DECENTRALIZED E-VOTING WITH SMART CONTRACTS

by

Rohit Kumar (1900320100131)

Lavi Badwal (1900320100080)

Under the guidance of

Ms. Sandhya Avasthi (Assistant Professor)

Department of Computer Science and Engineering

ABES Engineering College

19th Km Stone, NH-09, Ghaziabad (U.P)

April, 2023

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Submitted to the Department of Computer Science and Engineering

in partial fulfilment of the requirements

for the degree of

Bachelor of Technology

in

Computer Science and Engineering

Under the guidance of

Ms. Sandhya Avasthi (Assistant Professor)

ABES Engineering College, Ghaziabad

Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh Lucknow

April, 2023

STUDENT'S DECLARATION

We hereby declare that the work being presented in this report entitled **"*DECENTRALIZED E-VOTING WITH SMART CONTRACTS*"** is an authentic record of my / our own work carried out under the supervision of Ms. **"SANDHYA AVASTHI".**

The matter embodied in this report has not been submitted by us for the award of any other degree.

Dated: May 25, 2023

Signature of Student(s)

Rohit Kumar (1900320100131)

Lavi Badwal (1900320100080)

Department: CSE

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Signature of HOD **Signature of Project Coordinator** **Signature of Supervisor**

Prof. (Dr.) Divya Mishra

HOD

Computer Science and Engineering

Date: May 25, 2023

CERTIFICATE

This is to certify that Project Report entitled "**Decentralized EVoting with Smart Contracts**" which is submitted by **Rohit Kumar and Lavi Badwal** in partial fulfilment of the requirement for the award of degree Bachelors of Technology in Department of **Computer Science and Engineering** of Dr. A.P.J. Abdul Kalam Technical University, formerly Uttar Pradesh Technical University is a record of the candidate's own work carried out by him/them under my supervision.

The plagiarism percentage evaluated for the content presented is **14%**

The matter embodied in this Major Project Report is original and has not been submitted for the award of any other degree.

Dated: May 25, 2023

Supervisor Signature
Name: Sandhya Avasthi
Designation: Assistant Professor
Computer Science & Engineering
ABES Engineering College

ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the B.Tech. Project undertaken during B. Tech Final Year. We owe special debt of gratitude to Guide ***Ms. Sandhya Avasthi, Assistant Professor*** *of Department of Computer Science & Engineering, ABES Engineering College, Ghaziabad for his constant support and guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only his cognizant efforts that our endeavors have seen light of the day.*

We also take the opportunity to acknowledge the contribution of ***Professor (Dr.) Divya Mishra, Head of Department*** *of Computer Science & Engineering, ABES Engineering College, Ghaziabad for his full support and assistance during the development of the project.*

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the development of our project. Last but not the least, we acknowledge our friends for their contribution in the completion of the project.

Signature:

Name: Rohit Kumar

Roll No. 1900320100131

Date: May 25, 2023

Signature:

Name: Lavi Badwal

Roll No. 1900320100080

Date: May 25, 2023

ABSTRACT

A democratic election is a pivotal act in any country which decides the future of that country for a particular term. Some of the old means of voting like Ballot Paper and EVM (Electronic Voting Machine) has their drawback like transparency, low voter turn-out, votes tempering, and many more. As with the advancement of modern digital society, the online trend is getting accelerated, which further creates security and authenticity issues. The issues found in the Ballot system or EVM can be easily overcome by Blockchain technology and Smart Contracts.

Electronic Voting powered by Blockchain & Smart Contracts takes the miles over these old means of a voting system which securely delivers the results in less time and cost. With E-Voting using Blockchain costs can be reduced, the need for Polling stations and the use of resources like EVM, Ballot Paper can also reduce as well as security can also be enhanced by providing End to End Encryption and authenticity. This blockchain-powered e-voting can easily gain trust as the transaction is transparent, and immutable as well as not easily be changed once hosted due to smart contracts. The proposed method is a MERN-based web Application with lots of enhanced methods for authentication and authorization that can be achieved using OTP Verification and face verification. This voting data is stored in the form of a transaction stored in a Blockchain-based ledger through Smart Contracts to enhance security features.

