147523bab1552fb4818
  > Blocks: 0          Seconds: 0
  > contract address: 0x5CB707eC7ADb15d8815C76562C48AaFBa925c568
  > block number:     33
  > block timestamp:  1681659743
```

Figure 101: Compiling Contract

```
C:\Users\rauni\Pictures\New folder\workin\fyp>npm run dev
> thesis@1.0.0 dev
> lite-server

** browser-sync config **
{
  injectChanges: false,
  files: [ './**/*.{html,htm,css,js}' ],
  watchOptions: { ignored: 'node_modules' },
  server: {
    baseDir: [ './web', './build/contracts' ],
    middleware: [ [Function (anonymous)], [Function (anonymous)] ]
  }
}
[Browsersync] Access URLs:
-----
  Local: http://localhost:3000
  External: http://192.168.239.1:3000
-----
  UI: http://localhost:3001
  UI External: http://localhost:3001
-----
[Browsersync] Serving files from: ./web
[Browsersync] Serving files from: ./build/contracts
[Browsersync] Watching files...
23.04.16 21:28:35 304 GET /index.html
23.04.16 21:28:35 304 GET /css/styles.css
```

Figure 102: Deploying Project

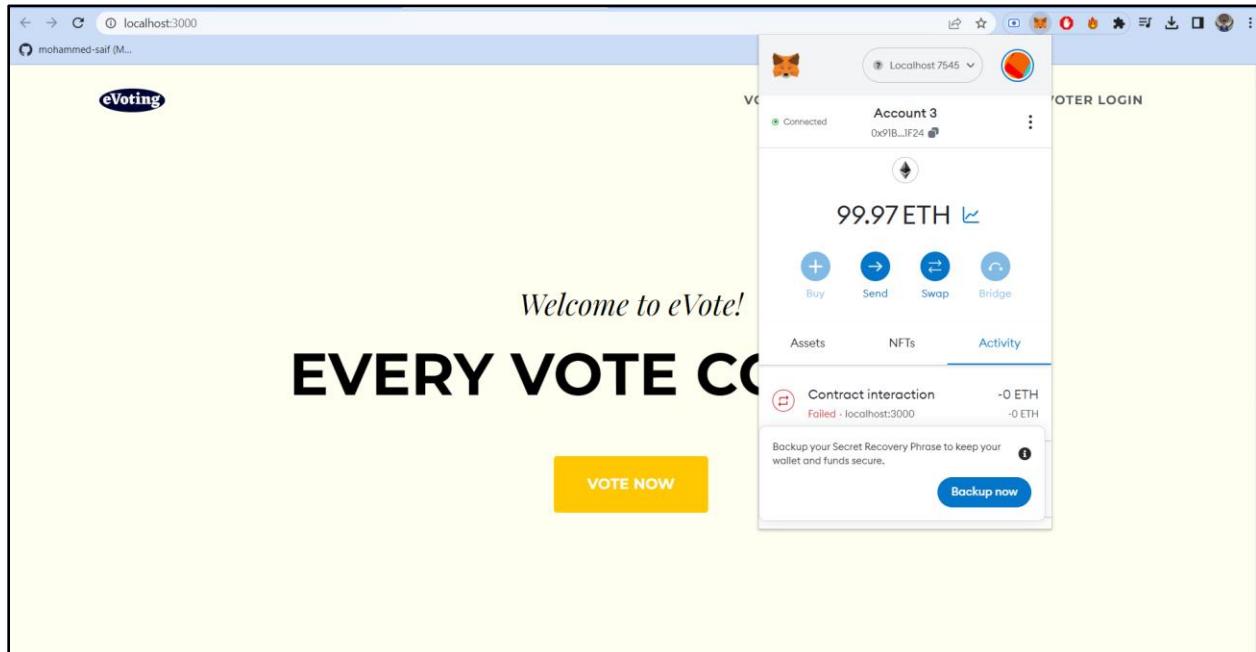


Figure 103: MetaMask

Test No	2
Objective	To verify the admin can login and add candidates.
Action	<p>Logging in as admin and adding candidates using admin's eth address.</p> <p><b>Username:</b> admin@admin.com  <b>Password:</b> admin  <b>Candidate Name:</b> Mihir  <b>Eth Address:</b>  0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</p>
Expected result	The login and adding candidate function should be executed successfully.
Actual result	The login and adding candidate function was executed successfully.
Conclusion	The test was successful.

Table 25: System Test Case 2

Figure 104: Admin Login

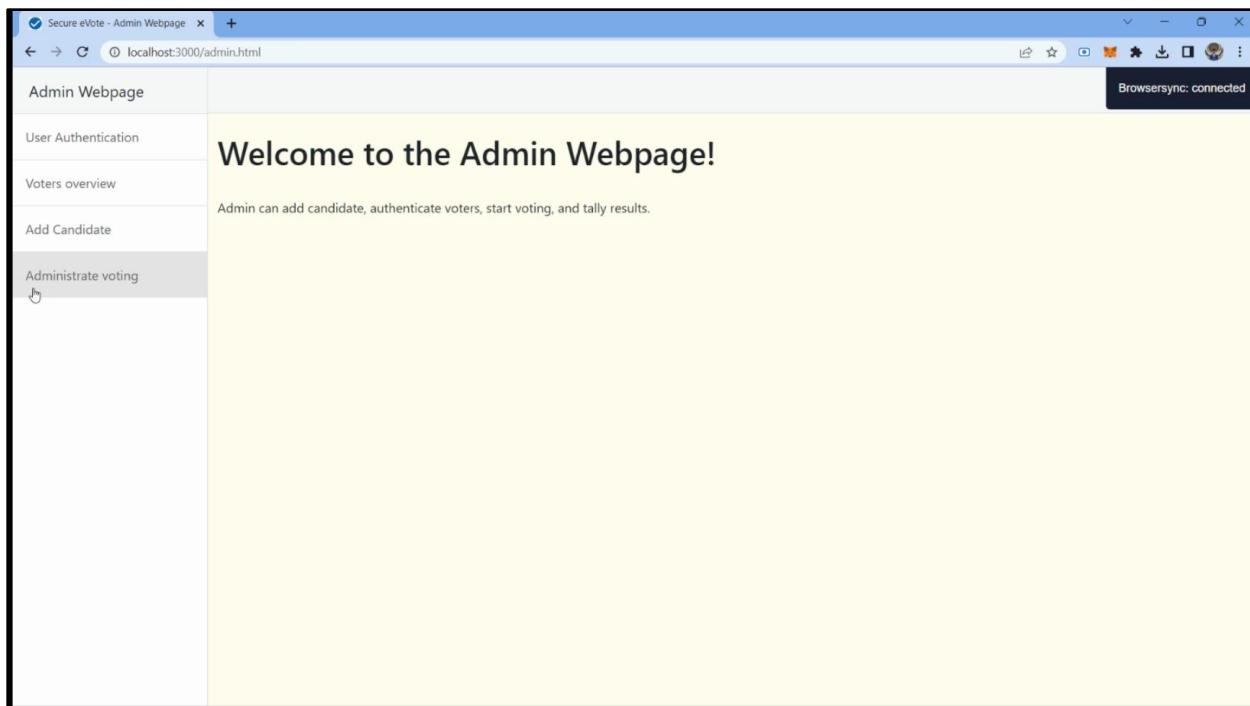


Figure 105: Admin Logged In

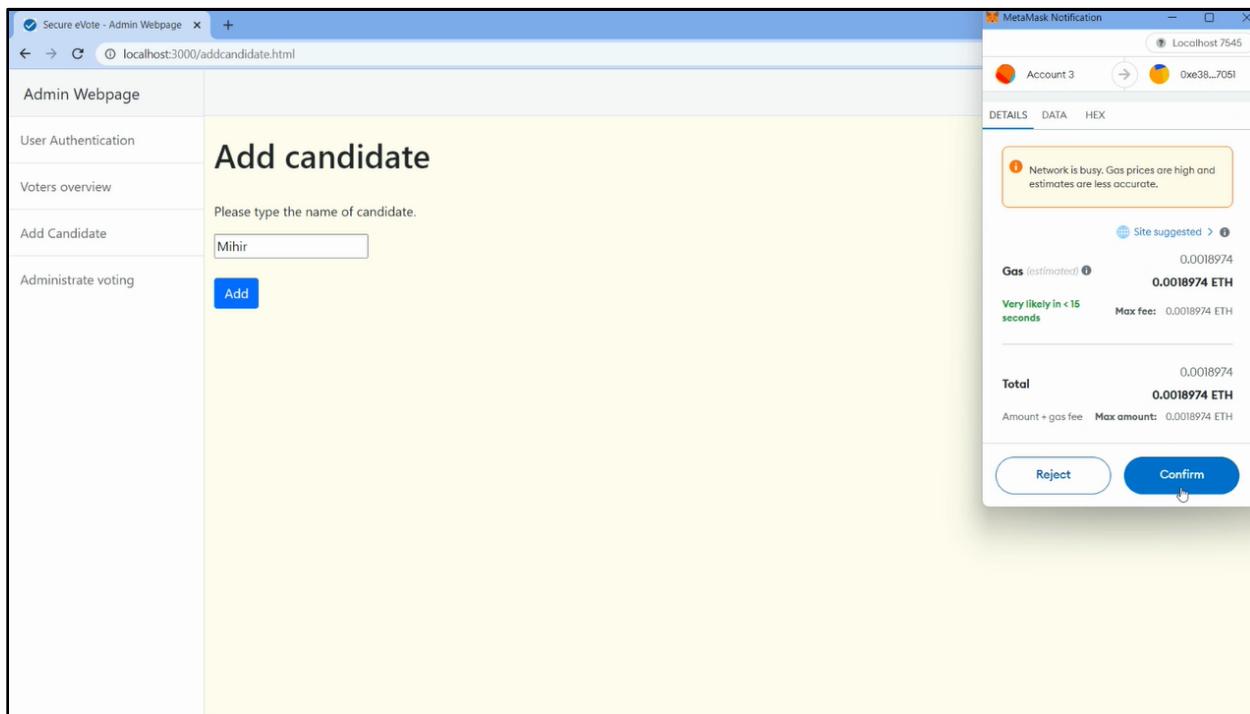


Figure 106: Add Candidate

Test No	3
Objective	To verify voter can register and login.
Action	<p>Filling up all the fields in the registration page, clicking register and confirming the transaction.</p> <p><b>Name:</b> abc <b>Email:</b> abc@abc.com  <b>Identity Number:</b> 123  <b>Password:</b> 123  <b>Confirm Password:</b> 123</p> <p>Logging in with the registered credentials.</p> <p><b>Eth Address:</b>  0x45EbB0b44215383cfa6f3858DCFee8517ae8A465</p>
Expected result	The registration and log in should be successful.
Actual result	The registration and log in were successful.
Conclusion	The test was successful.

Table 26: System Test Case 3

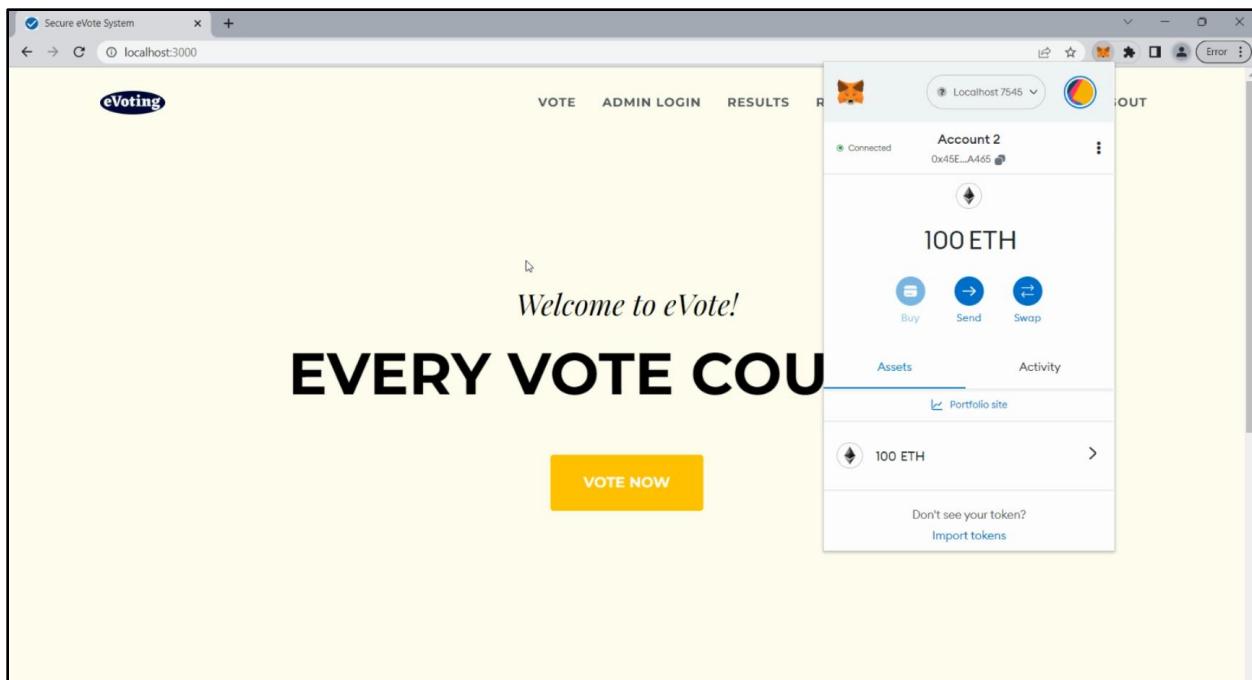


Figure 107: Landing Page

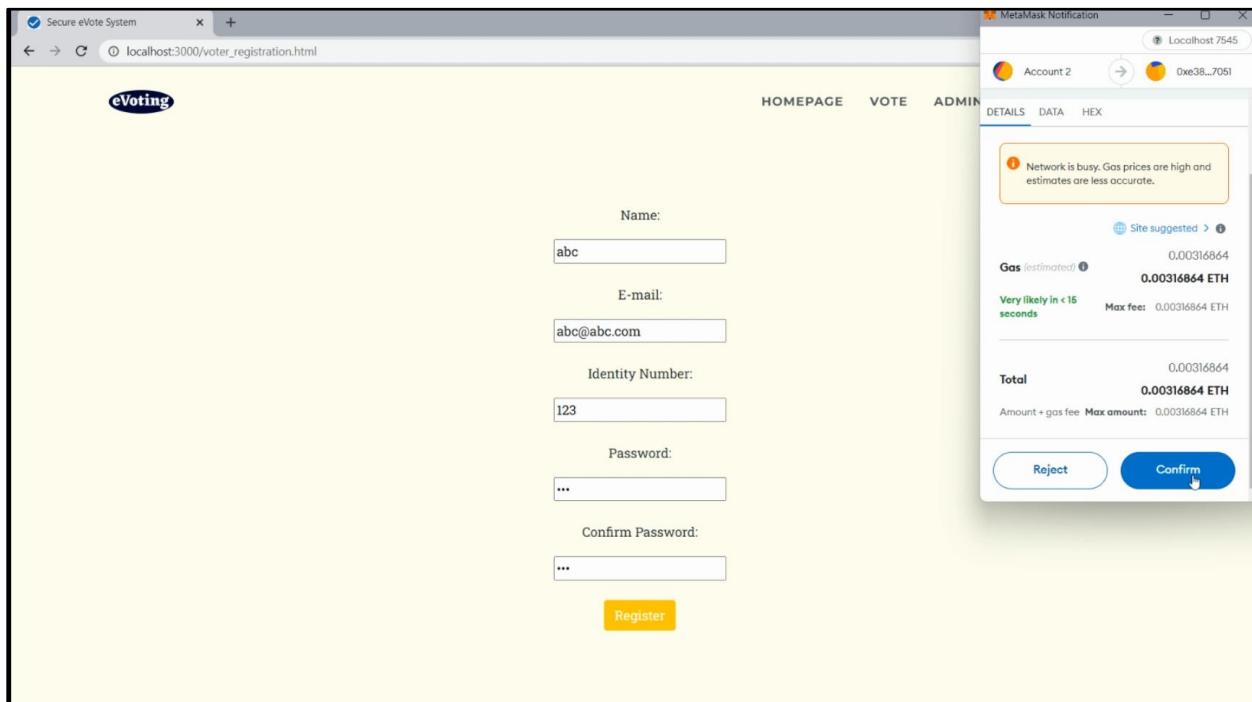


Figure 108: Voter Registration

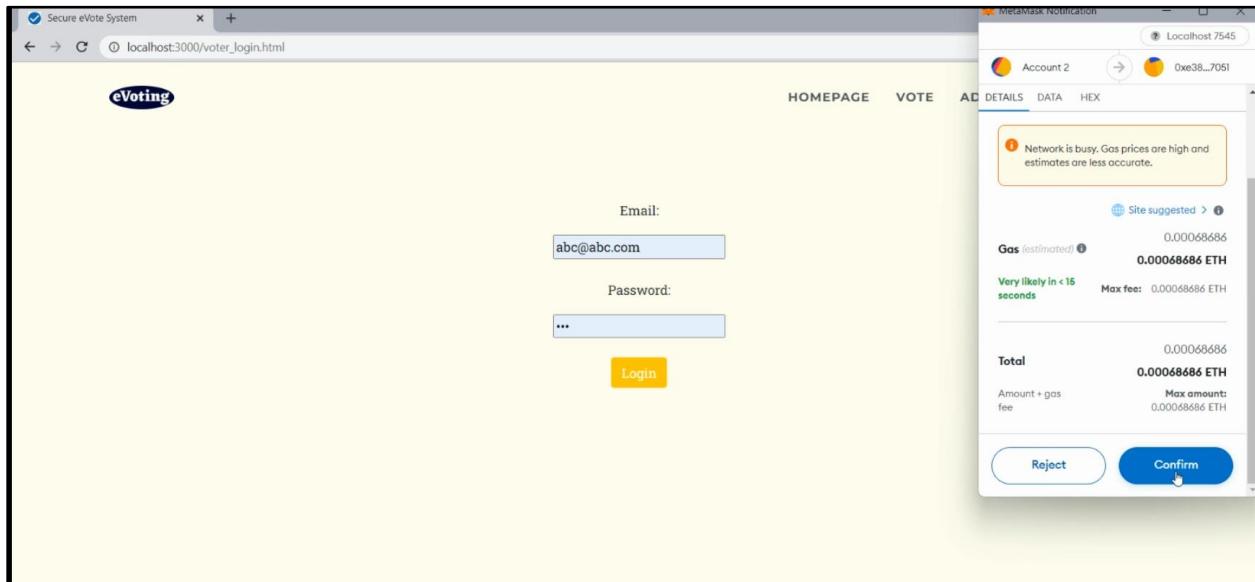


Figure 109: Voter Login

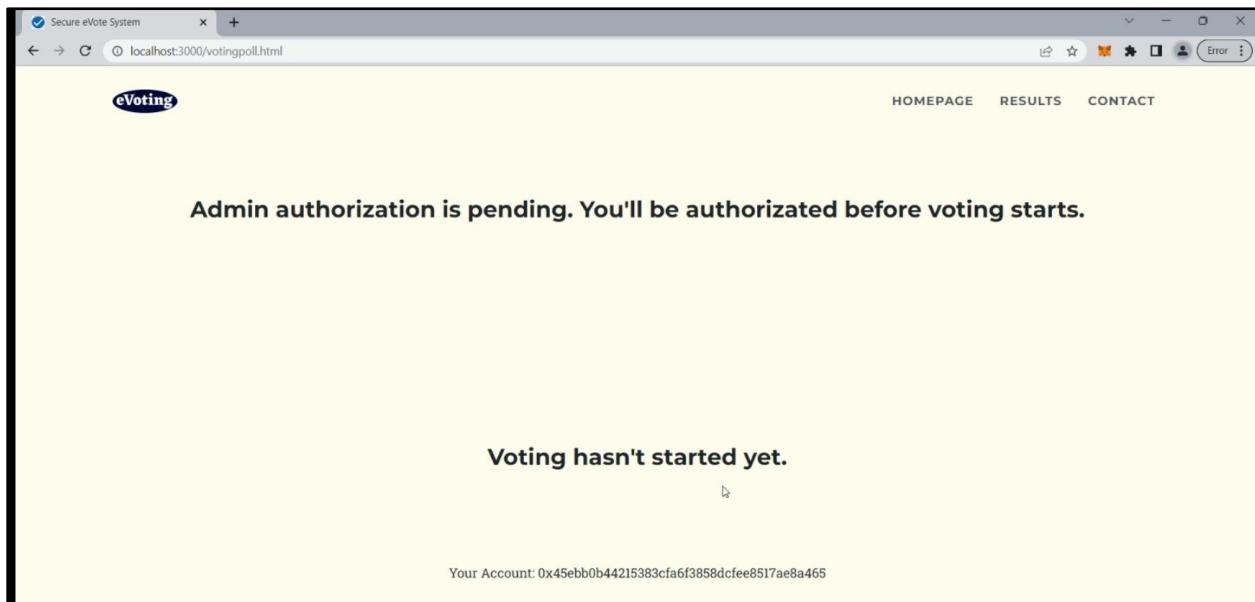


Figure 110: Voter Login Successful

Test No	4
Objective	To verify the admin can authenticate voters and start election.
Action	<p>Changing Phase to Authenticate Voters, authenticate registered voters, changing phase to start voting, and viewing analytics.</p> <p><b>Eth Address:</b></p> <p>0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</p>
Expected result	The admin should be able to authenticate voters and start election.
Actual result	The admin was successfully able to authenticate voters and start election.
Conclusion	The test was successful.

Table 27: System Test Case 4

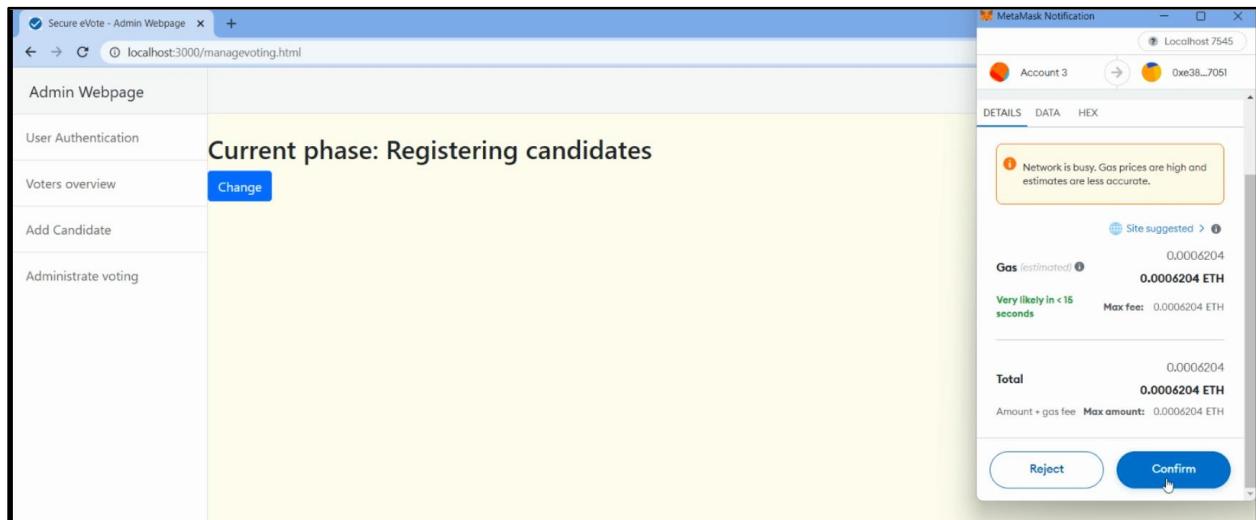


Figure 111: Changing Phase

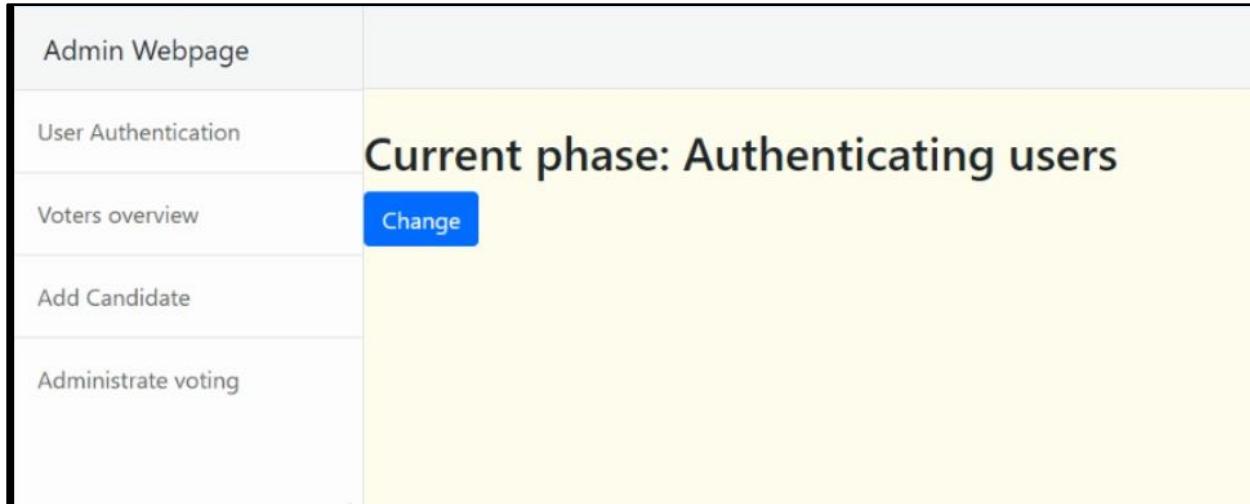


Figure 112: Authenticating Users Phase

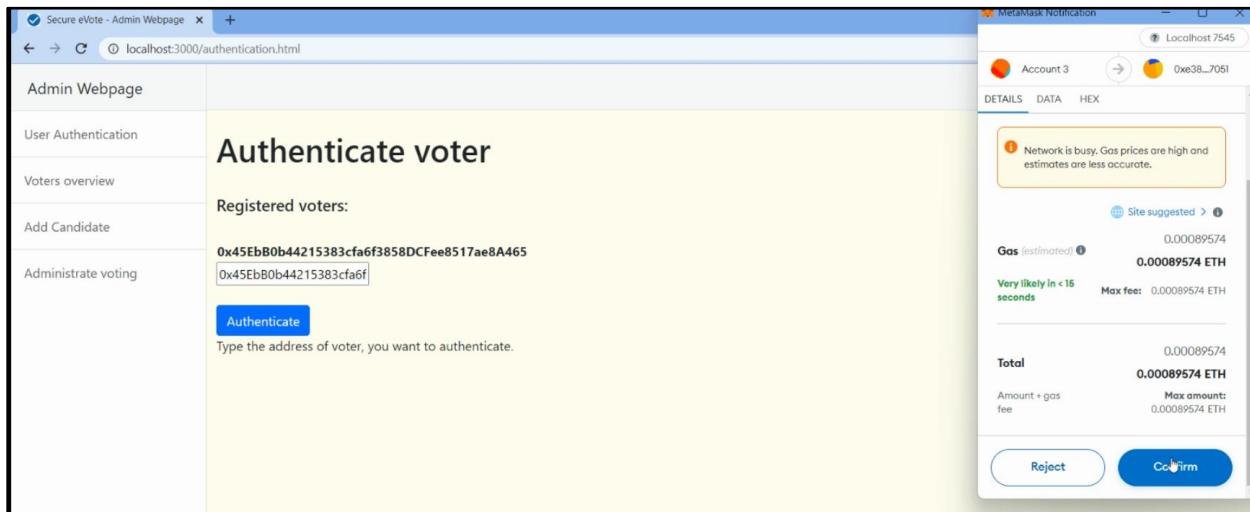


Figure 113: System Test Voter Authentication

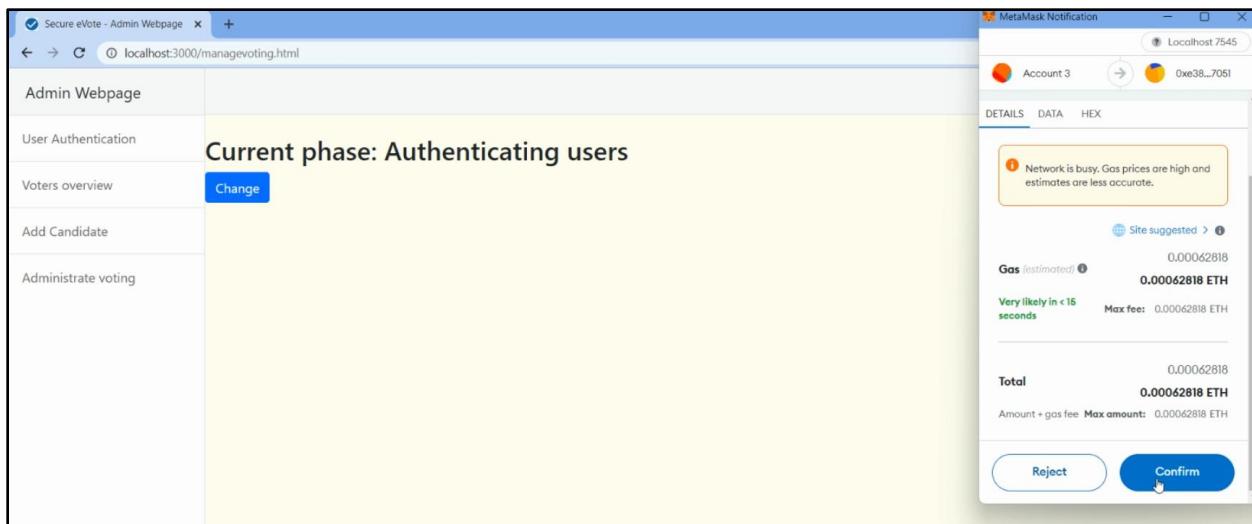


Figure 114: System Test Start Election

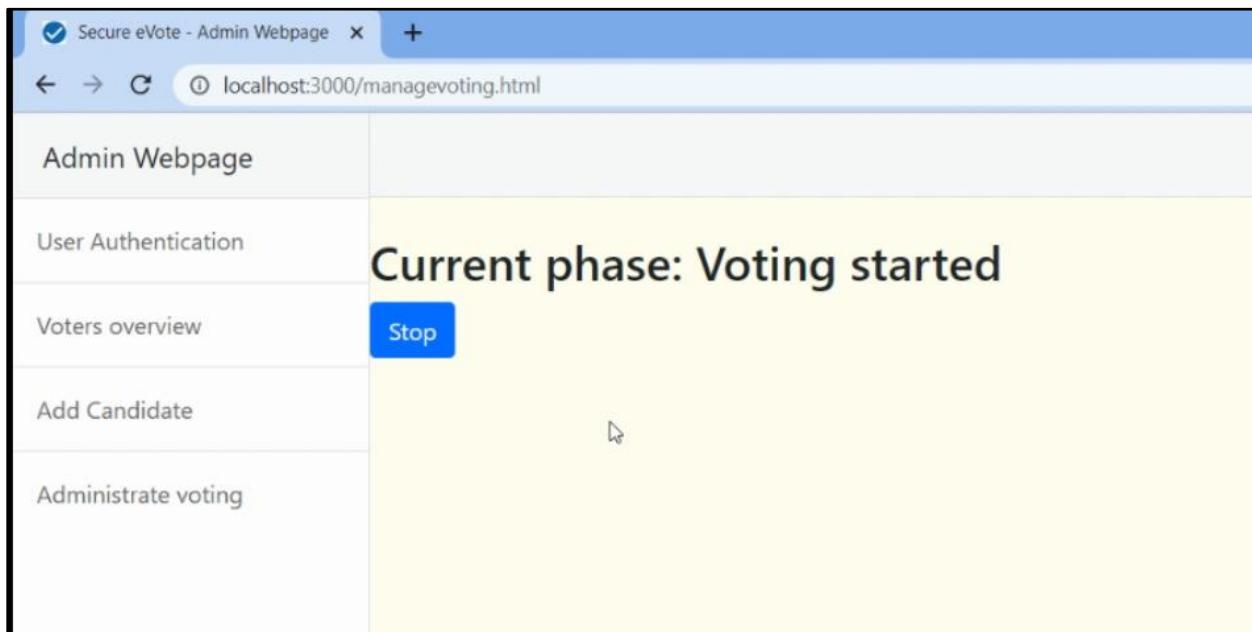


Figure 115: System Test Election Started

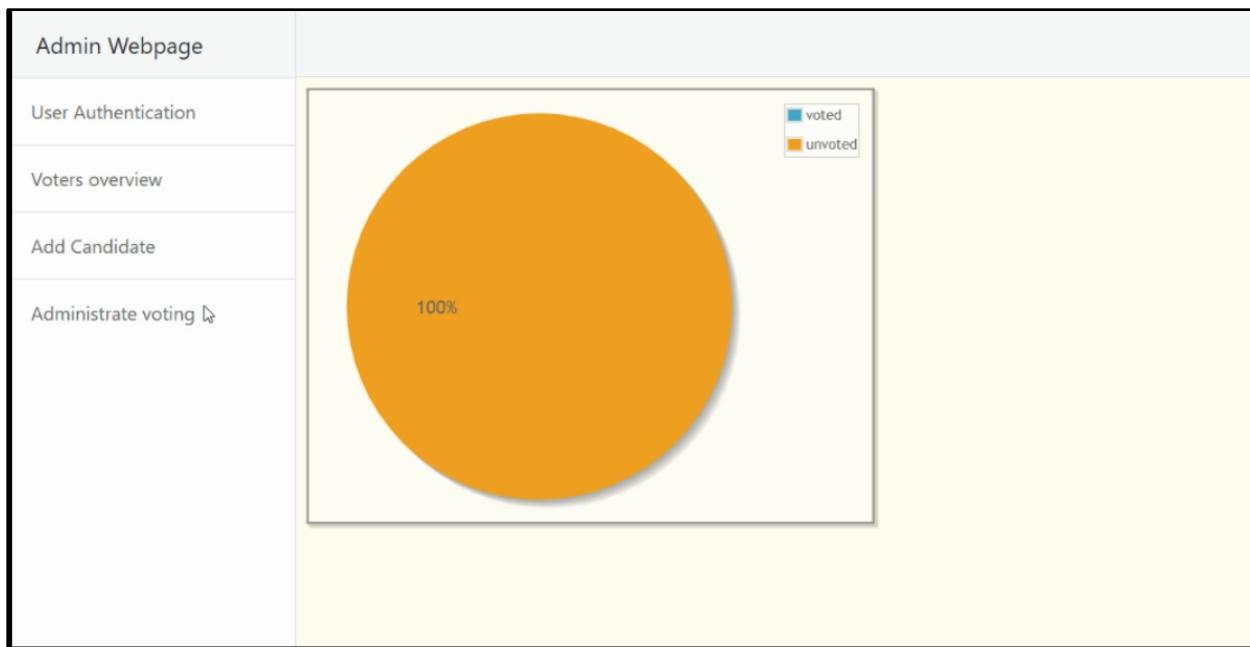


Figure 116: System Test- Analytics 1

Test No	5
Objective	To verify the voter can vote to their desired candidate but only once.
Action	Selecting the desired candidate, voting by confirming transaction.  <b>Eth Address:</b> 0x45EbB0b44215383cfa6f3858DCFee8517ae8A465
Expected result	The voter should be able to vote but only once.
Actual result	The voter successfully voted and couldn't vote twice.
Conclusion	The test was successful.

Table 28: System Test Case 5

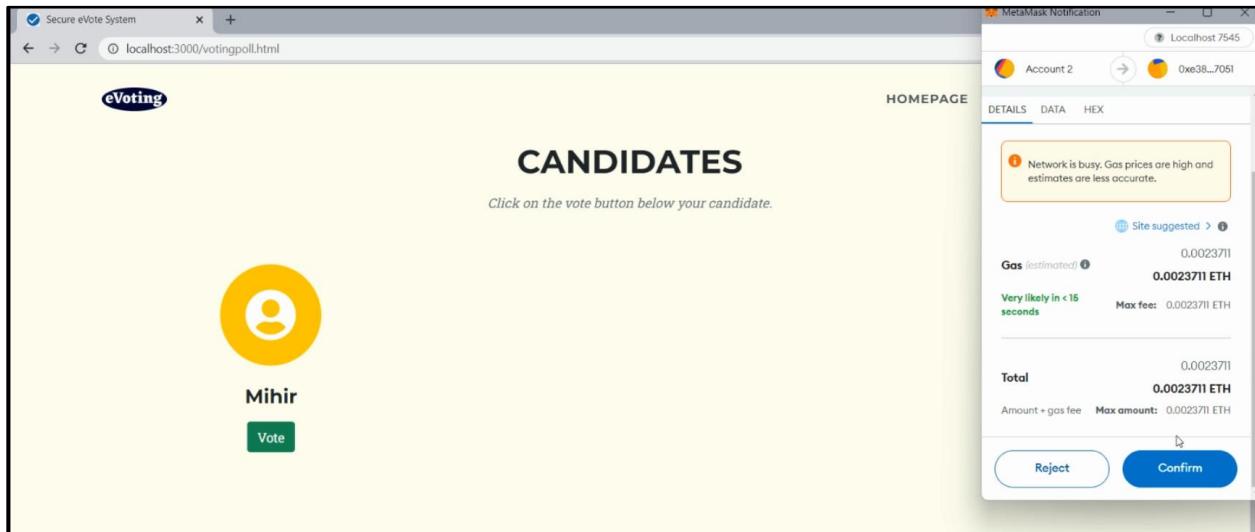


Figure 117: System Test Vote

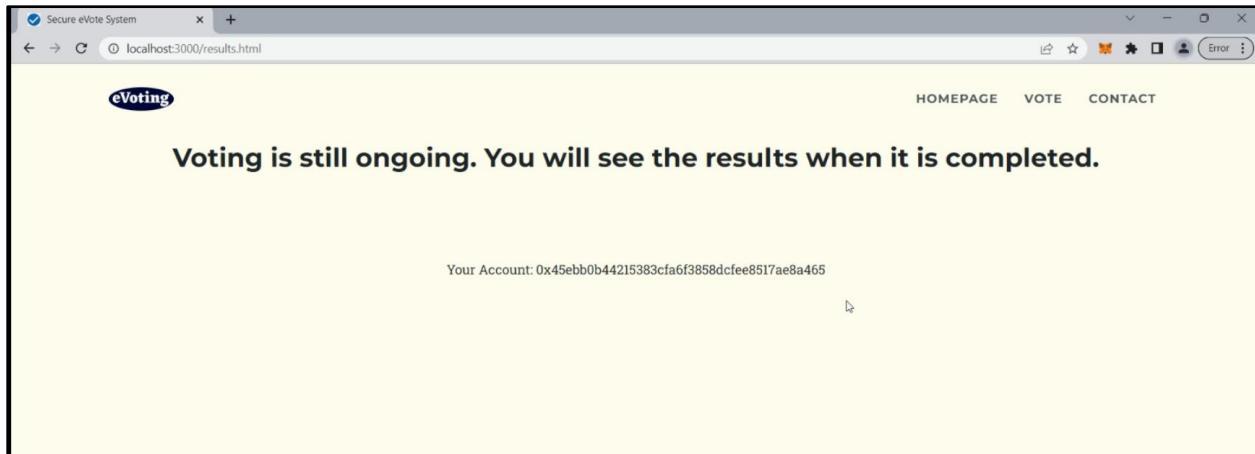


Figure 118: System Test After Voter Voted

Test No	6
Objective	To verify the admin can end election, tally votes accurately and verify votes without hampering voter's privacy to ballot.
Action	<p>Changing phase to end election and verifying the transparency of votes and privacy of voters.</p> <p><b>Eth Address:</b></p> <p>0x91Bc00c58C78d07EC069DECFCeA6e5CBF9a41F24</p>
Expected result	The voter should be able to vote but only once.
Actual result	The voter successfully voted and couldn't vote twice.
Conclusion	The test was successful.

Table 29: System Test Case 6

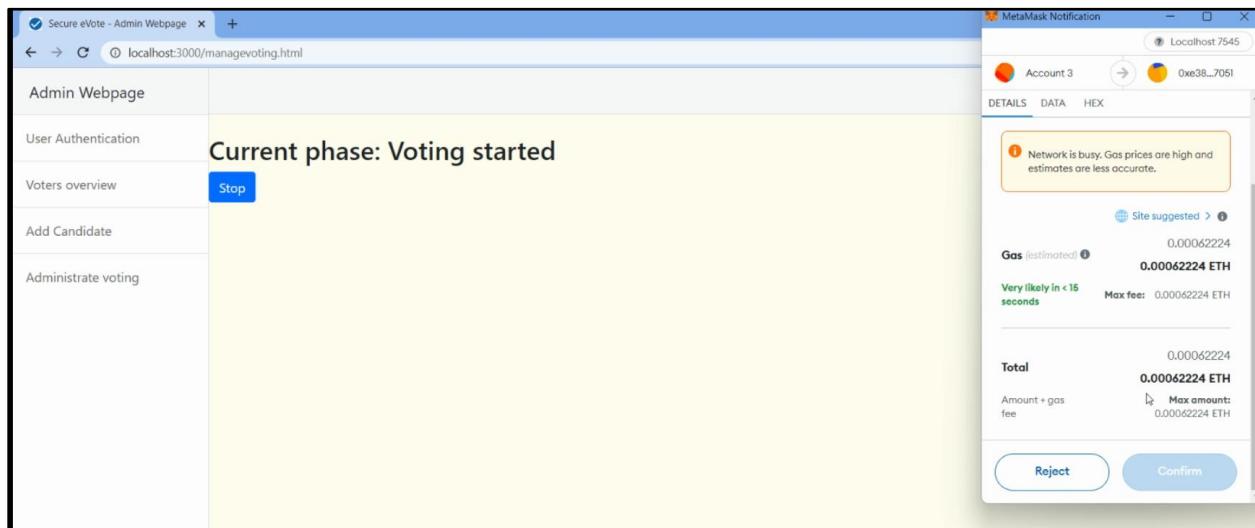


Figure 119: Ending Election

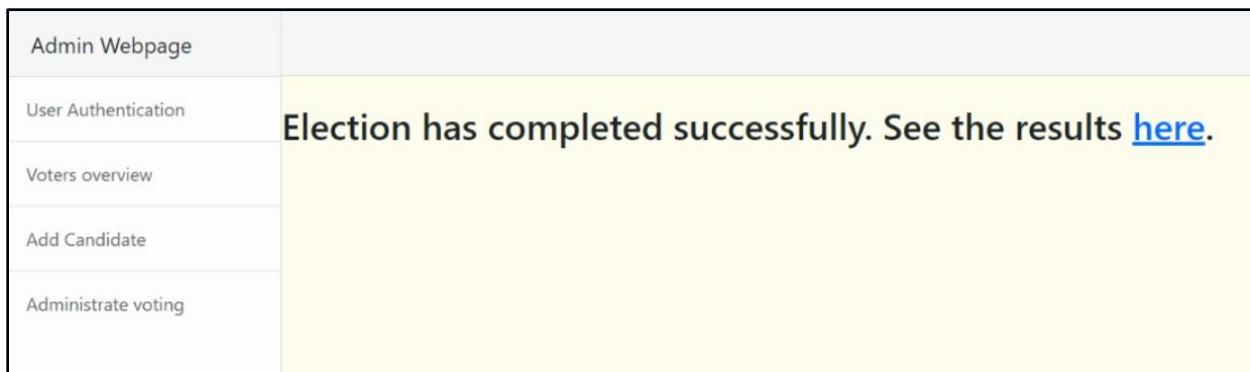


Figure 120: System Test View Results

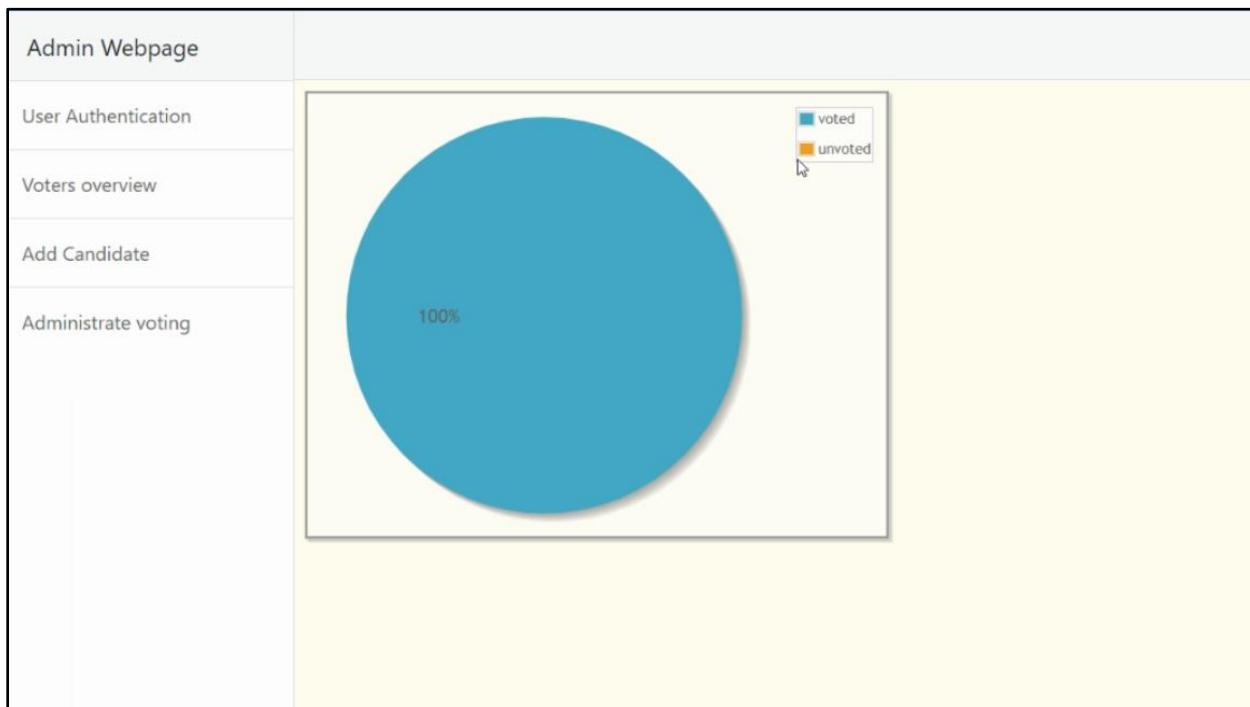


Figure 121: System Test Analytics 2



Figure 122: System Test- Winner

## 4.4 CRITICAL ANALYSIS

### 4.4.1 Working Under Prototype Methodology

Working under the prototype methodology involved creating a preliminary version of the e-voting system using blockchain. This allowed for quick development and testing of the core functionality like add candidates, vote etc. of the system before moving onto more advanced features like analytics, secure login, voter authentication etc. The prototype served as a working model to demonstrate the feasibility of the concept and identify any potential challenges early on like required dependencies, errors/ bugs etc.

The iterative nature of the prototype methodology allowed for continuous feedback mainly from supervisors also from client and improvement throughout the development process, resulting in a more refined final product. Additionally, the prototype served as a valuable tool for obtaining supervisors and client's input and ensuring that the system met their needs.

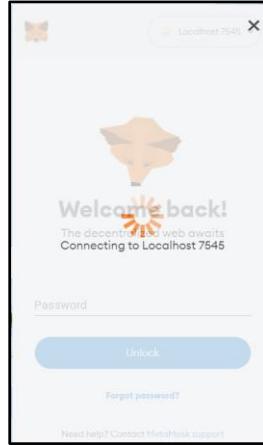
As a whole, the prototype technique was very helpful in developing the blockchain-based e-voting system since it provided an organized and efficient approach to development, testing, and feedback. It shortened the time to complete while ensuring that the finished product satisfied the needs and expectations of client.

### 4.4.2 Some Difficulty While Testing

The problems faced during the testing and how it was fixed are explained below:

- Connectivity Issue:

While testing the MetaMask did not connect to the local network as well as the project. It was fixed by reinstalling the wallet after a failed troubleshoot.



- Smart Contract Error:

There was a bug in the smart contract related to compilation and solidity version. It was fixed by using a lower version of solidity.