Through this above-mentioned system, we can conduct election online and with High Security.

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LIST OF ABBREVIATIONS

AWS	Amazon Web Services
S3	Simple Storage Services
MERN	MongoDB ExpressJS ReactJS and NodeJS
DB	Database
JS	JavaScript
HTML	Hypertext Markup Language
CSS	Cascading Stylesheet
EVM	Electronic Voting Machine
E Voting	Electronic Voting
API	Application programming interface
SMS	Short Message Service
NSDL	National Securities Depository Limited
CDSL	Central Depository Services Limited
SQL	Structured Query Language

CHAPTER 1
INTRODUCTION

Elections are significant, particularly in a sizable democracy like India. Election officials in a nation like India, where a large portion of the underprivileged population is illiterate or ignorant, must carefully examine the signatures or thumbprints on paper ballots to determine the validity of votes. Due to the numerous errors they include, votes from underrepresented groups are essentially ignored. The accurate counting of these groups' votes is ensured by the use of EVM technology. albeit EVM has its difficulties. This problem, which includes vote tampering, polling place capture, EVM hacking, and vote manipulation, results from it. These issues were discovered through the traditional voting process, and we tried to address them by using our innovative way.

"Online voting," the newest trend in election or poll voting, simplifies and speeds up the process. Electronic voting systems used in elections must be considered as legitimate, trustworthy, secure, and helpful. However, acceptance would be difficult owing to possible problems with automated voting methods. Blockchain technology, which offers decentralized nodes for electronic voting, was designed to address these issues. Due to its advantages, end-to-end verification is utilized to develop electronic voting systems. Because of its widespread acceptance, non-repudiation, and security features, this system is a great substitute for conventional electronic voting techniques.

This electronic voting system's adoption of blockchain technology increases the vote records' end-to-end encryption, security, and authenticity, making it impossible for them to be created or manipulated. Every node linked to the network gets access to all of the data and is immediately informed if any changes are made since these records are kept in a decentralized manner. Our system or application decreases the cost of elections and increases voter turnout by enabling Citizens to cast votes that have been approved by Admin without going to polling sites.

1. 1. Problem Introduction

Elections have been held ever since the days when monarchs' ministers convened to vote and kings were chosen by popular vote. However, paper ballots and EVMs (Electronic Voting Machines) are now the two voting systems that are used the most frequently. Voting Elections conducted with ballots include drawbacks such vote tampering/manipulation and polling place capture. Additionally, it requires

human presence and large financial resources. On the other side, because the EVM is easily hackable and manipulated, many do not trust this method of voting.

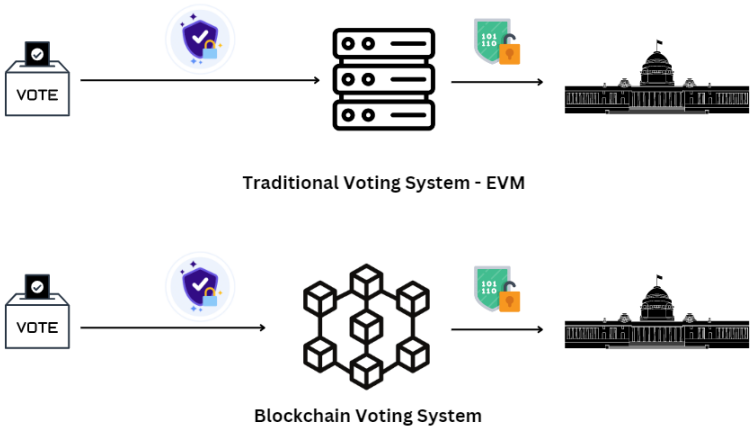


Figure 1: Comparison b/w EVM and Blockchain Mode of Voting

We discussed the drawbacks of conventional voting procedures and proposed an electronic voting system that minimizes these drawbacks.

1. 1. 1. Motivation

The motivation for taking the next step towards a more decentralized voting structure comes from having a huge increase in the number of people and entities that have a vested interest in a particular outcome. In addition to current third-party involvement and the necessity for votes to be recorded and verified, this poses problems as a single party can manipulate the entire process by either altering the vote count or voting

1. 1. 2. Project Objective

To develop a highly secure, accurate, cost-effective, and dependable electronic voting system that covers up the flaws in conventional voting procedure.

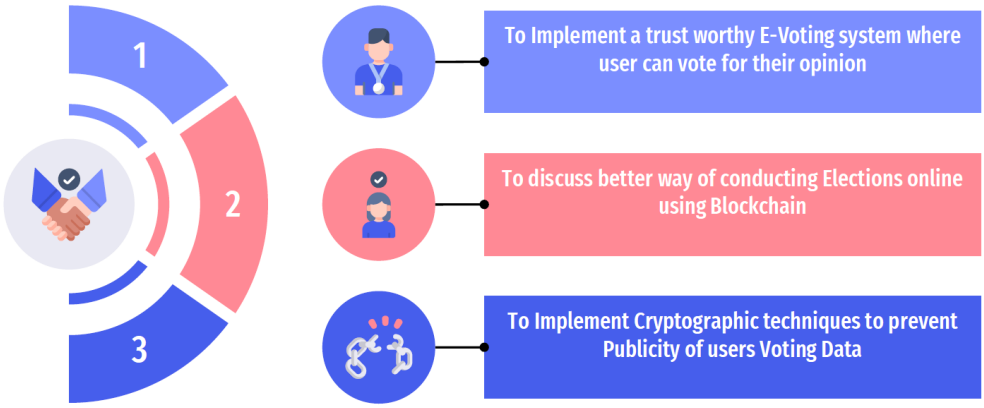


Figure 2: Deliverables of this Project

1. 1. 3. Scope of the Project

This project's main objective is to enhance voting online by providing alternatives to conventional voting procedures that address their limitations and provide a safe, risk-free manner.

Elections are crucial in establishing how to rate a person based on the opinions of others, including those for government, surveys, and society. Online voting systems are quite beneficial in this case because they allow voters to cast their ballots in a highly secure, irreversible way without the need for further setup, saving both time and money.

1. 2. Related Previous Work

The Popular E Voting Application build using Blockchain with their Limitations are:

1. Follow My Vote (https://followmyvote.com)
   Follow My Vote is a non-profit, independent election integrity and blockchain voting technology developer that is developing decentralized voting infrastructure using the Bitcoin blockchain.
   Follow My Vote has one major mission: to protect the integrity of the voting process and to ensure that every vote cast in an election is treated equally, even if one side or the other happens to win. In the case of an election, each side will win every time an election is true.

Limitations:

- During the voting process, if a vote is recorded incorrectly, the vote is invalid. In case of doubt, all votes are checked against a "kill-switch."
- Vote counts are NOT final until 48 hours after the close of voting on Election Day.
- Every voter will also have to use a special app, not available on the App Store, that they have to download to their phone and enter their personal information to prove their identity.

2. Ballotchain

Ballotchain makes it possible for an online process with the same security measures as a public election. The fundamental idea behind the Ballotchain solution is to associate a Bitcoin transaction with a voter's support for the candidate of their choice. Every vote benefit from the qualities of the Blockchain since a Blockchain transaction cannot be altered, it cannot be cancelled, it cannot be registered in more than one way, and all nodes have a valid copy. In practice, a vote is cast by putting a little amount of cryptocurrency known as a "Ballot coin" into the candidate's wallet.