```
pragma solidity >=0.5.16;

contract eVote {
    struct Voter {
        bool hasVoted;
        uint vote;
        bool isRegistered;
        bool isLoggedIn;
        bool allowedToVote;
    }
    struct VoterDetails{
        string email;
        string pass;
        string identityno;
    }
    struct Candidate {
        uint id;
        bytes32 name;
        uint totalVotes;
    }
    address chairman;
```

#### 4.4.3 Test Summary

According to the results of the system testing, the system can be concluded reliable and functioning. The key functionality of the system, which securely records votes on the blockchain, has been carefully tested and verified. Overall, the system is strong and secure, but the user interface design and connectivity may be updated to improve the overall user experience. More testing and adjusting will be necessary to guarantee that the system works properly in real-world circumstances.

- Strong Aspect
  - i. The promised and core features are working well.
  - ii. The system is double secured i.e., login credentials and eth address.
  - iii. The voters can be authenticated.
  - iv. The votes are tallied accurately and quickly.
  - v. The votes are transparent as well as does not reveal voter's information.
  
- Weak Aspect
  - i. The admin cannot remove authenticated voters.
  - ii. For admin to remove the added candidates it has to start and end election.
  - iii. 2FA could have added more security.
  - iv. The UI can be improved.

<b>Critical Analysis Table</b>			
S.N.	Factors	Rating (0-5)	Remarks
<b>1</b>	Accuracy	5	The votes were tallied accurately.
<b>2</b>	Security	3	The admin login should be improved.
<b>3</b>	Efficiency	4	The system is fast and less time consuming.
<b>4</b>	Reliability	4	The smart contract / decentralization makes it reliable.
<b>5</b>	Usability	4	The system is easy to use.
<b>6</b>	Scalability	3	It is difficult to achieve scalability.
<b>7</b>	Accessibility	4	It is easy to access as it runs in a browser.
<b>8</b>	Transparency	5	The votes are transparent.
<b>9</b>	Accountability	5	The votes are accountable using the eth address.
<b>10</b>	Cost-effective	5	It required negligible capital for development.

Table 30: Critical Analysis Table

## Chapter 5. CONCLUSION

In conclusion, e-voting using blockchain has the potential to revolutionize the way we vote, providing a secure, transparent and efficient way to conduct elections. However, there are a number of legal, social and technical challenges that need to be addressed before e-voting using blockchain can become a viable alternative to traditional voting methods.

### 5.1 LEGAL, SOCIAL AND ETHICAL ISSUES

#### 5.1.1 LEGAL ISSUES

##### i. Legal Issues due to Cryptocurrency Ban

In Nepal, the use and trading of cryptocurrencies, including Bitcoin, are currently banned by the government. The Nepal Rastriya Bank (NRB), the central bank of Nepal, issued a notice in 2017 prohibiting banks and financial institutions from dealing with or providing services to any individuals or businesses involved in cryptocurrencies (Dikpal Khatri Chhetry, 2019).

The primary reason for this ban is to prevent the use of cryptocurrencies for illegal activities such as money laundering, terrorist financing, and other criminal activities. Additionally, the NRB has stated that cryptocurrencies are not recognized as legal tender in Nepal, and therefore their use is not permitted. But, the Nepal Ristra Bank's ban on cryptocurrencies does not specify any specific laws that cryptocurrencies violate, but it cites concerns about the potential misuse of cryptocurrencies for illegal activities such as money laundering, terrorist financing, and other criminal activities (Dikpal Khatri Chhetry, 2019).

##### ii. Legal Issues regarding Voter Identification

This project may face legal issues related to voter identification as it can be challenging to ensure that voters are who they claim to be while voting, and the absence of clear regulations for voter identification may raise concerns about the accuracy and integrity of the voting process. In Nepal, the Election Commission Act 2017 and in the UK, the Representation of the People Act 2000 sets out the requirements for voter identification

in elections which may be violated if clear and robust regulations are not enforced (Nepal Law Commission, 2021).

### iii. Lack of Regulatory Framework

The absence of clear regulations is another legal issue that this project may face. The lack of regulatory framework can create uncertainty for developers, vendors, and users, and may increase the risk of legal challenges to the validity of the voting results. In context of Nepal, the Electronic Transaction Act 2008, which requires that electronic transactions must be conducted in a secure and reliable manner, with adequate safeguards in place to protect the confidentiality and integrity of electronic records (Nepal Law Commission, 2008).

In context of UK, the Data Protection Act 2018, which requires that personal data must be processed in a lawful, fair, and transparent manner, with adequate safeguards in place to protect the rights of data subjects. The lack of a regulatory framework for e-voting using blockchain technology may violate these requirements, particularly if personal data is not adequately protected (legislation.gov.uk, 2018).

### iv. Liability in case of cyber attacks

In the context of this project, liability in case of cyber-attacks is a legal issue that needs to be addressed. The potential for cyber-attacks and the impact they could have on the integrity of the voting process raise questions about who would be liable in case of such an attack. If this system is compromised due to a cyber-attack, it can be difficult to determine who should bear the responsibility for any resulting damages or losses. This could result in a lack of accountability and difficulties in ensuring that the affected parties receive adequate compensation.

Nepal Penal Code contains provisions related to cybercrime and hacking. If a cyber-attack is perpetrated against an e-voting system, it may be in violation of the provisions of this code related to cybercrime (Nepal Law Commission, 2021). Computer Misuse Act

1990 provides provisions related to cybercrime and hacking in the UK which may be violated in case of attack (Nepal Law Commission, 2021).

#### v. Legal Recognition and Acceptance

Legal recognition and acceptance of this project is a problem that has yet to be fully addressed. The legal recognition of blockchain technology and e-voting varies from country to country, with some countries recognizing blockchain technology as a legitimate form of electronic communication, while others have yet to define it under their legal frameworks. This lack of legal recognition creates uncertainty about the legal status of the project, and may lead to challenges to its legal validity.

If e-voting using blockchain technology is not recognized or accepted under Nepali law, it violates these laws i.e., Constitution of Nepal 2015 which provides for free and fair elections and states that elections must be held in accordance with the law (Government of Nepal, 2015) and The Representation of the People Act 1983 which governs parliamentary and local government elections in the UK and outlines the procedures for voting, counting of votes, and the resolution of disputes (legislation.gov.uk, 2015).

### 5.1.2 SOCIAL ISSUES

#### i. Dependence on internet connectivity

E-voting systems relies heavily on the internet are vulnerable to disruptions in connectivity. This can be a problem in areas with poor or limited internet connectivity, as well as during natural disasters or cyber-attacks that can disrupt internet connectivity. In such situations, voters may be unable to access the e-voting system, preventing them from casting their votes and potentially disenfranchising them.

#### ii. Limited Accessibility

Not all voters may have access to the technology required to participate in e-voting systems. This can be due to factors such as age, income, education, or physical disability. In such cases, e-voting systems may disproportionately favour certain segments of the population while leaving others behind, leading to a lack of equal representation.

### iii. Gaps in transparency and understanding

In some cases, e-voting systems may lack transparency due to technical complexities, which can make it difficult for voters to understand how their votes are being counted and how the system is ensuring the integrity of the election. This can lead to a lack of trust in the e-voting system and a sense of unease among voters about the accuracy of the results. Many voters may not be familiar with the technical aspects of e-voting or may not fully understand how to use the system. This can lead to confusion, errors, and ultimately, a lack of confidence in the e-voting process.

### iv. Loss of perception and trust

The use of e-voting using blockchain can also lead to loss of perception and trust as a social issue. One reason for this loss of trust is the unfamiliarity of many voters with blockchain technology and e-voting systems. Blockchain is a relatively new technology and many voters may not understand how it works or how it can be used to secure e-voting. This lack of understanding can make voters sceptical of the technology and may lead them to question the accuracy and security of the e-voting system.

### v. Lack of international standards

The absence of a uniform set of standards or guidelines for e-voting with blockchain technology can create confusion and inconsistency in the implementation of the technology across different countries and jurisdictions. This can also make it difficult to establish accountability and transparency in the election process. Without clear standards, there may be differences in how the technology is developed, tested, and

deployed, which can lead to variations in the level of security, reliability, and usability of e-voting systems. This issue highlights the need for international cooperation and coordination to establish a framework for e-voting with blockchain technology that promotes fairness, accuracy, and trust in the electoral process.

### **5.1.3 ETHICAL ISSUES**

#### i. Access and control ownership

When it comes to access and control ownership, there is a risk that certain businesses or people may have unauthorized access to electronic voting systems and the data it contains. This creates questions of data privacy and security, as well as worries about the fairness and impartiality of the democratic process.

#### ii. Integrity and fraud concerns

This ethical issue arises due to the possibility of manipulation or fraud in the e-voting process. The use of technology can create opportunities for cybercriminals as well as the party in control to compromise the voting system, leading to the crash of the system or unethical practices such as vote tampering and election rigging etc.

#### iii. Voter's limited control over their own data

This issue is related to the collection, storage, and use of voter data. E-voting system requires personal information to authenticate voters, and there may be concerns about how this data is used, shared, and protected. Voters may not have complete control over their data, which could be used for unintended purposes.