Limitations:

- There is no centralized authority which can perform the processing. Voting systems all have a central authority which is in charge of data integrity and account encryption and/or security.
- Ballotchain is also not designed to work across state or country borders.
- Ballotchain voting solutions do not fix the most significant problem with elections, which is access and participation

3. NSDL e-Voting System (https://www.evoting.nsdl.com)

E-voting is the practice of approving or disapproving corporate decisions via an electronic voting mechanism. E-voting is necessary when a company wishes to pass a resolution that needs the consent of members or shareholders by postal ballot, AGM, or EGM. The Ministry of Corporate Affairs has authorized NSDL to develop an electronic platform that would allow members and shareholders to cast ballots online. In light of this, NSDL set up an electronic infrastructure to allow shareholders and members to vote online through electronic means.

Limitations:

- Limited to Certain groups of people belongs from an organization
- Not Totally based on Blockchain
- Deals with Elections related to shareholders or organization structure

4. CDSL e-Voting System (https://www.evotingindia.com)
   The e-Voting platform aims to increase corporate governance standards and transparency. It also helps reduce administrative expenses associated with postal ballots and enables results to be announced immediately after voting is complete.

   Limitations:
   - Limited to Certain groups of people belongs from an organization
   - Not Totally based on Blockchain
   - Deals with Elections related to shareholders or organization structure

5. Polys (https://polys.votee)
   Blockchain-based online voting platform Polys is supported by open-source cryptographic techniques. It makes it easier for communities, corporations, educational institutions, and governments to reduce paperwork and hold effective online elections.
   Limitations:
   - No more than 20 voters can participate in the free version of Polys.
   - Polys functionality does not allow voting on multiple issues within one voting session.
   - Presently It cannot delete or hide the voting even after it ends.
6. B-Voting
   Developed by Net Service, B-Voting (Blockchain-Voting) is a state-of-the-art electronic voting system that is integrated with one or more electoral event management processes (system setup, credential distribution, voting, collection of ballots, preference counting, and results publication).

   Limitations:
   - Not Scalable
   - Costly
   -

Table 1: Table for Comparison with Existing System

	Decentralized	Specific Groups	Immediate Result	Voting ID	Free	Central Authority
Our application	✓	✗	✓	✓	✓	✓
Follow my Vote	✓	✗	✗	✗	✗	✓
Ballot chain	✓	✗	✓	✗	✗	✗
NSDL eVoting System	✗	✓	✗	✓	✓	✓
CSDL eVoting System	✗	✓	✗	✓	✓	✓
Polys	✓	✗	✓	✗	✗	✓
B- Voting	✓	✗	✓	✗	✗	✓

CHAPTER 2

SOFTWARE REQUIREMENT SPECIFICATION

2. 1. Product Perspective

The E-Voting System (CastMyVote) is a self-contained system that helps in conduction of elections online due to that helps it helps in increasing voting percentage and saves a large amount of money of election organizing authority. It becomes the task of various stakeholder easy and in a convenient way i.e stakeholders requires a better medium of election and wants that large amount of voters involved in the election and voters also needs a convenient way to cast their votes online without going to Booths and no need to time spend.

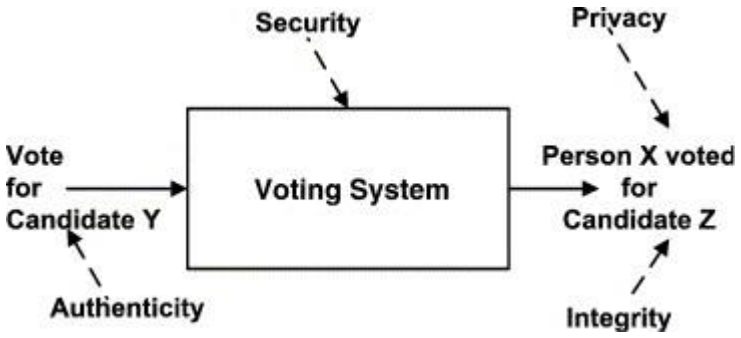


Figure 3: Product Perspective

The following subsections describe how the software operates inside various constraints.

2. 1. 1. System Interfaces

The various systems are used in order to fulfill the requirements of our system. These are:

(i) NodeMailler

NodeMailler is basically a NodeJS based library that is used to Email through SMTP API through this our work becomes easy to setup Emails Communication with the user.

(ii) Twilio

Twilio is a platform that is used to send SMS alert to the user. It permits message sender to only verified user without purchase plan

(iii) MongoDB

MongoDB is a Non-SQL (Key-Value) based database which we used in our system to maintains records. Here we have use MongoDB Atlas cluster

(iv) NodeJS Server

NodeJS Server is written in JavaScript scripting language. It helps in linking all other system in one place i.e Database, NodeMailler etc. Here we have API which is called by Client side as a response of those api a task is executed.

(v) Amazon Web Services (AWS) S3

AWS S3 is used to store files. Here we have used this to keep files that is linked in Database.

(vi) Ganache

The local Blockchain that provides some free Web 3 Account with some gas or ethers.

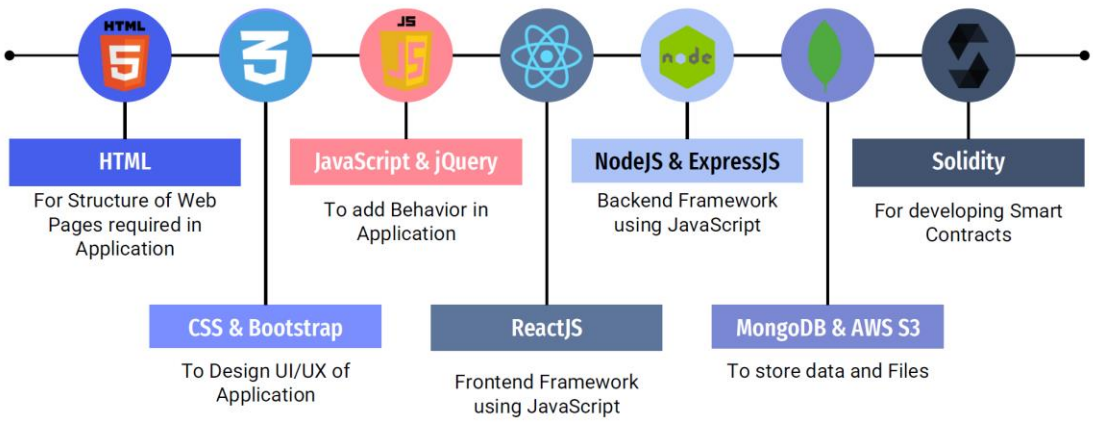


Figure 4: Tools & Technologies Used

2. 1. 2. Hardware Interfaces

The system has no proper hardware interface requirements expect some basic requirements.

2. 1. 3. Software Interfaces

- NodeJS Server v16.16.0. The system must use NodeJS Server which helps in maintaining connection database. This server also facilitates Email and SMS Communication and it also helps in generation of PDF Cards using PDF-Lib library. Communication with the DB is through API Calls. The system must provide No-SQL database through Mongoose Library.
- Client (Web Browser). The client (voter as well admin) requires a latest web browser which helps in communication with the server through API calls.
- MongoDB Database. This system used MongoDB NO-SQL (key-value based) database which are linked with server through mongoose.
-

2. 1. 4. Communications Interfaces

This system used https protocol for the communication between client and server. Our server is hosted in a NodeJS Web Hosting which performs task when the API Calls.

When a client wants to execute a task then web browser (from client) calls a respective API as the result of that respective API server can do a task and a response to returned to client web browser and a valid result is shown on browser window as an output.

2. 1. 5. Memory Constraints

This system has certain memory constraints which were:

i. For the System it requires a client latest web browser latest run properly.
ii. AWS S3 has limitations of 10 GB Files Storage
iii. MongoDB Atlas has a storage limit of upto 500MB
iv. Size of NodeJS Server should be less than 1GB.

2. 1. 6. Operations

The normal and special operations required by the user such as:

(1) User must wait for server to becomes active and status is available to them.