#### iv. Absence of human supervision

This issue arises from the absence of human supervision during the electronic voting process. A situation where there is no human involvement may result through the employment of automated systems and algorithms, raising questions about fairness, transparency, and accountability since a circumstance may emerge that the system wasn't developed to tackle.

#### v. Cybersecurity vulnerabilities and threats

Although blockchain is secure, attackers can find and exploit vulnerabilities in the system, compromise data integrity, and manipulate the results, leading to unethical practices and outcomes. This issue highlights the importance of ensuring that e-voting systems are designed and implemented with robust cybersecurity measures in place.

## 5.2 ADVANTAGES

### i. Transparency and Accountability

This project provides transparency and accountability in the election process by providing a clear and auditable record of the votes cast. This can help ensure that the results are accurate and trustworthy, and can reduce the likelihood of disputes or challenges. Additionally, this project allows for real-time monitoring of the voting process, further enhancing transparency (Vikram Dhillon, 2017).

### ii. Efficiency

This project significantly improves the efficiency of the election process by automating many of the manual processes involved in traditional paper-based voting systems, it can reduce the time and resources needed to conduct an election. This leads to a faster and more accurate results, as well as reduced costs for election organizers (Vikram Dhillon, 2017).

### iii. Immutability and Security

This project provides a high degree of immutability and security for the votes cast. By leveraging blockchain network, it can create a tamper-evident record of the votes that is extremely difficult to alter or manipulate. This can help ensure the integrity of the election process (Vikram Dhillon, 2017).

### iv. Accessibility

This project increases accessibility by a lot for voters in comparison to the traditional paper-based voting. By providing alternative methods for casting and verifying votes, this project can help ensure that all eligible voters are able to participate in the election process (Vikram Dhillon, 2017).

### v. Flexibility

This project provides greater flexibility in the design and implementation of the election process. By allowing for customization of the voting process and the ability to adapt to changing circumstances or requirements, electronic voting systems can help ensure that the election process remains fair, efficient, and effective (Vikram Dhillon, 2017).

### **5.3 LIMITATIONS**

#### i. Security Vulnerabilities

While blockchain is a secure technology, there are still potential attack vectors that could be exploited by malicious actors to compromise the integrity of the voting system. This is a critical issue that needs to be carefully addressed to ensure the security and integrity of the voting process (Vikram Dhillon, 2017).

#### ii. Dependent of Technology

This project is heavily dependent on technology and requires a reliable and robust infrastructure. Any technical failure or disruption could have serious consequences for the voting process, potentially resulting in a loss of trust and legitimacy. This dependence on technology also means that e-voting may not be a feasible option for regions with poor internet connectivity or limited access to technology (Vikram Dhillon, 2017).

#### iii. Requires Digital Literacy

E-voting requires a certain level of digital literacy from voters, which may not be accessible or easy for all segments of the population, particularly elderly or less technologically literate individuals. This could potentially create a digital divide and limit participation in the voting process (Vikram Dhillon, 2017).

#### iv. Legal and regulatory compliance

This system must comply with a complex set of legal and regulatory requirements to ensure the integrity of the voting process. This includes issues related to voter identification, data protection, and transparency. Any failure to comply with these requirements could result in legal challenges or a loss of trust in the voting system (Vikram Dhillon, 2017).

#### v. High Cost

Implementing this system can be expensive, requiring significant investment in technology infrastructure and ongoing maintenance costs. This cost may be prohibitive for many governments or organizations, limiting the potential for widespread adoption of this technology (Vikram Dhillon, 2017).

## 5.4 FUTURE WORK

### i. Using IPFS as Database

Using IPFS as a database offers a decentralized and distributed file system that can improve data security, reliability, and availability. This approach can reduce the cost associated with centralized databases by eliminating the need for a centralized server infrastructure.

### ii. Implementing on mobile devices

Implementing the project on mobile devices can enhance the accessibility and convenience of the voting process. With the increasing use of mobile devices, mobile-based e-voting can improve the participation of the voters, especially among young and mobile populations.

### iii. Enhancing the user interface

Enhancing the user interface of the project can improve the usability and user experience of the voting process, which can lead to higher participation rates. Future work can focus on designing a user-friendly and intuitive interface for the e-voting system using blockchain technology. This can involve using visual aids, such as graphs and charts, to help voters understand the voting process and the results.

### iv. Enhancing privacy features and voter authentication

Enhancing privacy features and voter authentication can be a critical area for future work for the project. This can involve improving the cryptography used to secure the voting process, including implementing advanced encryption algorithms and multi-factor authentication methods. Additionally, exploring new approaches to ensure voter anonymity and confidentiality, such as zero-knowledge proofs, can enhance the privacy of the voting process.

v. Enabling smart contract interoperability

This involves developing a standard framework for smart contracts that can communicate with one another across different blockchain platforms. This can enhance the scalability and efficiency of e-voting systems, as it can facilitate the exchange of data and information between different blockchain networks.

vi. Enabling real-time vote counting

With real-time vote counting, the results of an election can be determined quickly and accurately, providing a more efficient and transparent electoral process. This can also reduce the potential for fraud and errors in the vote counting process.

vii. Developing a more robust governance model

A well-designed governance model can ensure that the voting system operates fairly and transparently, with clear rules and procedures for voting, data privacy, and security. Blockchain technology can provide a secure and transparent platform for implementing such a governance model.

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## CHAPTER 8: APPENDIX

### 8.1 APPENDIX A: PRE-SURVEY

#### Responders:

<a href="mailto:kamalthap58@gmail.com">kamalthap58@gmail.com</a>	thunderlordnik712@gmail.com
rauniyarsujal123@gmail.com	adhikarikushal4444@gmail.com
<a href="mailto:birajbhattacharya58@gmail.com">birajbhattacharya58@gmail.com</a>	rabinpathak246@gmail.com
aidenxettri2001@gmail.com	anjanacharya.077@kathford.edu.np
baniyajitendra245@gmail.com	aasishstha09op1@gmail.com
kishortimalsina.17@gmail.com	paudyalpankaj26@gmail.com
<a href="mailto:024.shuvam@gmail.com">024.shuvam@gmail.com</a>	aayushbidari460@gmail.com
<a href="mailto:oshanr27@gmail.com">oshanr27@gmail.com</a>	sanjelsuccess@gmail.com
mdrezatausif06@gmail.com	profile.archak@gmail.com
shresthapratik795@gmail.com	demonish100@gmail.com
dipeshdahal08@gmail.com	arushrijal7@gmail.com
nischalsilwaltd@gmail.com	kunal.rocker2017@gmail.com
razztamang888@gmail.com	<a href="mailto:chaulagaining00@gmail.com">chaulagaining00@gmail.com</a>

#### Responses:

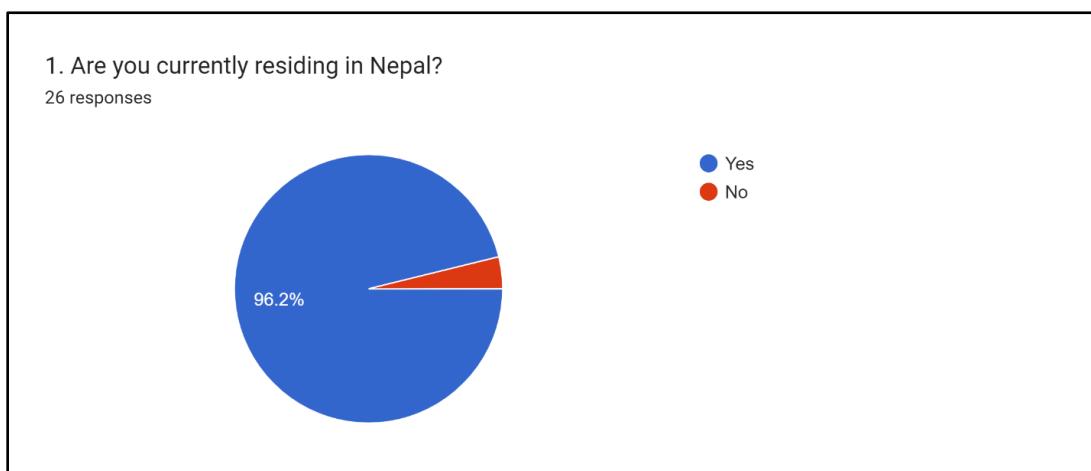


Figure 123: Pre-Survey 1

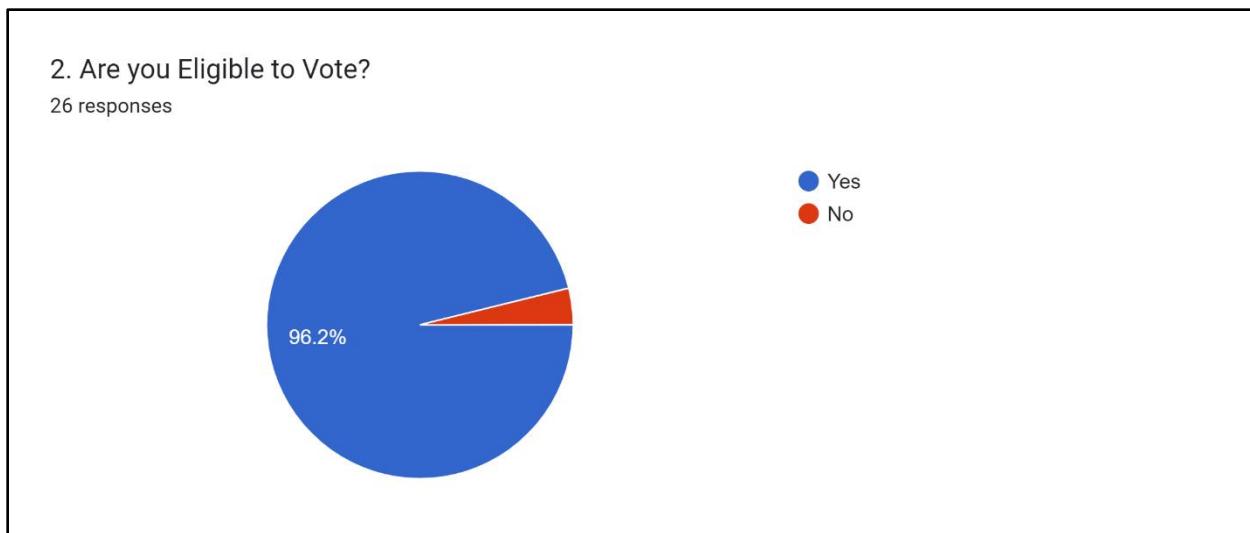


Figure 124: Pre-Survey 2

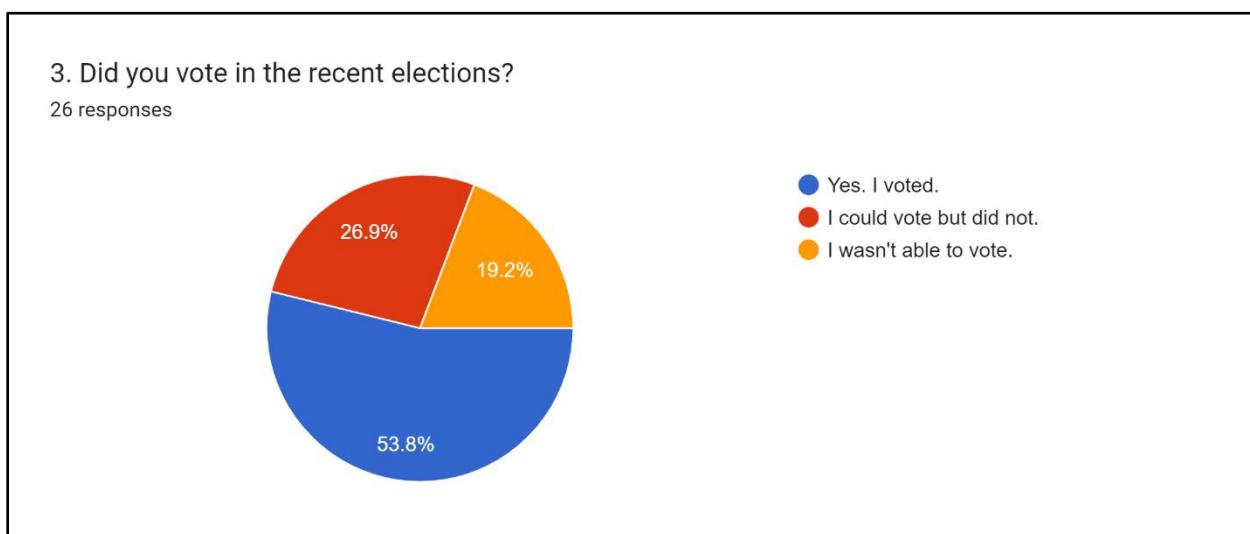


Figure 125: Pre-Survey 3

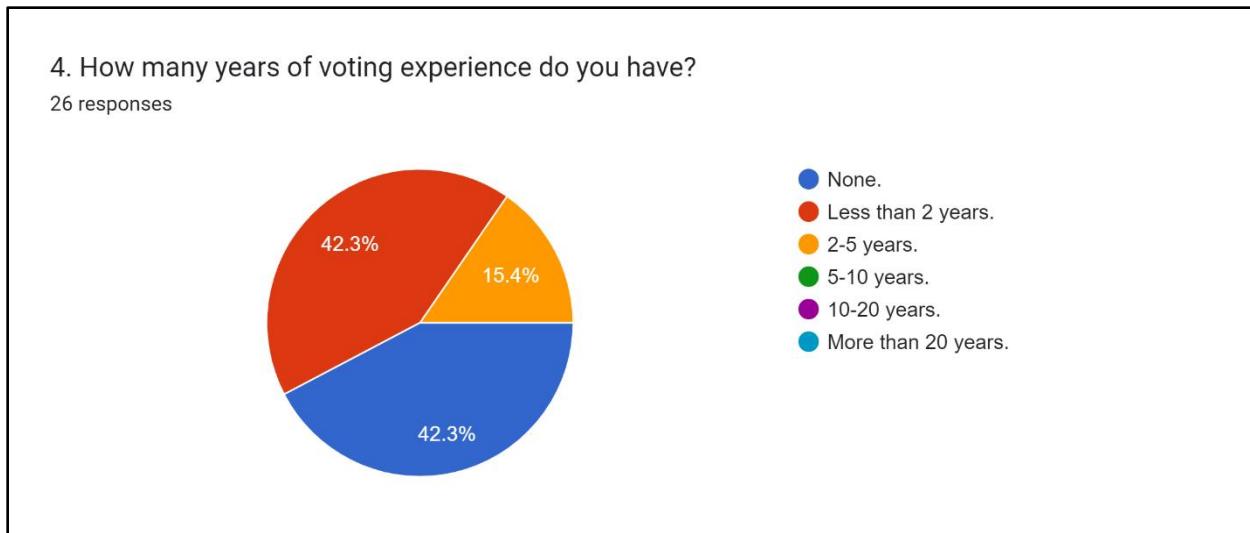


Figure 126: Pre-Survey 4

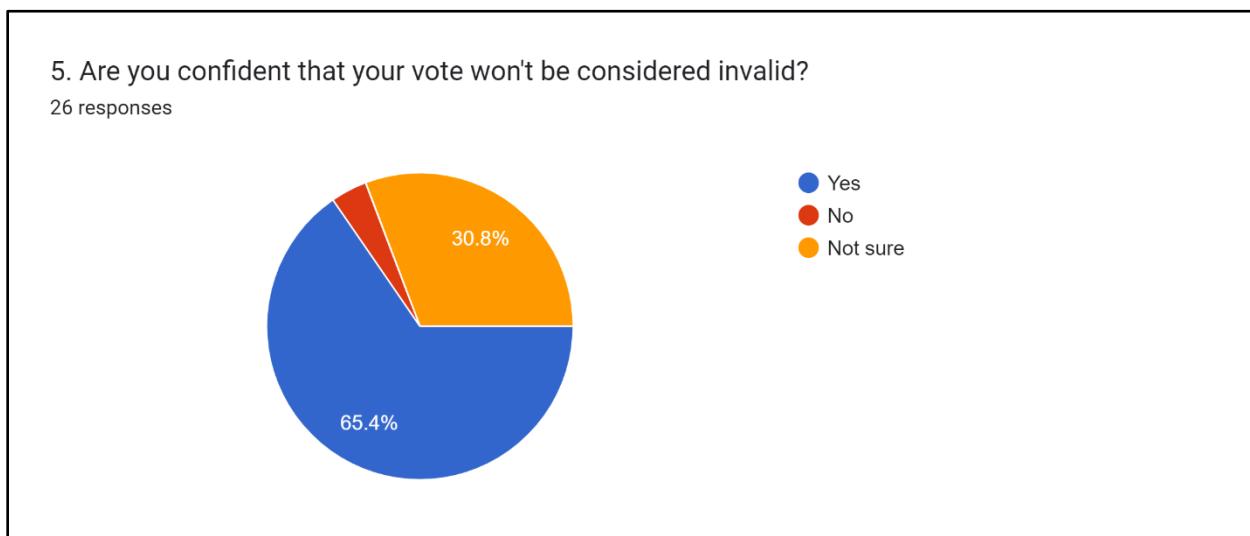


Figure 127: Pre-Survey 5

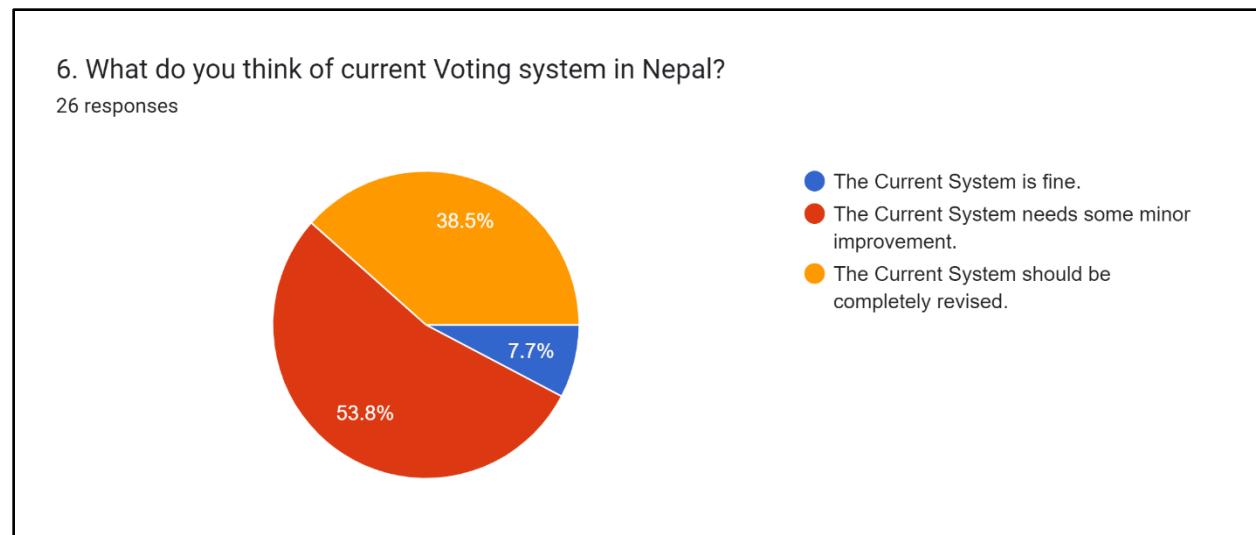


Figure 128: Pre-Survey 6

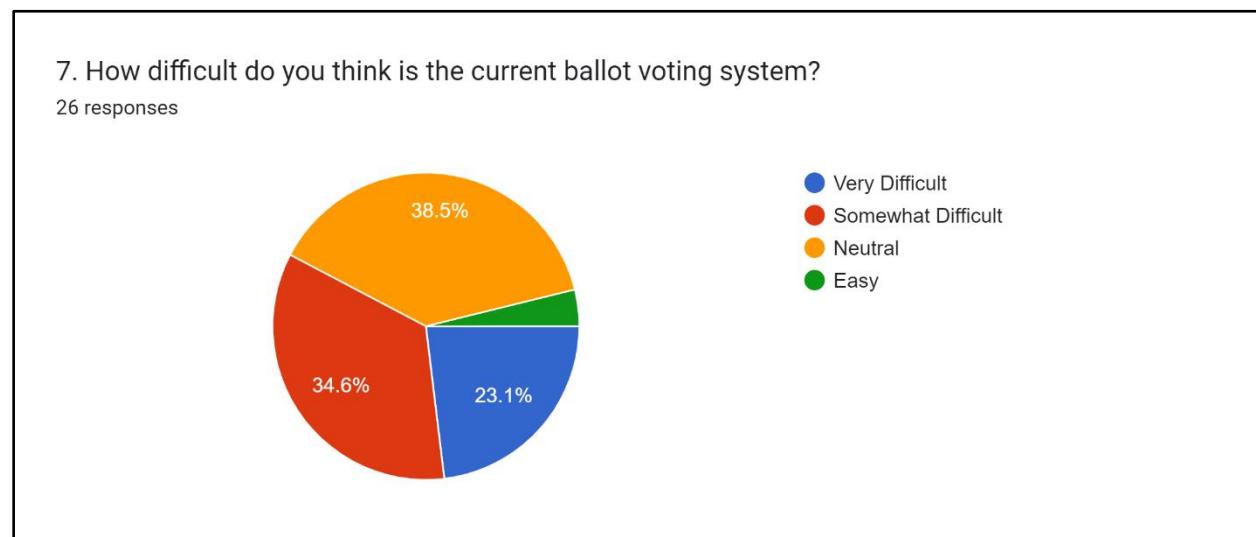


Figure 129: Pre-Survey 7

8. What do you think of the inaccessibility to vote from foreign nations while being a citizen of Nepal?

26 responses

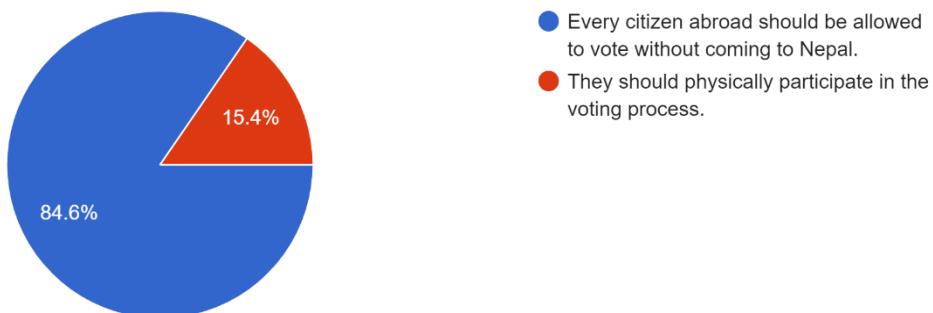


Figure 130: Pre-Survey 8

9. What do you think about the Efficiency and Security of the current voting system?

26 responses

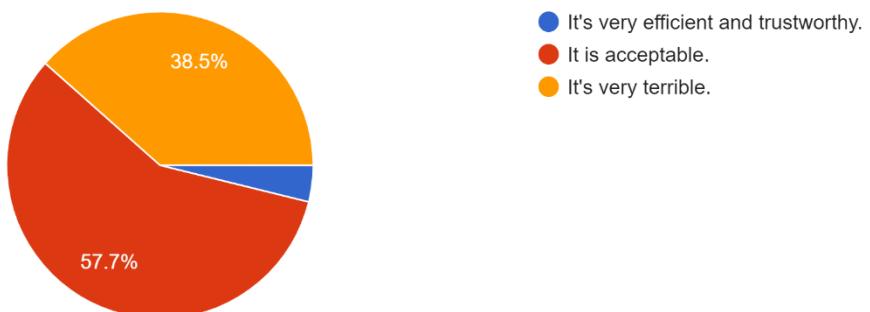


Figure 131: Pre-Survey 9

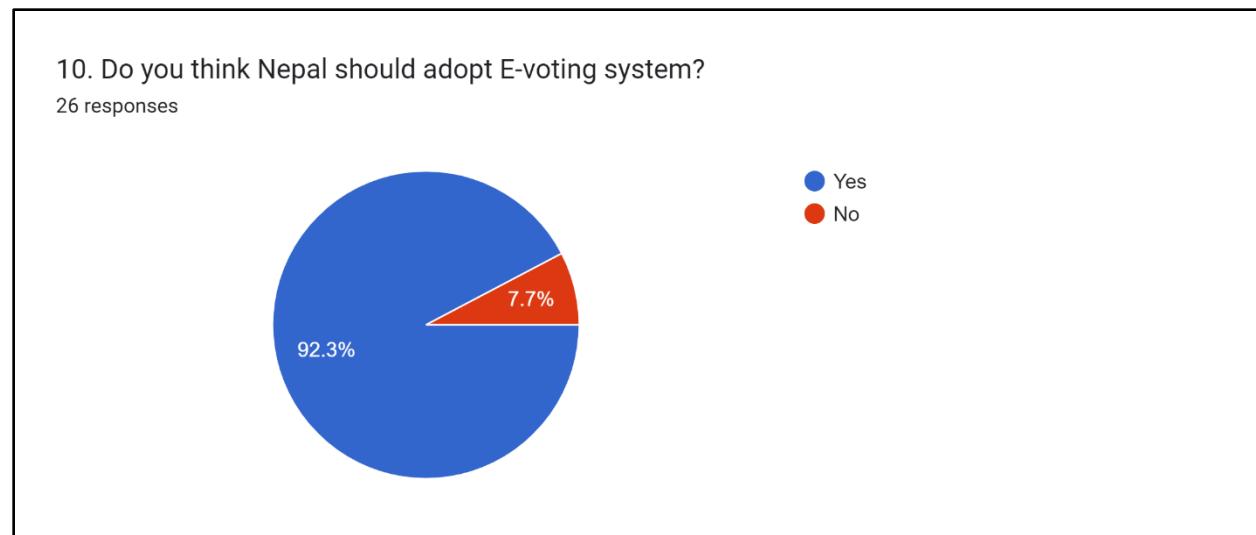


Figure 132: Pre-Survey 10

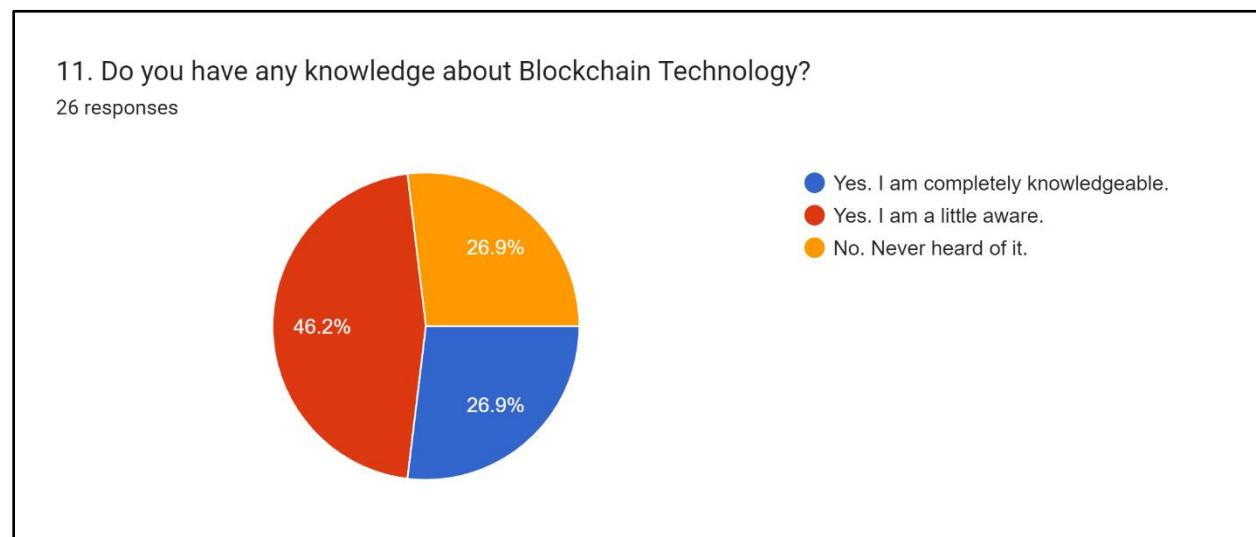


Figure 133: Pre-Survey 11

12. What do you think about blockchain technology implemented in E-voting system? (Leave if you don't have knowledge about blockchain.)

10 responses

It's a perfect idea

Blockchain technology must be implemented on e voting system for better accountability and effectiveness.

It makes the voting system fair.

It's most effective and secured system.

It is an effective idea and should be implemented in country like ours.

Thought of implementing in E-voting seems to be nice idea but its very difficult to implement in this technology unfriendly country.

I dont think nepal can adopt this technology.

If this system has strong security then it can be accepted.

Figure 134: Pre-Survey 12

## 8.2 APPENDIX B: POST-SURVEY

### Responders:

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birajbhatta58@gmail.com

mdrezatausif06@gmail.com

oshanr27@gmail.com

t5.cs.soft9@gmail.com

### Responses:

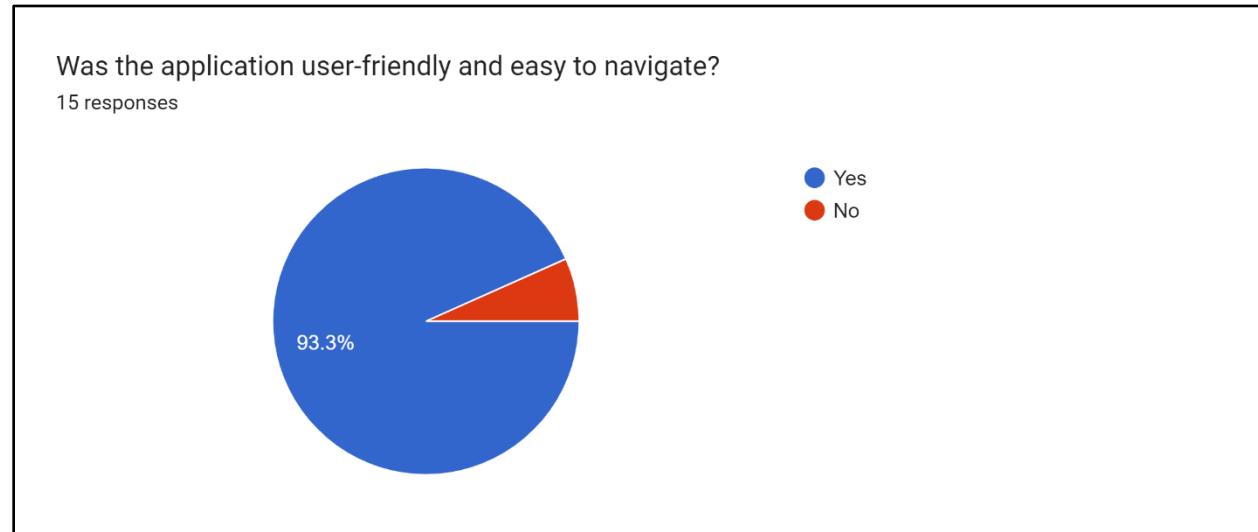


Figure 135: Post Survey 1

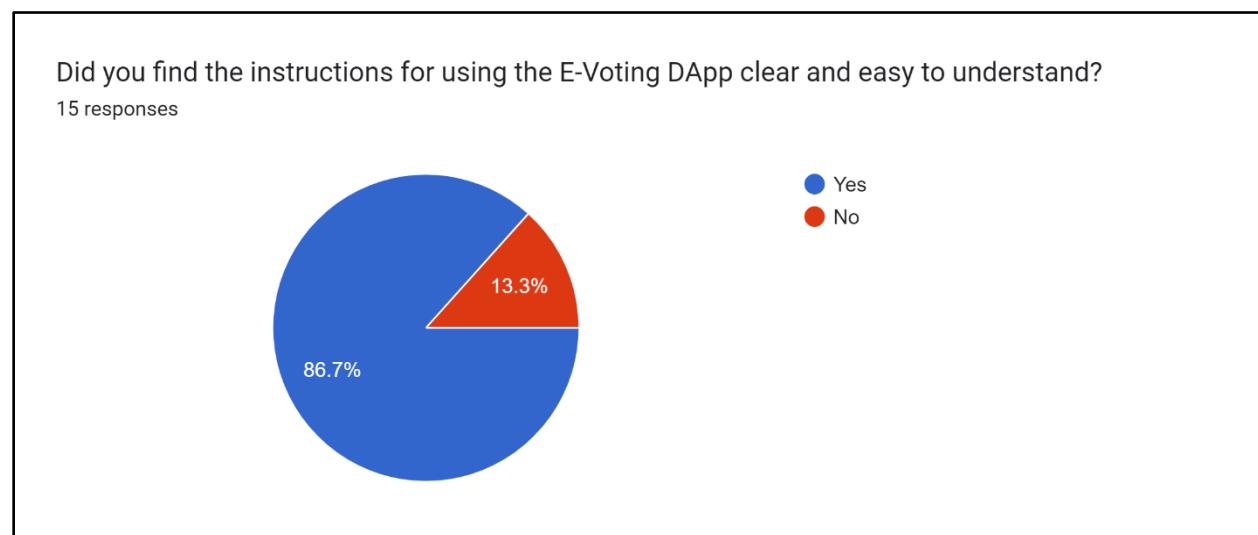


Figure 136: Post Survey 2

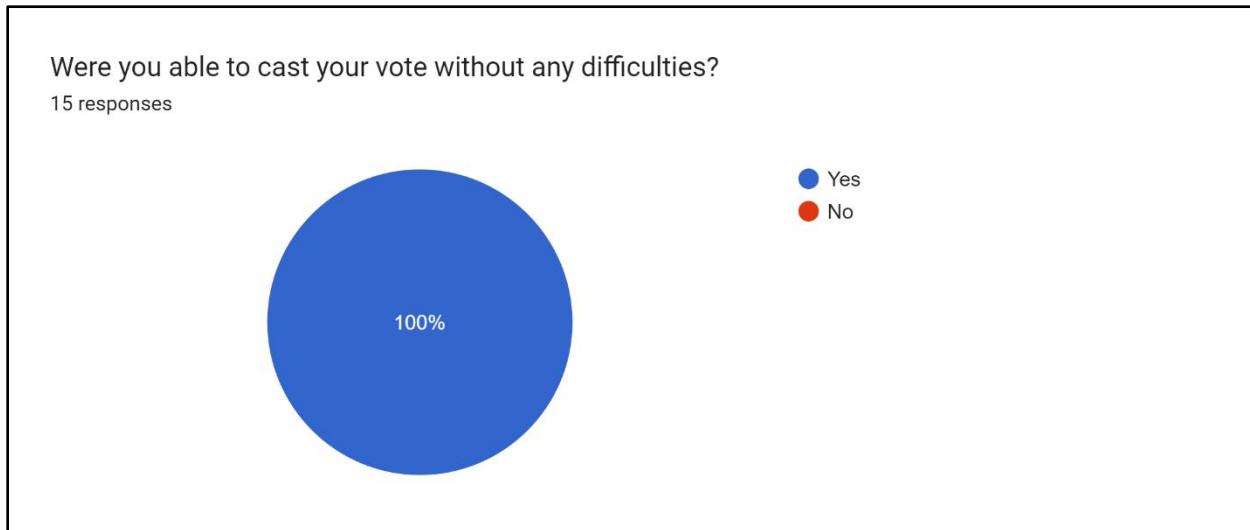


Figure 137: Post Survey 3

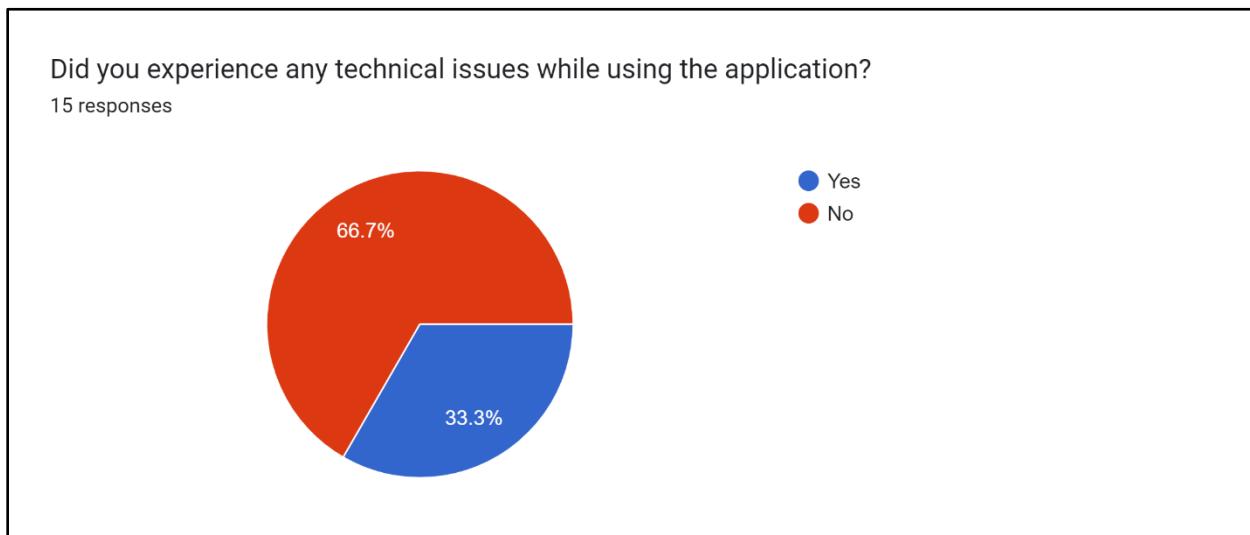


Figure 138: Post Survey 4

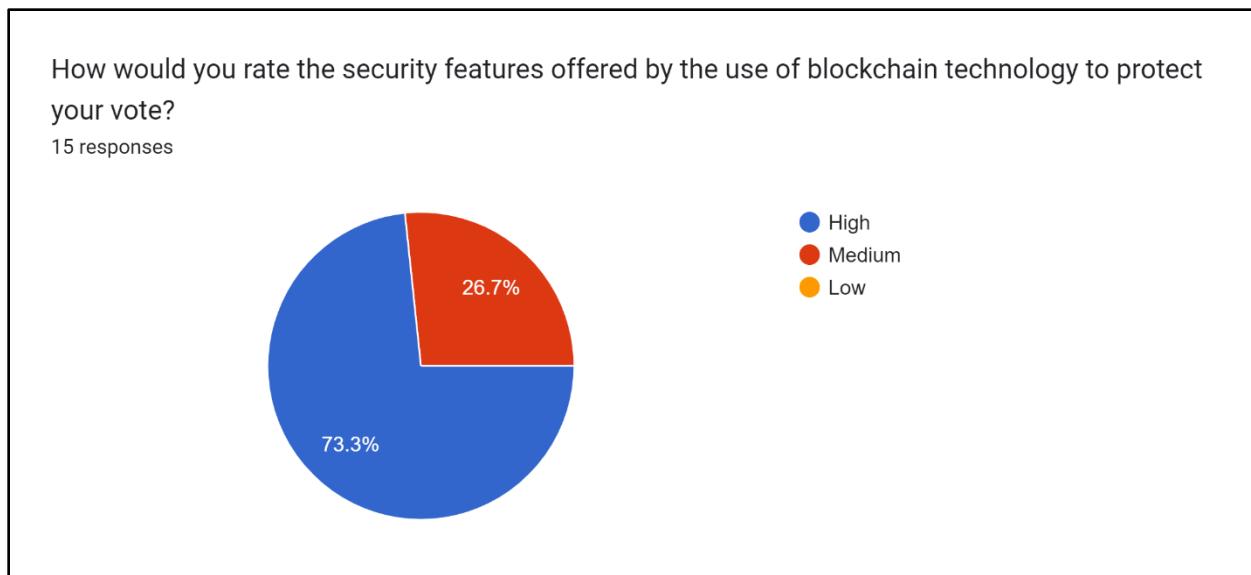


Figure 139: Post Survey 5

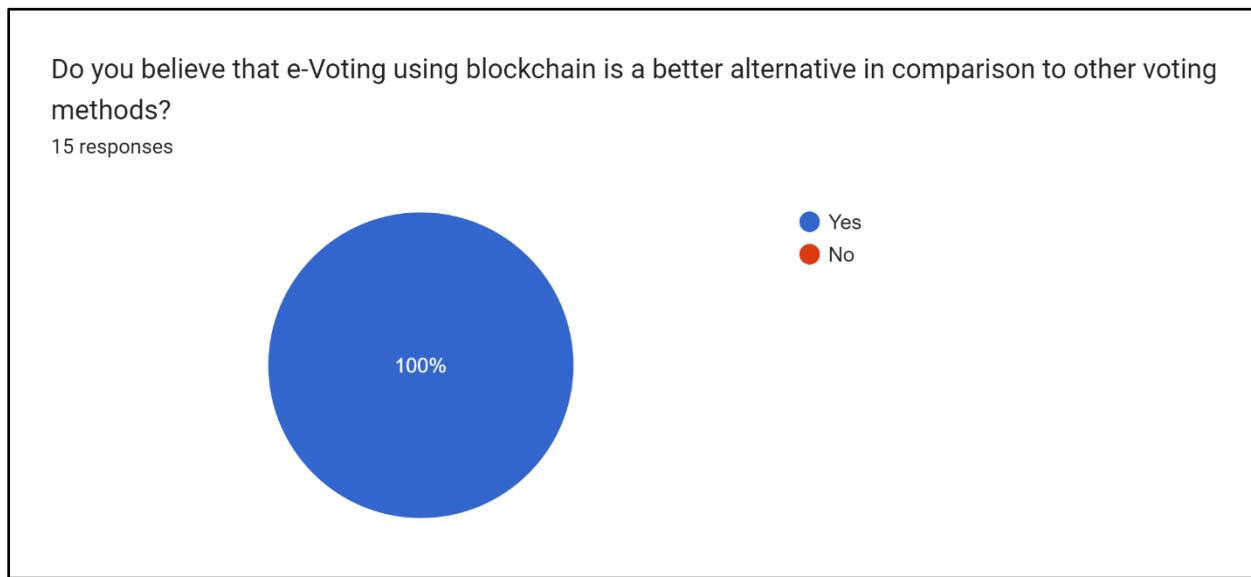


Figure 140: Post Survey 6

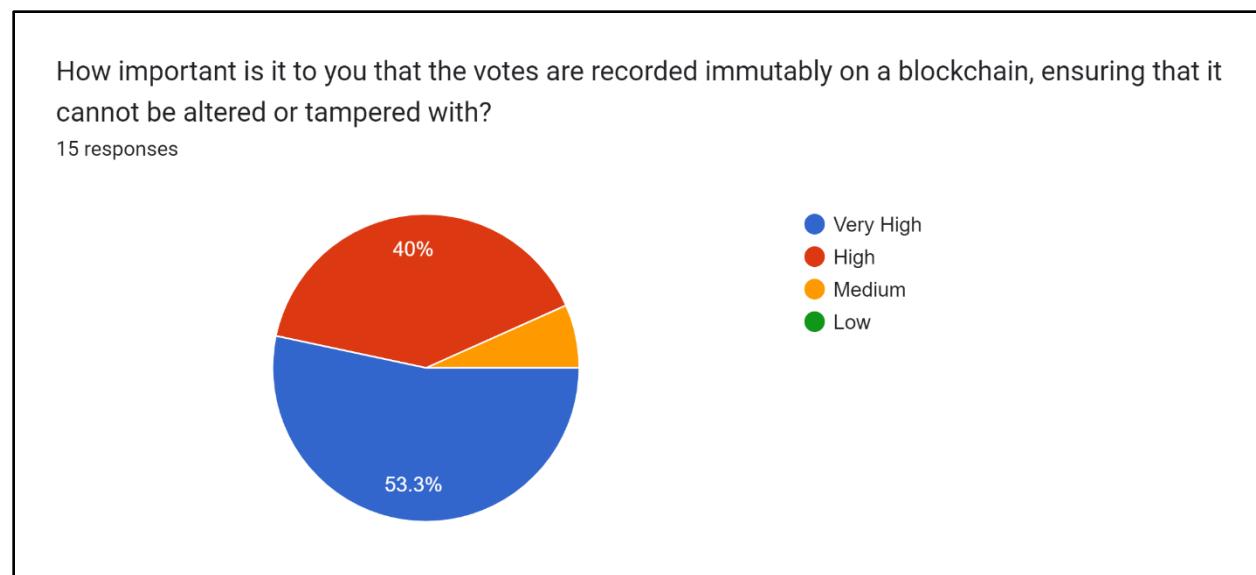


Figure 141: Post Survey 7

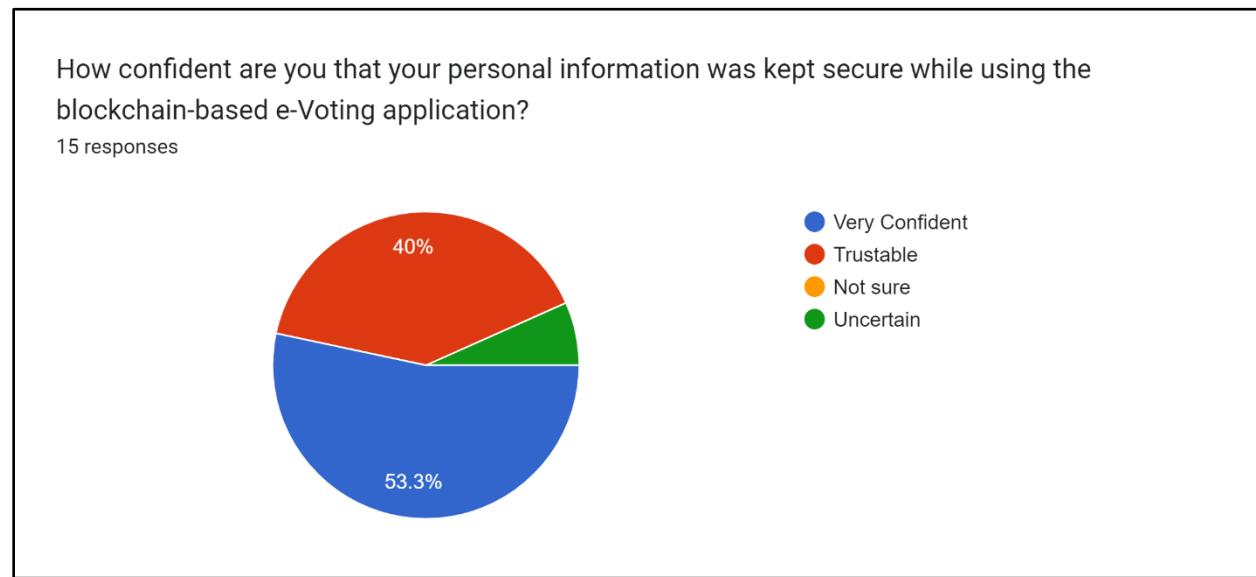


Figure 142: Post Survey 8

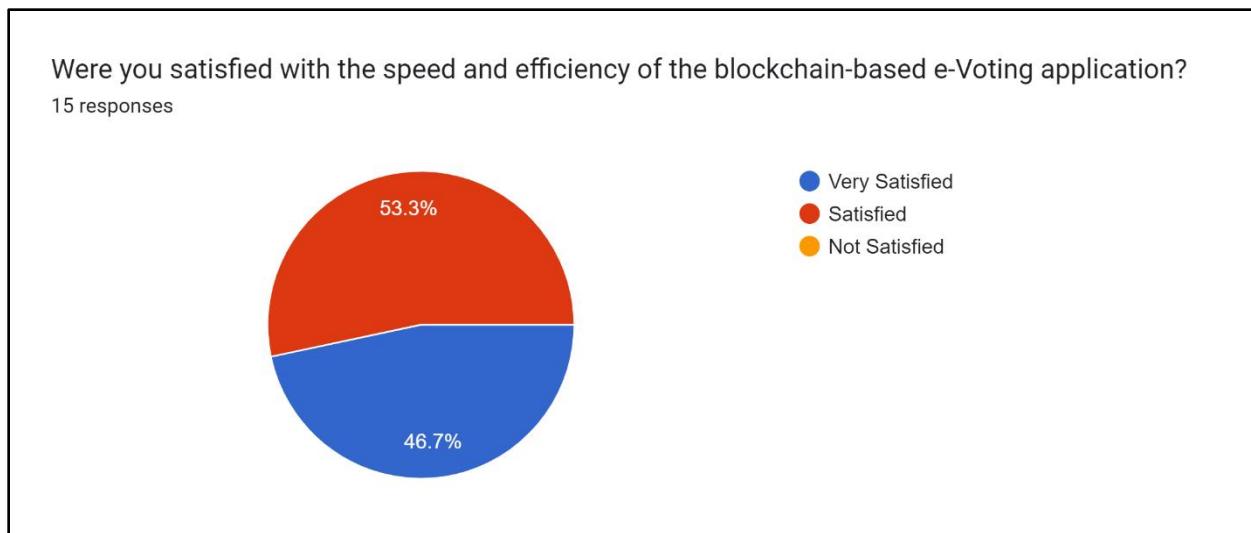


Figure 143: Post Survey 9

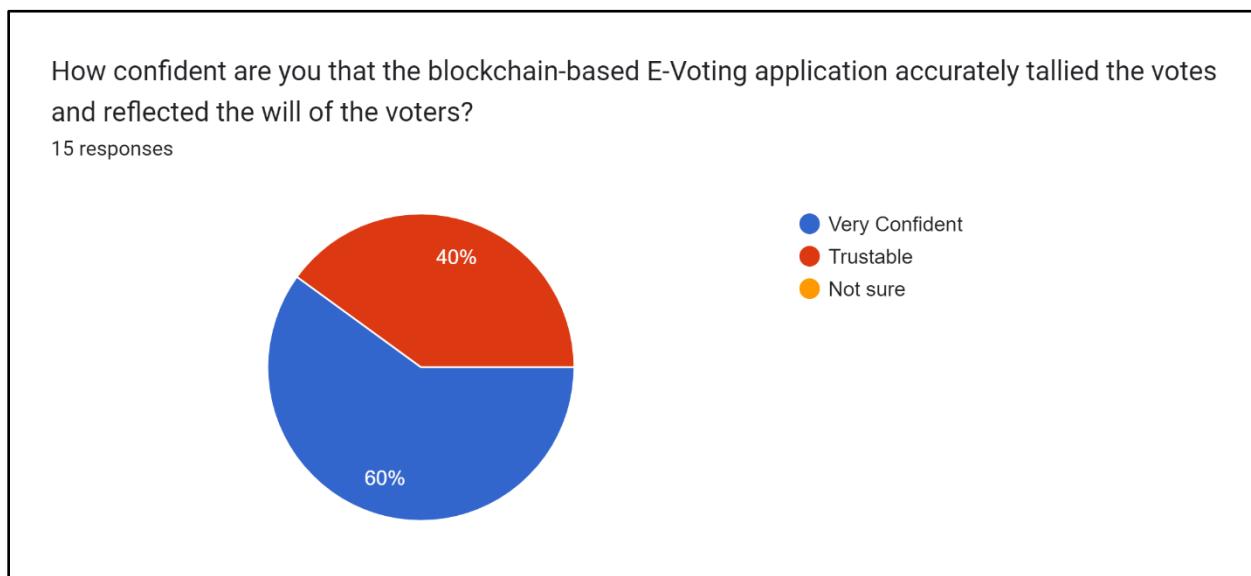


Figure 144: Post Survey 10

What could be improved on this project?

10 responses

This is new technology so it might take time to adjust in real life scenario otherwise furthermore maintaining can be an issue.

Nothing

The application's UI/UX may use a small upgrade.

Everything is awesome

Ui/ user friendly approach for old and illiterate people

Think its perfect as per the effort

I think the features provided are clear, simple and sufficient.

It is good enough.

Some improvement should be done in security

Figure 145: Post Survey 11

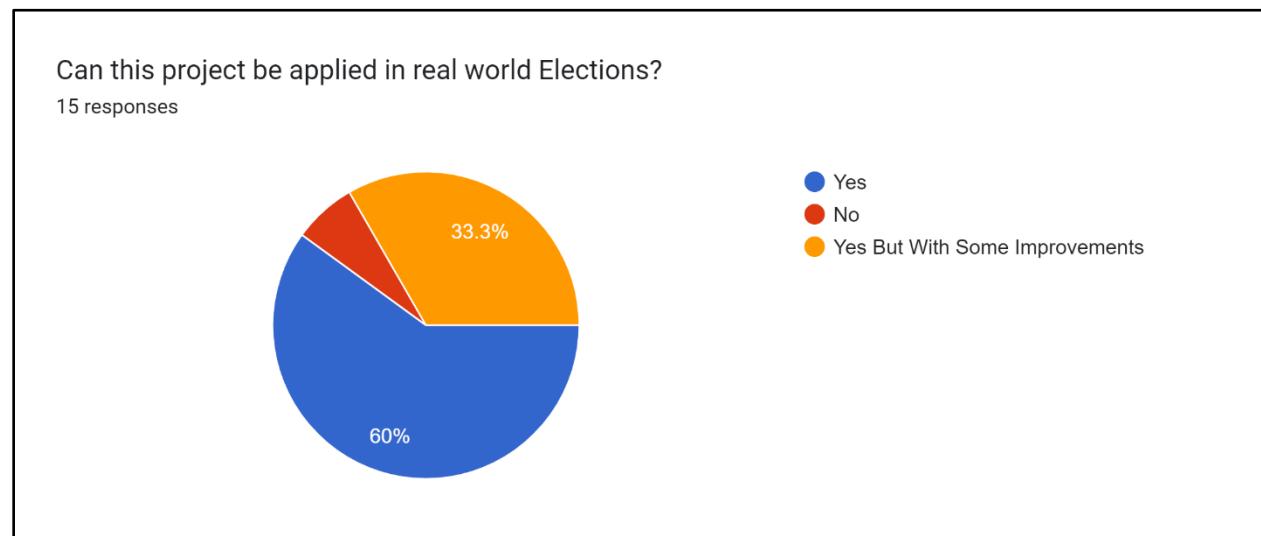


Figure 146: Post Survey 12

### 8.3 APPENDIX C: SAMPLE CODES

```
contracts > eVote.sol
1 pragma solidity >=0.5.16;
2
3 contract eVote {
4     struct Voter {
5         bool hasVoted;
6         uint vote;
7         bool isRegistered;
8         bool isLoggedIn;
9         bool allowedToVote;
10    }
11
12    struct VoterDetails{
13        string email;
14        string pass;
15        string identityno;
16    }
17
18    struct Candidate {
19        uint id;
20        bytes32 name;
21        uint totalVotes;
22    }
23
24    address chairman;
25
26
27    mapping(address => Voter) public voters;
28    mapping(address => VoterDetails) voterdetails;
29    mapping(uint => address) public voterList; //addresses of registered voters
30    mapping(uint => Candidate) public candidates;
31
32    uint public totalVoters = 0;
33    uint public votedUsers = 0;
34    uint public totalCandidates = 0;
35
36    bool public registerCands = true;
37    bool public authorizeUsers;
38    bool public startVote;
39    bool public finishedVote;
```

Figure 147: Code- eVote

```
pragma solidity >=0.5.16;

contract Migrations {
    address public owner = msg.sender;
    uint public last_completed_migration;

    modifier restricted() {
        require(
            msg.sender == owner,
            "This function is restricted to the contract's owner"
        );
    }

    function setCompleted(uint completed) public restricted {
        last_completed_migration = completed;
    }
}
```

Figure 148: Code- Migration

```
JS testvote.js ×
test > JS testvote.js > ...
1 var eVote = artifacts.require("./eVote.sol");
2
3 contract("eVote", function(accounts) {
4   var evoteInstance;
5
6   it("starts with 0 candidates", function() {
7     return eVote.deployed().then(function(instance) {
8       evoteInstance = instance;
9       | return evoteInstance.totalCandidates();
10      }).then(function(candidates) {
11        assert.equal(candidates, 0);
12      });
13    });
14
15 it("admin adds first candidate successfully", function() {
16   return eVote.deployed().then(function(instance) {
17     evoteInstance = instance;
18     | return evoteInstance.addCandidate(web3.utils.fromAscii("Angela"), { from: accounts[0] })
19   }).then(function(receipt) {
20     return evoteInstance.totalCandidates();
21   }).then(function(candidates) {
22     assert.equal(candidates, 1);
23   });
24 });
25
26 it("successful registration for voter", function() {
27   return eVote.deployed().then(function(instance) {
28     evoteInstance = instance;
29     | return evoteInstance.registerVoter("blabla@gmail.com","somepass","1232142", {from: accounts[0]})
30   }).then(function(receipt) {
31     return evoteInstance.totalVoters();
32   }).then(function(voters) {
33     assert.equal(voters, 1);
34   });
35 });
36
37 it("successful login for the registered voter", function() {
38   return eVote.deployed().then(function(instance) {
39     evoteInstance = instance;
```

Figure 149: test vote