(2) The user must login properly in that System and Login session will be of only 15min within that user must complete their tasks.
(3) User must check their mails specially in Junk Mails.
(4) User will follow on-screen instructions to cast their votes.

2. 1. 7. Site Adaptation Requirements

The system is deployed in Online Hosting Provider which does not require any adaptation and additional hardware. This server is hosted in online Hosting provider which does not require server hardware management and no space and cooling of server is required.

Record entry does not require a special procedure it inserts records based on the DB Schema and no any other purchase software is required.

2. 2. Product Functions

This system level is divided into two view (i) Voter View and (ii) Admin View

The major functions available in Voter's view are:

i. Signup and Login
ii. Apply for new Voter and Track its Status
iii. Download their voter ID card
iv. Check His/her voting History
v. Cast their Votes
vi. Check Result of the election once election completed
vii. View Election Information.

The major functions available in Admin's View are:

i. Voter Management (i.e Voter addition and voter approval)
ii. Election Management (Add, Update and delete)

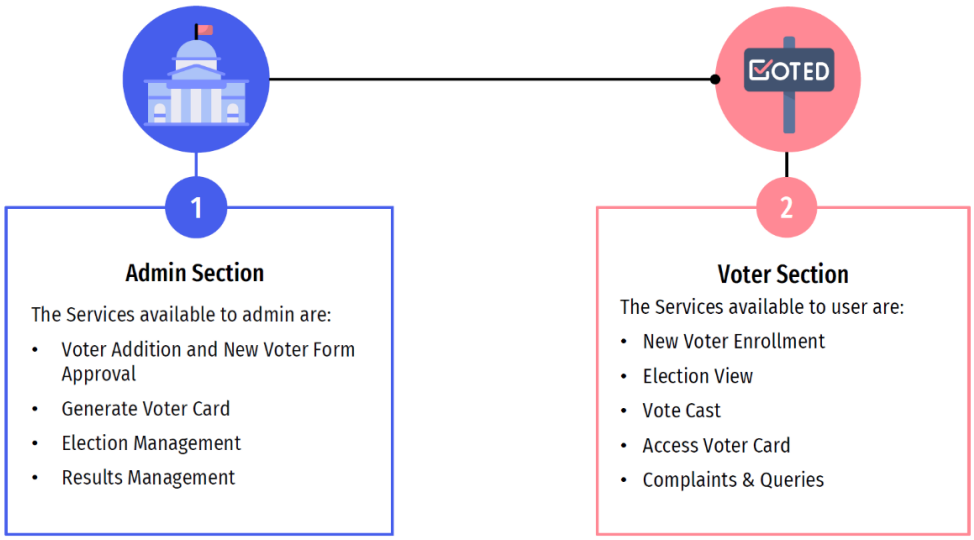


Figure 5: Level of Users

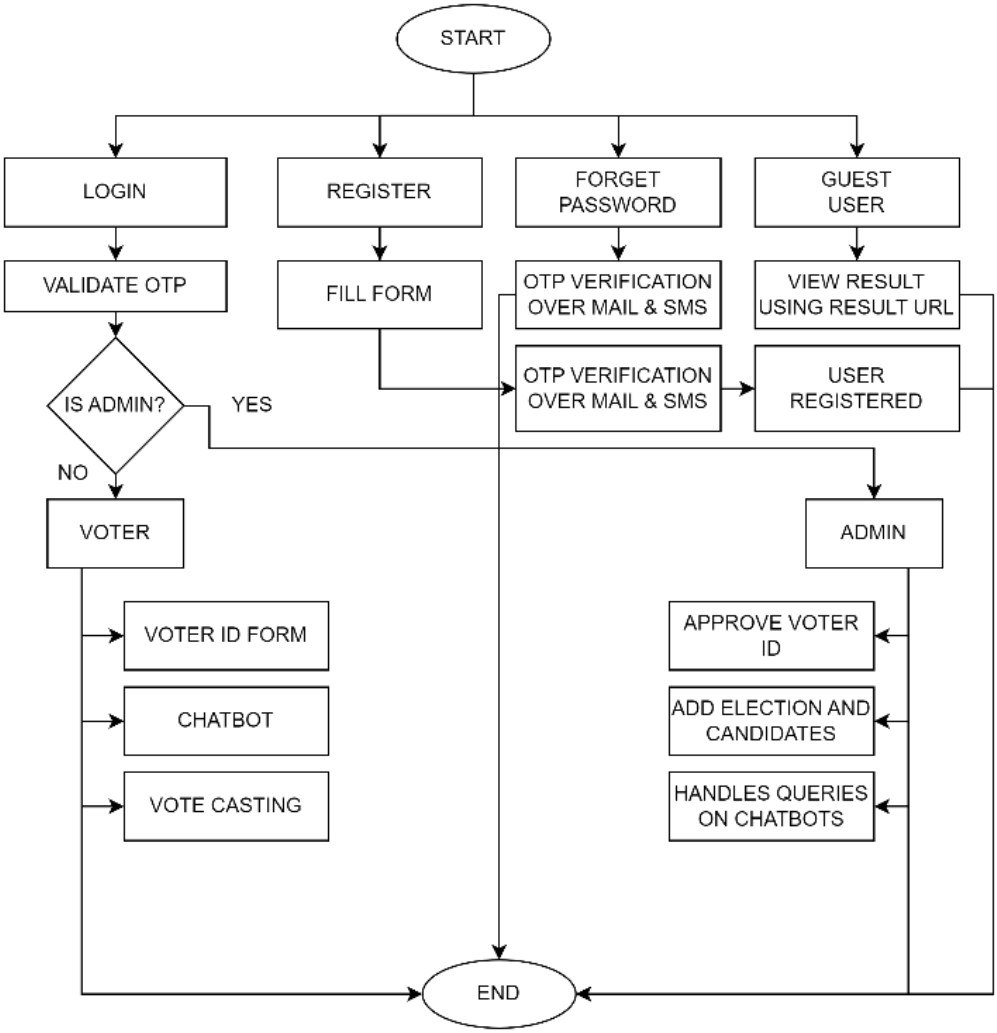


Figure 6: System Functions

2. 3. User Characteristics

To use this system voter/ User must have basic requirements or characteristics:

i. User must be a registered voter (Generated after approval from the admin)
ii. The User must have a valid email and phone for communication.
iii. The user must have basic knowledge about computer fundamentals.