```
JS app.js ×
web > js > JS app.js > ⚡ showStatistics > ⚡ then() callback
  1  var candidateId;
● 2  var candidatesResults;
  3  var allCandidates;
  4
  5  function adminLogin(email,pass) {
  6    var $address = $(email);
  7    var emailaddress = $address.val();
  8    var $passw = $(pass);
  9    var pass_val = $passw.val();
 10    console.log(emailaddress);
 11    console.log(pass_val);
 12
 13    if(emailaddress == "admin@admin.com" && pass_val=="admin"){
 14      window.location.replace("http://localhost:3000/admin.html");
 15    }else{
 16      alert("Wrong Credentials!");
 17    }
 18
 19  };
 20
 21
 22  function setId(id) {
 23    candidateId = id;
 24  }
 25
 26  App = {
 27    web3Provider: null,
 28    contracts: {},
 29    account: '0x0',
 30    hasVoted: false,
 31
 32
 33    init: function() {
 34      return App.initWeb3();
 35    },
 36
 37    initWeb3: function() {
 38      if (typeof web3 !== 'undefined') {
 39        web3.setProvider(new Web3.providers.HttpProvider('http://localhost:8545'));
 40      }
 41    }
 42  };
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```

```
JS jqplot.pieRenderer.js X
web > js > JS jqplot.pieRenderer.js > ...
1 /**
2  * jqPlot
3  * Pure JavaScript plotting plugin using jQuery
4  *
5  * Version: 1.0.9
6  * Revision: d96a669
7  *
8  * Copyright (c) 2009-2016 Chris Leonello
9  * jqPlot is currently available for use in all personal or commercial projects
10 * under both the MIT (http://www.opensource.org/licenses/mit-license.php) and GPL
11 * version 2.0 (http://www.gnu.org/licenses/gpl-2.0.html) licenses. This means that you can
12 * choose the license that best suits your project and use it accordingly.
13 *
14 * Although not required, the author would appreciate an email letting him
15 * know of any substantial use of jqPlot. You can reach the author at:
16 * chris at jqplot dot com or see http://www.jqplot.com/info.php .
17 *
18 * If you are feeling kind and generous, consider supporting the project by
19 * making a donation at: http://www.jqplot.com/donate.php .
20 *
21 * sprintf functions contained in jqplot sprintf.js by Ash Searle:
22 *
23 * version 2007.04.27
24 * author Ash Searle
25 * http://hexmen.com/blog/2007/03/printf-sprintf/
26 * http://hexmen.com/js/sprintf.js
27 * The author (Ash Searle) has placed this code in the public domain:
28 * "This code is unrestricted: you are free to use it however you like."
29 *
30 */
31 (function($) {
32 /**
33  * Class: $.jqplot.PieRenderer
34  * Plugin renderer to draw a pie chart.
35  * x values, if present, will be used as slice labels.
36  * y values give slice size.
37  *
38  * To use this renderer, you need to include the
39  */


```

Figure 151: pie chart

```

<> index.html <
web > <> index.html > ...
1   <!DOCTYPE html>
2   <html lang="en">
3     <head>
4       <meta charset="utf-8" />
5       <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6       <meta name="description" content="" />
7       <meta name="author" content="" />
8       <title>Secure eVote System</title>
9
10      <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12      <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
13
14      <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css" />
15      <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css" />
16
17      <link rel="stylesheet" href="css/styles.css"/>
18      <style>
19        @import url('https://fonts.googleapis.com/css2?family=Playfair+Display:ital@1&display=swap');
20      </style>
21
22  </head>
23  <body id="page-top" style="background-color: #f5f5f5;">
24    <!-- Navigation -->
25    <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
26      <div class="container">
27        <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" height="80px" width="80px" alt="Brand icon" />
28        <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive">
29          Menu
30          <i class="fas fa-bars ms-1"></i>
31        </button>
32        <div class="collapse navbar-collapse" id="navbarResponsive">
33          <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
34            <li class="nav-item"><a class="nav-link" href="votingpoll.html">Vote</a></li>
35            <li class="nav-item"><a class="nav-link" id="adminlogin" href="adminlogin.html">Admin Login</a></li>
36            <li class="nav-item"><a class="nav-link" id="results" href="results.html">Results</a></li>
37            <li class="nav-item"><a class="nav-link" id="voterreg" href="voter_registration.html">Register</a></li>
38            <li class="nav-item"><a class="nav-link" id="voterin" href="voter_login.html">Voter Login</a></li>

```

Figure 152: index.html

```
admin.html
web > admin.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote - Admin Webpage</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <link href="css/adminstyle.css" rel="stylesheet" />
13     </head>
14     <body style="background-color: #f0f0f0;">
15         <div class="d-flex" id="wrapper">
16             <!-- Sidebar-->
17             <div class="border-end bg-white" id="sidebar-wrapper">
18                 <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>
19                 <div class="list-group list-group-flush">
20                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="userauth" href="#">
21                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="statistics" href="#">
22                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="addcndid" href="#">
23                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="phasechange" href="#">
24                 </div>
25             </div>
26             <!-- Page content wrapper-->
27             <div id="page-content-wrapper">
28                 <!-- Top navigation-->
29                 <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">
30                     <div class="container-fluid">
31
32                         <div class="collapse navbar-collapse" id="navbarSupportedContent">
33                             <ul class="navbar-nav ms-auto mt-2 mt-lg-0">
34                                 <li class="nav-item active"><a class="nav-link" href="admin.html">Home</a></li>
35                         </ul>
36                     </div>
37                 </nav>
38             </div>
39         </div>
40     </div>
41 
```

Figure 153: admin.html

```
▷ adminlogin.html ×
web > ▷ adminlogin.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3  <head>
4      <meta charset="utf-8" />
5      <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6      <meta name="description" content="" />
7      <meta name="author" content="" />
8      <title>Secure eVote System</title>
9
10     <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12     <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
13
14     <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css">
15     <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css">
16
17     <link href="css/styles.css" rel="stylesheet" />
18 </head>
19 <body id="page-top" style="background-color: #f5f5f5;">
20     <!-- Navigation-->
21     <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
22         <div class="container">
23             <div class="sidebar-brand-icon rotate-n-15">
24             <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive">
25                 Menu
26                 <i class="fas fa-bars ms-1"></i>
27             </button>
28             <div class="collapse navbar-collapse" id="navbarResponsive">
29                 <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
30                     <li class="nav-item"><a class="nav-link" href="votingpoll.html">Vote</a></li>
31                     <li class="nav-item"><a class="nav-link" href="voter_registration.html">Register</a></li>
32                     <li class="nav-item"><a class="nav-link" href="voter_login.html">Voter Login</a></li>
33                 </ul>
34             </div>
35         </div>
36     </nav>
37     <!-- Masthead-->
```

Figure 154: admin login

```
web > authentication.html ...  
1  <!DOCTYPE html>  
2  <html lang="en">  
3      <head>  
4          <meta charset="utf-8" />  
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />  
6          <meta name="description" content="" />  
7          <meta name="author" content="" />  
8          <title>Secure eVote - Admin Webpage</title>  
9  
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />  
11  
12         <link href="css/adminstyle.css" rel="stylesheet" />  
13     </head>  
14     <body style="background-color: #f0f0f0;">  
15         <div class="d-flex" id="wrapper">  
16             <!-- Sidebar-->  
17             <div class="border-end bg-white" id="sidebar-wrapper">  
18                 <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>  
19                 <div class="list-group list-group-flush">  
20                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="userauth" href="#">  
21                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="statistics" href="#">  
22                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="addcnid" href="#">  
23                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="phasechange" href="#">  
24                 </div>  
25             </div>  
26             <!-- Page content wrapper-->  
27             <div id="page-content-wrapper">  
28                 <!-- Top navigation-->  
29                 <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">  
30                     <div class="container-fluid">  
31  
32                         <div class="collapse navbar-collapse" id="navbarSupportedContent">  
33                             <ul class="navbar-nav ms-auto mt-2 mt-lg-0">  
34                                 <li class="nav-item active"><a class="nav-link" href="admin.html">Home</a></li>
```

Figure 155: authentication

```
< contact.html >

web > < contact.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote System</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
13
14         <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css" />
15         <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css" />
16
17         <link href="css/styles.css" rel="stylesheet" />
18     </head>
19     <body id="page-top" style="background-color: #f5f5f5;">
20         <!-- Navigation-->
21         <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
22             <div class="container">
23                 <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" height="80px" width="80px" alt="Brand icon" />
24                 <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive">
25                     Menu
26                     <i class="fas fa-bars ms-1"></i>
27                 </button>
28                 <div class="collapse navbar-collapse" id="navbarResponsive">
29                     <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
30                         <li class="nav-item"><a class="nav-link" href="index.html">Homepage</a></li>
31                         <li class="nav-item"><a class="nav-link" href="votingpoll.html">Vote</a></li>
32                         <li class="nav-item"><a class="nav-link" href="results.html">Results</a></li>
33                     </ul>
34                 </div>
            </div>
```

Figure 156: contact

```
< managevoting.html >

web > < managevoting.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote - Admin Webpage</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <link href="css/adminstyle.css" rel="stylesheet" />
13     </head>
14     <body style="background-color: #f0f0f0;">
15         <div class="d-flex" id="wrapper">
16             <!-- Sidebar-->
17             <div class="border-end bg-white" id="sidebar-wrapper">
18                 <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>
19                 <div class="list-group list-group-flush">
20                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="userauth" href="#>
21                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="statistics" href="#>
22                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="addcnid" href="#>
23                     <a class="list-group-item list-group-item-action list-group-item-light p-3" id="phasechange" href="#>
24                 </div>
25             </div>
26             <!-- Page content wrapper-->
27             <div id="page-content-wrapper">
28                 <!-- Top navigation-->
29                 <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">
30                     <div class="container-fluid">
31
32                         <div class="collapse navbar-collapse" id="navbarSupportedContent">
33                             <ul class="navbar-nav ms-auto mt-2 mt-lg-0">
34                                 <li class="nav-item active"><a class="nav-link" href="admin.html">Home</a></li>
35
36                         </div>
37                     </div>

```

Figure 157: manage voting

```
<results.html>
web > results.html > ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote System</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
13
14         <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css" />
15         <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css" />
16
17         <link href="css/styles.css" rel="stylesheet" />
18     </head>
19     <body id="page-top" style="background-color: #f5f5f5;">
20         <!-- Navigation-->
21         <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
22             <div class="container">
23                 <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" height="80px" width="80px" alt="Brand icon" />
24                 <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive" aria-controls="navbarResponsive" aria-expanded="false" aria-label="Toggle navigation">
25                     <i class="fas fa-bars ms-1"></i>
26                 </button>
27                 <div class="collapse navbar-collapse" id="navbarResponsive">
28                     <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
29                         <li class="nav-item"><a class="nav-link" href="index.html">Homepage</a></li>
30                         <li class="nav-item"><a class="nav-link" href="votingpoll.html">Vote</a></li>
31                         <li class="nav-item"><a class="nav-link" href="contact.html">Contact</a></li>
32                     </ul>
33                 </div>
34             </div>
35         </nav>
36         <!-- Masthead-->
```

Figure 158: results

```
<!-- statisticaloverview.html -->
web > <-- statisticaloverview.html --> ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote - Admin Webpage</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <link href="css/adminstyle.css" rel="stylesheet" />
13         <link href="css/jquery.jqplot.min.css" rel="stylesheet" />
14     </head>
15     <body style="background-color: #f0f0f0;">
16         <div class="d-flex" id="wrapper">
17             <!-- Sidebar-->
18             <div class="border-end bg-white" id="sidebar-wrapper">
19                 <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>
20                 <div class="list-group list-group-flush">
21                     <a class="list-group-item list-group-item-action list-group-item-light p-3" href="authentication.html">U
22                     <a class="list-group-item list-group-item-action list-group-item-light p-3" href="statisticaloverview.ht
23                     <a class="list-group-item list-group-item-action list-group-item-light p-3" href="addcandidate.html">Add
24                     <a class="list-group-item list-group-item-action list-group-item-light p-3" href="managievoting.html">Adm
25                 </div>
26             </div>
27             <!-- Page content wrapper-->
28             <div id="page-content-wrapper">
29                 <!-- Top navigation-->
30                 <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">
31                     <div class="container-fluid">
32
33                         <div class="collapse navbar-collapse" id="navbarSupportedContent">
34                             <ul class="navbar-nav ms-auto mt-2 mt-lg-0">
35                                 <li class="nav-item active"><a class="nav-link" href="admin.html">Home</a></li>
36                             </ul>
37                         </div>

```

Figure 159: statical overview

```
<-- votingpoll.html -->  
web > <-- votingpoll.html --> ...  
1   <!DOCTYPE html>  
2   <html lang="en">  
3   <head>  
4       <meta charset="utf-8" />  
5       <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />  
6       <meta name="description" content="" />  
7       <meta name="author" content="" />  
8       <title>Secure eVote System</title>  
9  
10      <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />  
11  
12      <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></sc  
13  
14      <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="te  
15      <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet"  
16  
17      <link href="css/styles.css" rel="stylesheet" />  
18  </head>  
19  <body id="page-top" style="background-color: #f0f0f0;">  
20  <!-- Navigation-->  
21  <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">  
22      <div class="container">  
23          <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" height=  
24          <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#r  
25              Menu  
26              <i class="fas fa-bars ms-1"></i>  
27          </button>  
28          <div class="collapse navbar-collapse" id="navbarResponsive">  
29              <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">  
30                  <li class="nav-item"><a class="nav-link" href="index.html">Homepage</a></li>  
31                  <li class="nav-item"><a class="nav-link" href="results.html">Results</a></li>  
32                  <li class="nav-item"><a class="nav-link" href="contact.html">Contact</a></li>  
33              </ul>  
34          </div>  
35      </div>  
36  </nav>  
37  <!-- Masthead-->  
38
```

Figure 160: Voting poll

```
<!-- addcandidate.html -->
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
    <meta name="description" content="" />
    <meta name="author" content="" />
    <title>Secure eVote - Admin Webpage</title>
    <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
    <link href="css/adminstyle.css" rel="stylesheet" />
  </head>
  <body style="background-color: #f0f0f0;">
    <div class="d-flex" id="wrapper">
      <!-- Sidebar-->
      <div class="border-end bg-white" id="sidebar-wrapper">
        <div class="sidebar-heading border-bottom bg-light">Admin Webpage</div>
        <div class="list-group list-group-flush">
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="userauth" href="#">User Authentication</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="statistics" href="#">Statistics</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="addcnid" href="#">Add Candidate ID</a>
          <a class="list-group-item list-group-item-action list-group-item-light p-3" id="phasechange" href="#">Phase Change</a>
        </div>
      </div>
      <!-- Page content wrapper-->
      <div id="page-content-wrapper">
        <!-- Top navigation-->
        <nav class="navbar navbar-expand-lg navbar-light bg-light border-bottom">
          <div class="container-fluid">
            <!-- Collapsible navigation-->
            <div class="collapse navbar-collapse" id="navbarSupportedContent">
              <ul class="navbar-nav ms-auto mt-2 mt-lg-0">
                <li class="nav-item active"><a class="nav-link" href="admin.html">Home</a></li>
              </ul>
            </div>
          </div>
        </nav>
      </div>
    </div>
  </body>

```

Figure 161: add candidate

```

<-- voter_registration.html -->
<!-- voter_registration.html --> ...
1  <!DOCTYPE html>
2  <html lang="en">
3      <head>
4          <meta charset="utf-8" />
5          <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6          <meta name="description" content="" />
7          <meta name="author" content="" />
8          <title>Secure eVote System</title>
9
10         <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12         <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous"></script>
13
14         <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css">
15         <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css">
16
17         <link href="css/styles.css" rel="stylesheet" />
18     </head>
19     <body id="page-top" style="background-color: #f5f5f5;">
20
21         <!-- Navigation-->
22         <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
23             <div class="container">
24                 <div class="sidebar-brand-icon rotate-n-15">
25                 <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive">
26                     Menu
27                     <i class="fas fa-bars ms-1"></i>
28                 </button>
29                 <div class="collapse navbar-collapse" id="navbarResponsive">
30                     <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
31                         <li class="nav-item"><a class="nav-link" href="index.html">Homepage</a></li>
32                         <li class="nav-item"><a class="nav-link" href="votingpoll.html">Vote</a></li>
33                         <li class="nav-item"><a class="nav-link" href="adminlogin.html">Admin Login</a></li>
34                         <li class="nav-item"><a id="voterin" class="nav-link" href="voter_login.html">Voter ID</a></li>
35                     </ul>
36                 </div>
37             </div>
38         </nav>
39
40         <div class="page-content">
41             <div class="container">
42                 <div class="row justify-content-center">
43                     <div class="col-md-6">
44                         <div class="card border-0 shadow rounded-0">
45                             <div class="card-body p-4">
46                                 <div class="text-center">
47                                     <img alt="User icon" class="img-fluid mb-2" style="width: 100px;" />
48                                     <h3>Welcome User!</h3>
49                                     <p>Please login to continue</p>
50                                     <div class="text-center">
51                                         <button class="btn btn-primary" href="voter_login.html">Login</button>
52                                         <button class="btn btn-primary" href="register.html">Register</button>
53                                     </div>
54                                 </div>
55                             </div>
56                         </div>
57                     </div>
58                 </div>
59             </div>
60         </div>
61
62         <div class="page-bottom">
63             <div class="text-center">
64                 <small>Copyright © 2021. All Rights Reserved. Secure eVote System</small>
65             </div>
66         </div>
67     </body>
68 </html>

```

Figure 162: voter registration

```

<> voter_login.html <
web > <> voter_login.html > ...
1   <!DOCTYPE html>
2   <html lang="en">
3     <head>
4       <meta charset="utf-8" />
5       <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
6       <meta name="description" content="" />
7       <meta name="author" content="" />
8       <title>Secure eVote System</title>
9
10      <link rel="icon" type="image/x-icon" href="assets/favicon.jpg" />
11
12      <script src="https://use.fontawesome.com/releases/v5.15.3/js/all.js" crossorigin="anonymous">
13
14      <link href="https://fonts.googleapis.com/css?family=Montserrat:400,700" rel="stylesheet" type="text/css">
15      <link href="https://fonts.googleapis.com/css?family=Roboto+Slab:400,100,300,700" rel="stylesheet" type="text/css">
16
17      <link href="css/styles.css" rel="stylesheet" />
18    </head>
19    <body id="page-top" style="background-color: #f5f5f5;">
20      <!-- Navigation -->
21      <nav class="navbar navbar-expand-lg navbar-dark fixed-top" id="mainNav">
22        <div class="container">
23          <div class="sidebar-brand-icon rotate-n-15"><img class="rounded-circle img-fluid" href="#" alt="Brand Logo" />
24          <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive">
25            <i class="fas fa-bars ms-1"></i>
26          </button>
27          <div class="collapse navbar-collapse" id="navbarResponsive">
28            <ul class="navbar-nav text-uppercase ms-auto py-4 py-lg-0">
29              <li class="nav-item"><a class="nav-link" href="index.html">Homepage</a></li>
30

```

Figure 163: voter login

## 8.4 APPENDIX D: DESIGNS

### 8.4.1 GANTT CHART

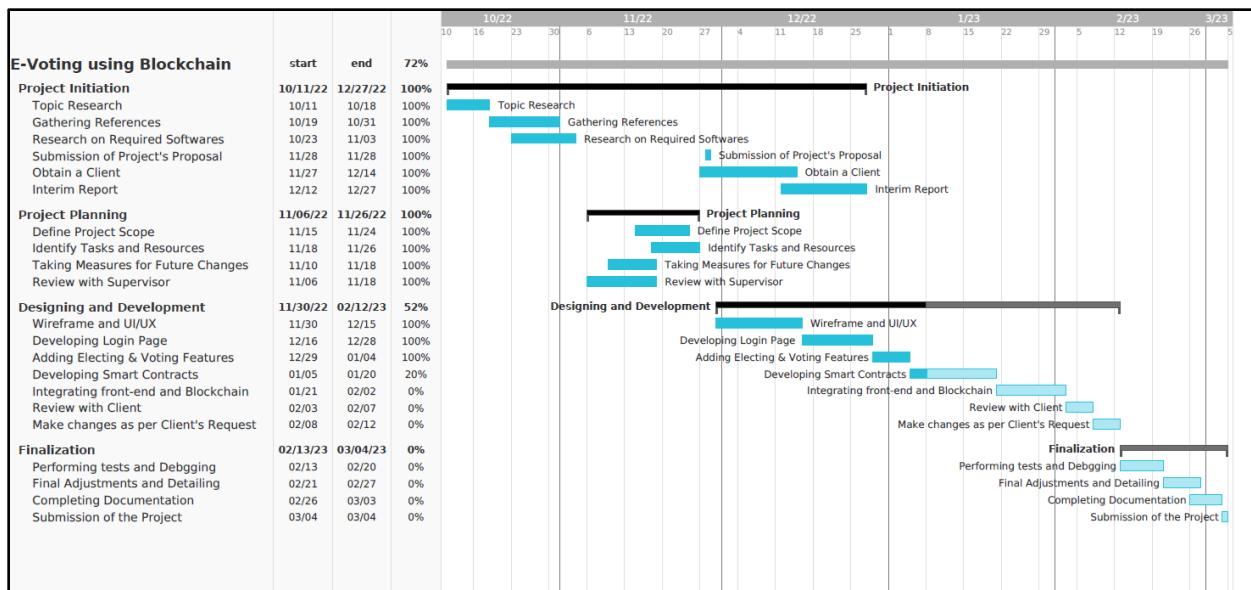


Figure 164: Gantt Chart

#### 8.4.2 WORK BREAKDOWN STRUCTURE

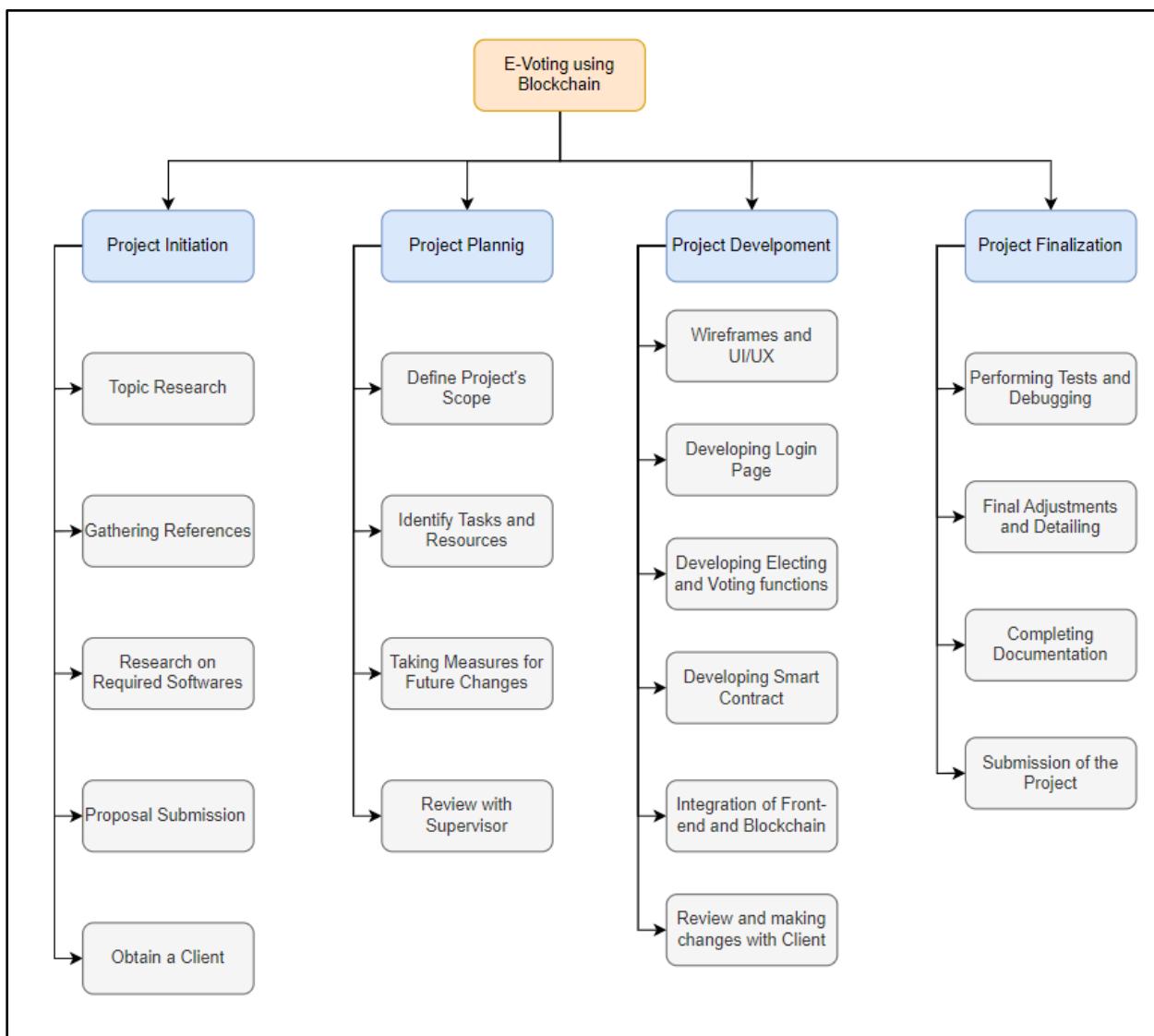


Figure 165: Work-breakdown structure

### 8.4.3 WIREFRAMES

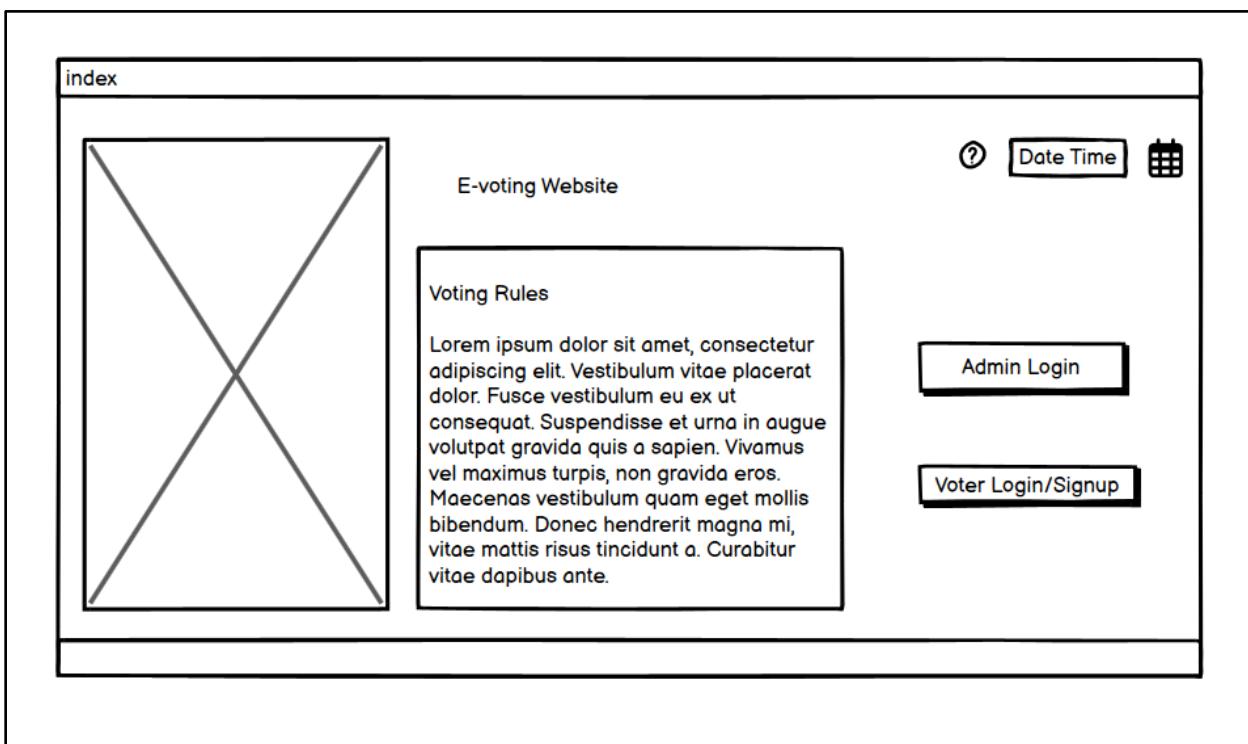


Figure 166: Wireframe- Landing Page

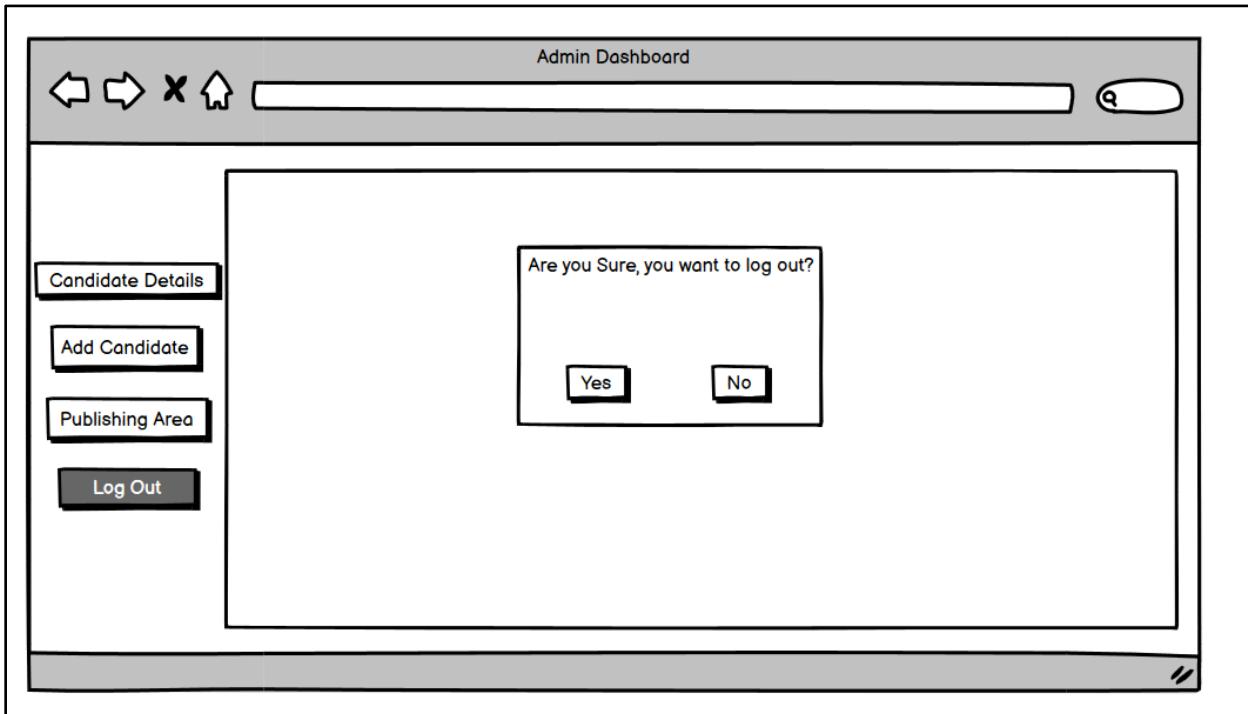


Figure 167: Wireframe- Logout

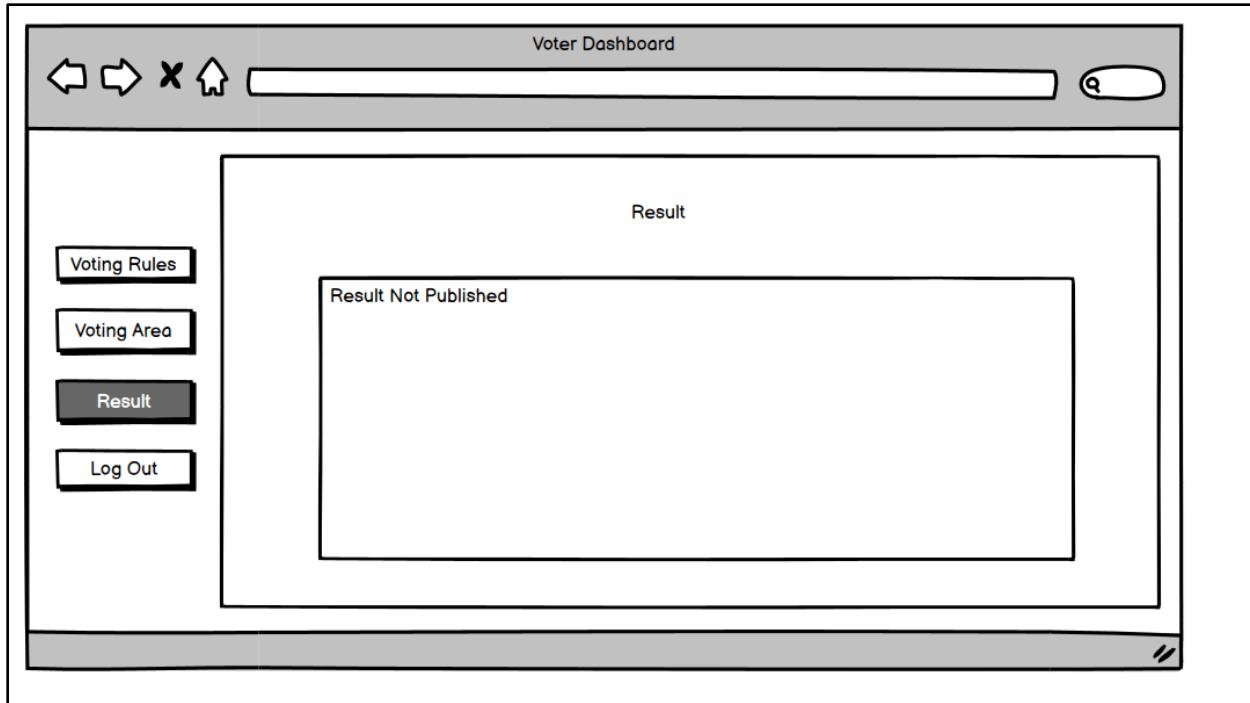


Figure 168: Wireframe- Result

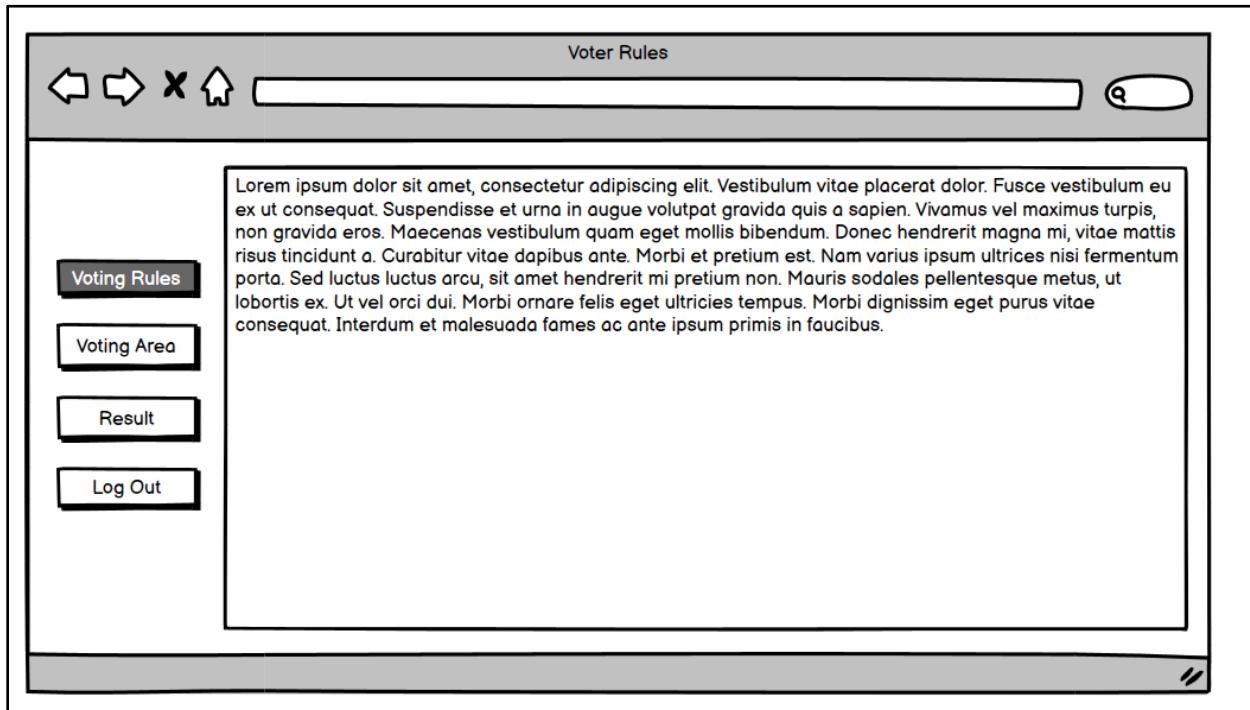


Figure 169: Voter Rules

## 8.5 APPENDIX E: SYSTEM'S SCREENSHOTS

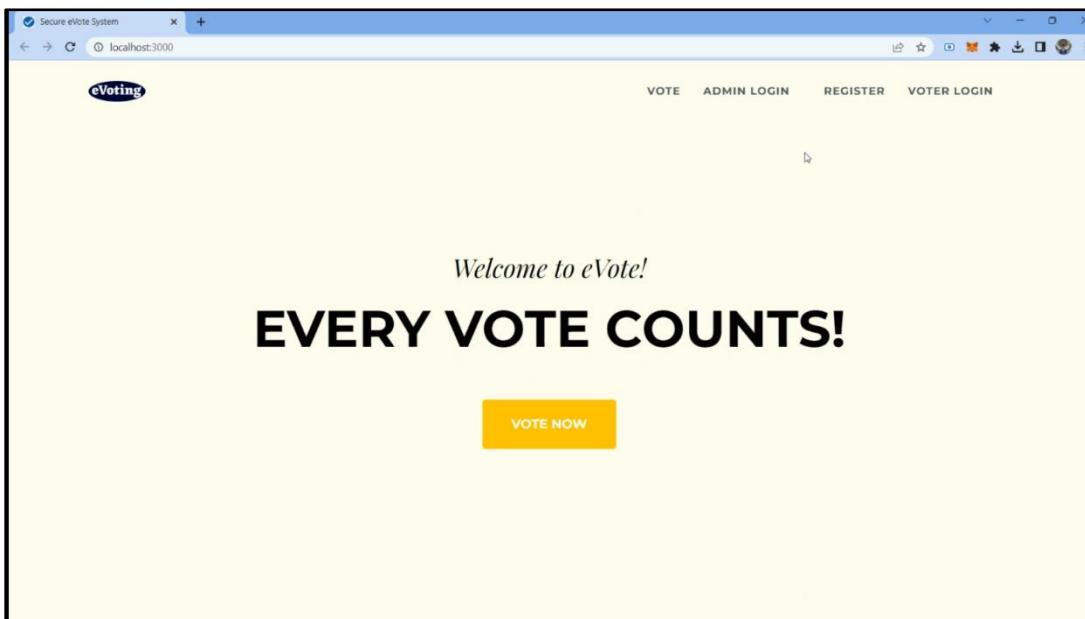


Figure 170: Landing Page

A screenshot of the Admin Login page from the eVote system. The page has a yellow background. It features the "eVoting" logo at the top right and navigation links for "VOTE", "REGISTER", and "VOTER LOGIN". Below these, there are two input fields: "Admin Email:" containing "admin@admin.com" and "Admin Password:" containing ".....". A yellow "Login" button is positioned below the password field. A cursor arrow is visible, pointing towards the "Login" button.

Figure 171: Admin Login

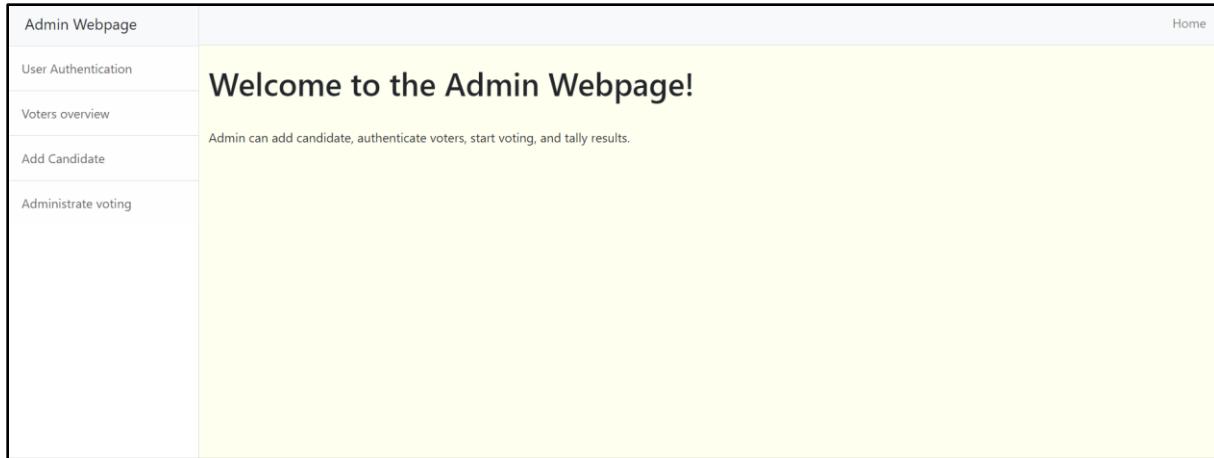


Figure 172: Admin Webpage

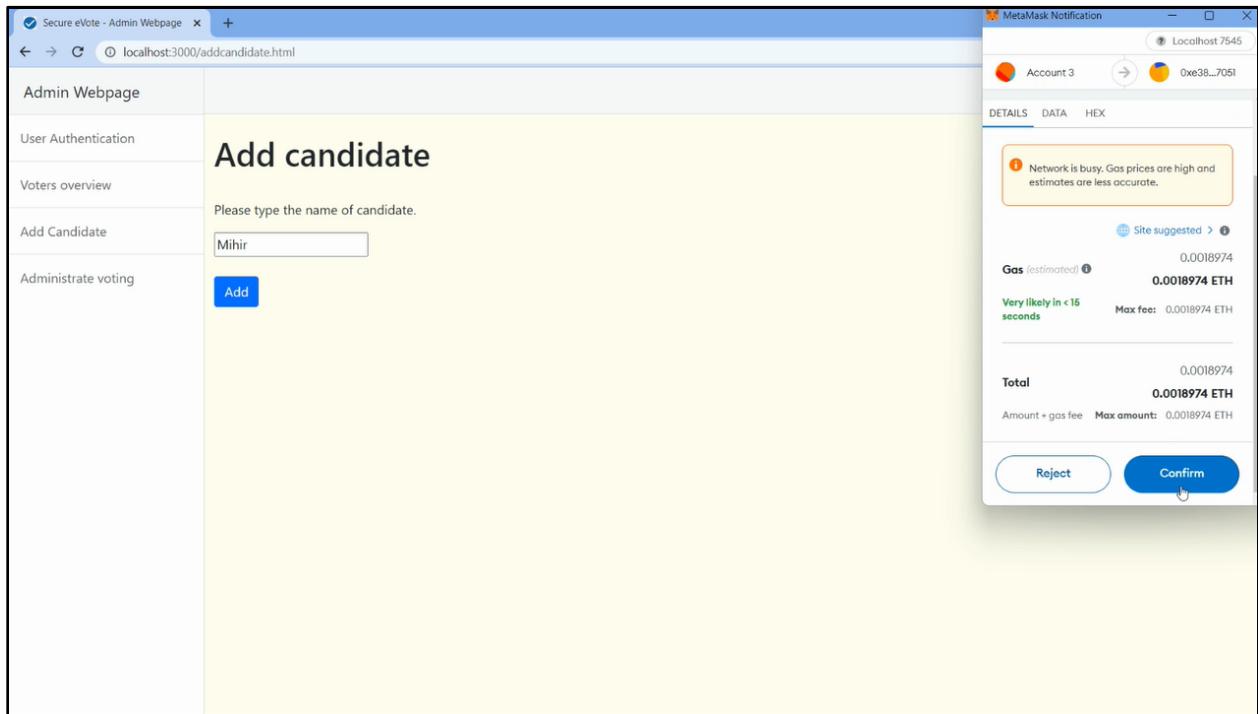


Figure 173: Add Candidate

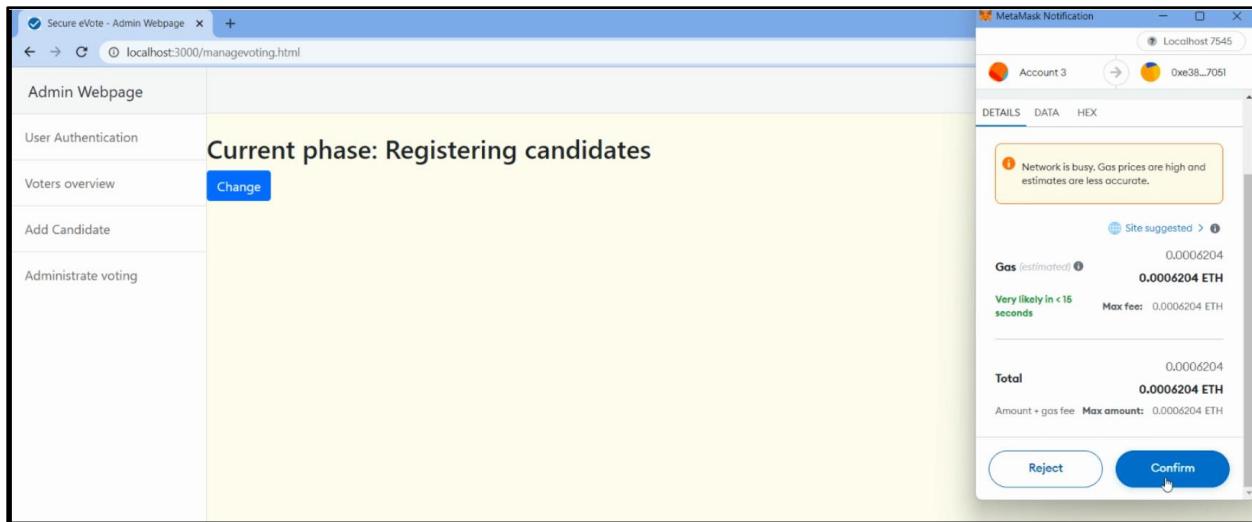


Figure 174: Change Phase

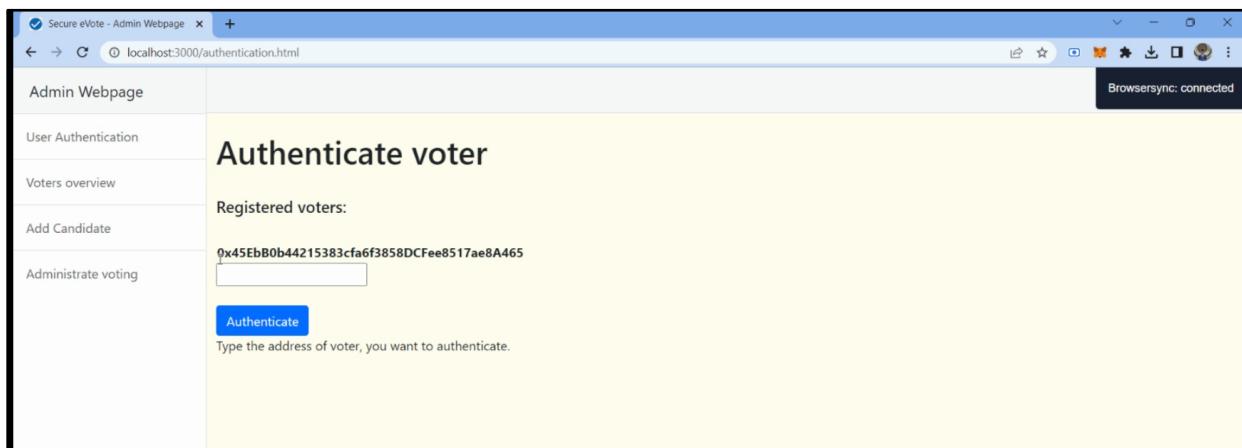


Figure 175: Authenticate Voter

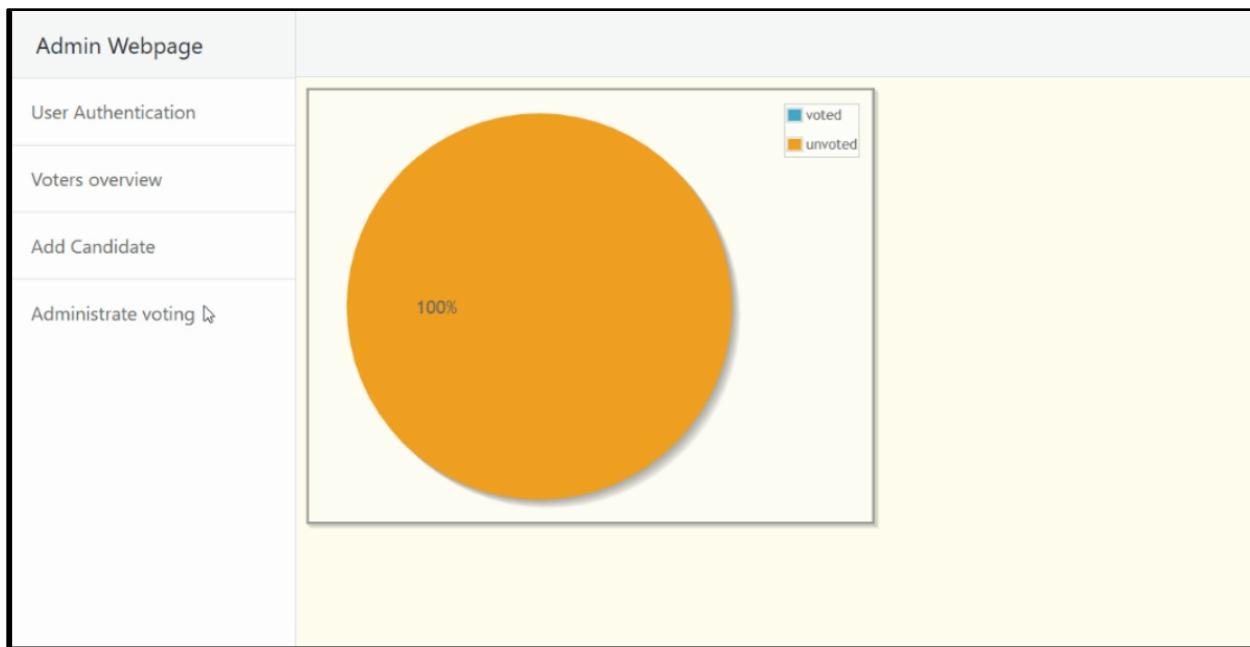


Figure 176: Analytics

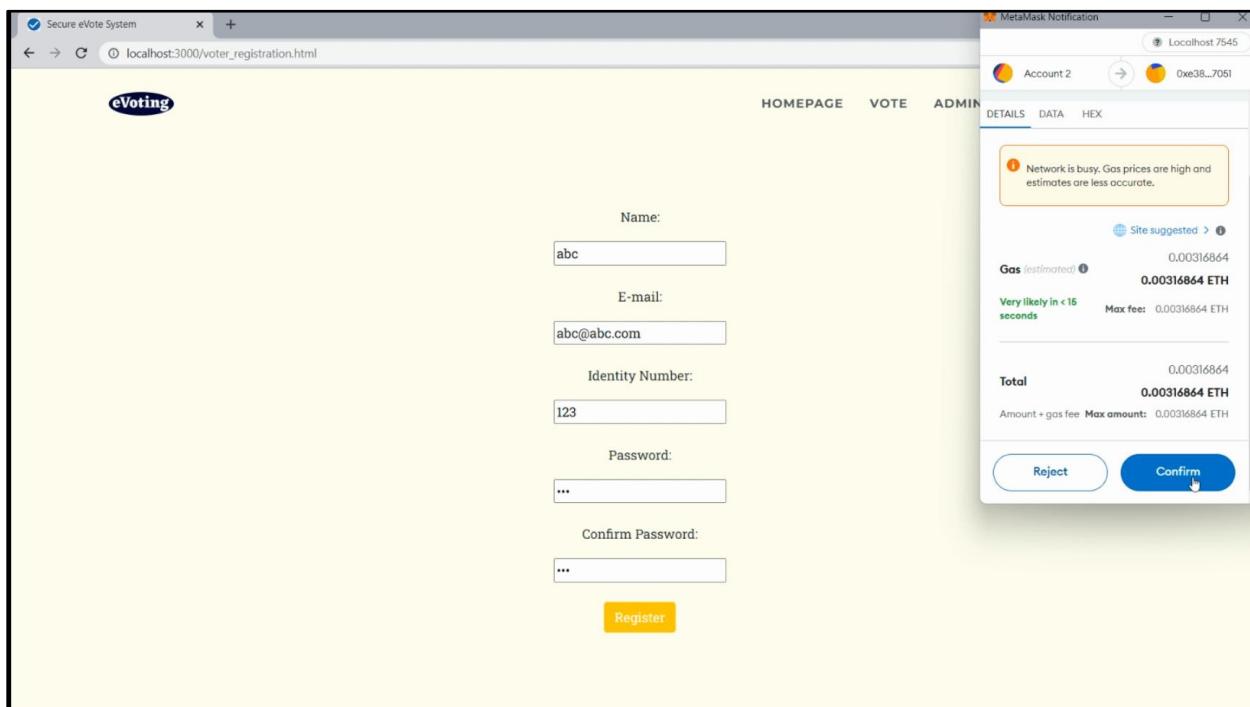


Figure 177: Registration

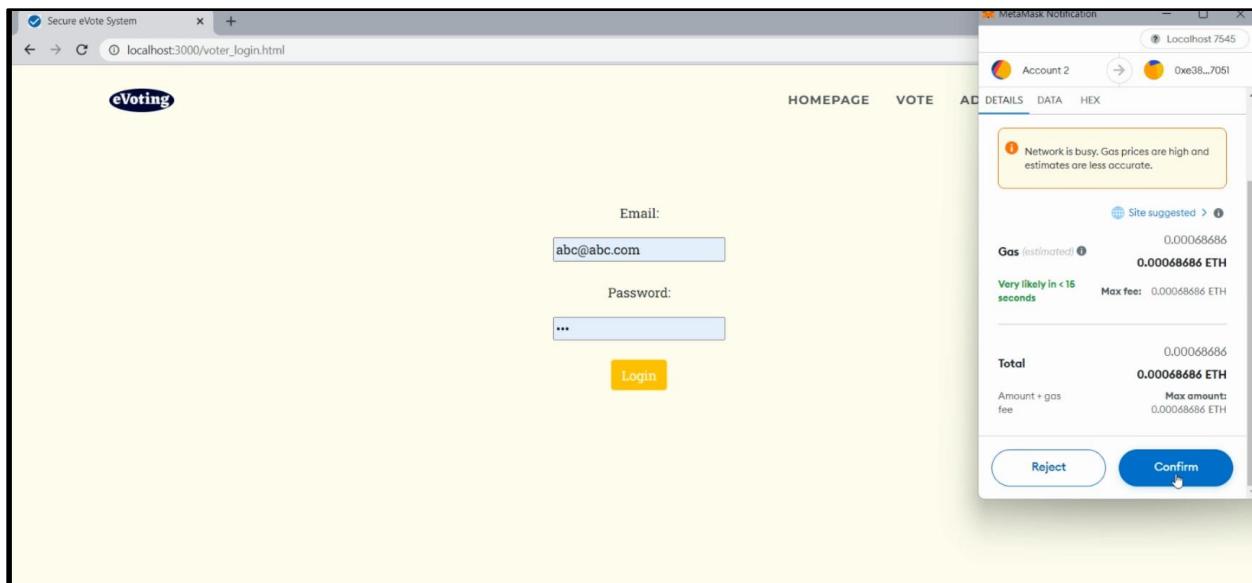


Figure 178: Voter Login

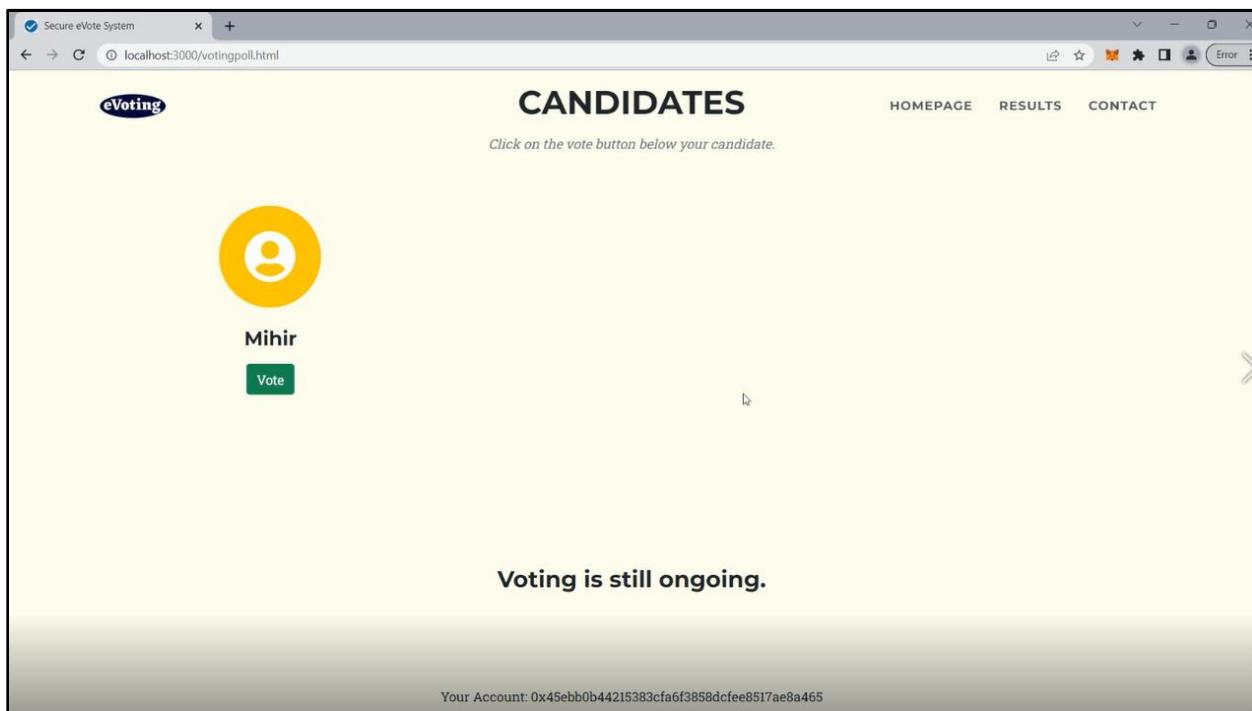


Figure 179: Voter Account

## 8.6 APPENDIX F: USER FEEDBACK

**8.6.1 USER FEEDBACK FORM**

# E-Voting Using Blockchain

This is the post-survey form containing questions related to the project's deliverables, functions and user's experiences and thoughts.

Email \*

rajanghimire412@gmail.com

Was the application user-friendly and easy to navigate? \*

- Yes  
 No

Did you find the instructions for using the E-Voting DApp clear and easy to understand? \*

- Yes  
 No

Were you able to cast your vote without any difficulties? \*

- Yes  
 No

Did you experience any technical issues while using the application? \*

- Yes  
 No

How would you rate the security features offered by the use of blockchain technology to protect your vote?

- High  
 Medium  
 Low

Do you believe that e-Voting using blockchain is a better alternative in comparison to other voting methods? \*

- Yes
- No

How important is it to you that the votes are recorded immutably on a blockchain, ensuring that it cannot be altered or tampered with? \*

- Very High
- High
- Medium
- Low

How confident are you that your personal information was kept secure while using the blockchain-based e-Voting application? \*

- Very Confident
- Trustable
- Not sure
- Uncertain

Were you satisfied with the speed and efficiency of the blockchain-based e-Voting application? \*

- Very Satisfied
- Satisfied
- Not Satisfied

How confident are you that the blockchain-based E-Voting application accurately tallied the votes and reflected the will of the voters? \*

- Very Confident
- Trustable
- Not sure

What could be improved on this project?

You have done a good job

Can this project be applied in real world Elections? \*

- Yes
- No
- Yes But With Some Improvements

Are you satisfied with the End Products? (For client only)

- Yes
- No

This form was created inside Islington College.

Google Forms

## 8.7 APPENDIX G: FUTURE WORK

### 8.7.1 READINGS FOR FUTURE WORK

#### i. Using IPFS as Database

Using IPFS as a database offers a decentralized and distributed file system that can improve data security, reliability, and availability. This approach can reduce the cost associated with centralized databases by eliminating the need for a centralized server infrastructure.

#### ii. Implementing on mobile devices

Implementing the project on mobile devices can enhance the accessibility and convenience of the voting process. With the increasing use of mobile devices, mobile-based e-voting can improve the participation of the voters, especially among young and mobile populations.

iii. Enhancing the user interface

Enhancing the user interface of the project can improve the usability and user experience of the voting process, which can lead to higher participation rates. Future work can focus on designing a user-friendly and intuitive interface for the e-voting system using blockchain technology. This can involve using visual aids, such as graphs and charts, to help voters understand the voting process and the results.

iv. Enhancing privacy features and voter authentication

Enhancing privacy features and voter authentication can be a critical area for future work for the project. This can involve improving the cryptography used to secure the voting process, including implementing advanced encryption algorithms and multi-factor authentication methods. Additionally, exploring new approaches to ensure voter anonymity and confidentiality, such as zero-knowledge proofs, can enhance the privacy of the voting process.

v. Enabling smart contract interoperability

This involves developing a standard framework for smart contracts that can communicate with one another across different blockchain platforms. This can enhance the scalability and efficiency of e-voting systems, as it can facilitate the exchange of data and information between different blockchain networks.

vi. Enabling real-time vote counting

With real-time vote counting, the results of an election can be determined quickly and accurately, providing a more efficient and transparent electoral process. This can also reduce the potential for fraud and errors in the vote counting process.

vii. Developing a more robust governance model

A well-designed governance model can ensure that the voting system operates fairly and transparently, with clear rules and procedures for voting, data privacy, and security. Blockchain technology can provide a secure and transparent platform for implementing such a governance model.

## 8.8 APPENDIX I: ORIGINALITY CHECK

4/18/23, 6:07 PM

[Prabesh Hada] 20049173 Mihir Rauniyar - Final

### Originality report

---

COURSE NAME

CS6P05 - FYP - Subekshya Pradhan and Prabesh Hada

STUDENT NAME

MIHIR RAUNIYAR

FILE NAME

[Prabesh Hada] 20049173 Mihir Rauniyar - Final

REPORT CREATED

18 Apr 2023

---

**Summary**

Flagged passages	6	0.9%
Cited/quoted passages	3	0.6%

**Web matches**

neajc.org	2	0.4%
scaler.com	1	0.2%
acknowledgementletter.com	2	0.2%
glensingh.net	1	0.2%
books.google.com	1	0.2%
futurelearn.com	1	0.2%
simplilearn.com	1	0.1%

1 of 9 passages

---

### Student passage

FLAGGED

Acknowledgement would like to express my sincere gratitude to all those who have contributed to the successful completion of my final year project

Top web match

**Acknowledgement** for English project class 11 I would like to express my greatest gratitude to all those who directly or indirectly helped and supported me throughout the project.

Acknowledgement For English Project (7+ Samples) <https://acknowledgementletter.com/acknowledgement-for-english-project/>

---

2 of 9 passages

## Student passage

FLAGGED

Finally, I would like to thank all those who have supported me throughout this journey, including my family and friends, and the faculty and staff of my institution.

Without their encouragement...

Top web match

I would like to thank my family , who have supported me throughout the journey ; my friends , who have supported me with encouraging messages via social media ; Manchester Coach Ramblers , who...

Polar Exposure: An All-Women's Expedition to the North Pole <https://books.google.com/books?id=6oRqEAAQBAJ&pg=PA257&lpg=PA257&dq=finally+thank+those+supported+throughout+journey+friends&source=bl&ots=lqeiaSSQuS&sig=ACfU3U2ZeSERwmuC7c>

---

3 of 9 passages

## Student passage

FLAGGED

...staff of my institution. Without their encouragement and support, this project would not have been possible.

Top web match

I think the completion of this project would not have been possible without their guidance and support. I would like to sincerely thank my family and friends ...

Acknowledgement For English Project (7+ Samples) <https://acknowledgementletter.com/acknowledgement-for-english-project/>

---

4 of 9 passages

## Student passage

CITED

[https://classroom.google.com/u/1/g/sr/NTQ2MzMyMjYwODI5/NTE4NzY3MDIxNjU2/1umvY9rxhTOq\\_wlZcwtLC5CWAwlYn2dWlwnaoHSq9EyE](https://classroom.google.com/u/1/g/sr/NTQ2MzMyMjYwODI5/NTE4NzY3MDIxNjU2/1umvY9rxhTOq_wlZcwtLC5CWAwlYn2dWlwnaoHSq9EyE) 1/2 4/18/23, 6:07 PM [Prabesh Hada] 20049173 Mihir Rauniyar - Final

**Paper** ballot voting requires cumbersome manual work, a huge budget, and a substantial amount time and manpower for the overall election

Top web match

Traditional paper balloting requires cumbersome manual work, a huge budget, and a substantial amount time for the overall election process. In contrary, e- ...

E-Voting: Possibilities and Challenges in the Nepalese Context <http://www.neajc.org/events/workshop2009/Kumar-Simkhada.pdf>

---

5 of 9 passages

## Student passage

CITED

E-voting is a faster and more economy efficient and can be the best alternative in countries like Nepal where the infrastructure is poor and the population highly

Top web match

In contrary, e-voting, a faster and more economical approach, can be effective alternative in countries like Nepal where the infrastructure is poor and the population highly dispersed.

E-Voting: Possibilities and Challenges in the Nepalese Context <http://www.neajc.org/events/workshop2009/Kumar-Simkhada.pdf>

---

6 of 9 passages

## Student passage

FLAGGED

Smart contracts: **Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code**

Top web match

Smart Contracts **Smart Contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code.**

Understanding Smart Contracts <https://glensingh.net/blog/f/understanding-smart-contracts>

---

7 of 9 passages

## Student passage

FLAGGED

...cycle model for software development is the waterfall model. **It is** crucial since the conventional waterfall model serves **as the foundation for** all other **software development life cycle models**

Top web match

Because **it is** so simple, it can serve **as the foundation for** different **software development life cycle models**. Here are the benefits of SDLC model:..

What is the Waterfall Model in Project Management? - Simplilearn <https://www.simplilearn.com/tutorials/project-management-tutorial/waterfall-model-in-projectmanagement>

---

8 of 9 passages

## Student passage

CITED

In this approach, a prototype of the eventual product is created, tested, and improved based on consumer input until a final acceptable prototype is reached, which serves as the foundation for...

Top web match

In this paradigm, a prototype of the eventual product is created, tested, and refined based on consumer feedback until a final acceptable prototype is reached, which serves as the foundation for...

Prototype Model in Software Engineering - Scaler Topics <https://www.scaler.com/topics/software-engineering/prototype-model-in-software-engineering/>

---

9 of 9 passages

## Student passage

FLAGGED

requires that personal data must be processed in a lawful, fair, and transparent manner, with adequate safeguards in place to protect the rights of data subjects

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It requires that personal data are processed in a lawful, fair and transparent manner in relation to data subjects. Transparency implies that any information and communication concerning the...

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