2. 4. Constraints

The main constraints in this system are:

(1) The Free database (MongoDB) has a certain limit of 512 MB.
(2) The file storage AWS S3 has also limit of 10GB.
(3) The Free server hosting makes our server sleep so that it takes some time in seconds to start server till than API calls does not work.
(4) The admin panel is accessed by Admin Email Address with Password and OTP.

2. 5. Assumptions and Dependencies

The above SRS requirements are also affected by various factors. While considering that this system has some dependencies and assumptions taken into consideration.

Assumptions:

i. Each voter has a valid Email and Phone no for authentication.
ii. Each voter has an internet accessed Device (i.e., Mobile Phone or a computer)
iii. Voter has a good Internet Connectivity.
iv. The system should be user-friendly so that it is easy to use for the users
v. This Application is Error Free

Dependencies:

i. Database and File Storage is limited so it can’t be scalable but it can be scalable with Money.
ii. SMTP Mail API has a limit of 200 Mails per Day.
iii. Free Mobile SMS API has a certain limit and can be send to registered mobile number.
iv. AWS S3 Free Plan is valid only for 12 Months after that it starts money.
v. Free NodeJS Server hosting has also limits of 750hrs (Render Hosting) and it makes server offline to save time.

2. 6. Apportioning of Requirements.

The basic requirements that may be delayed until future versions of the system but if I look at the projects plan are:

i. Proper functioning of elections (like as a Lok Sabha and a Vidhan Sabha elections)
ii. Proper decentralized model of projects

2. 7. Use case Diagram

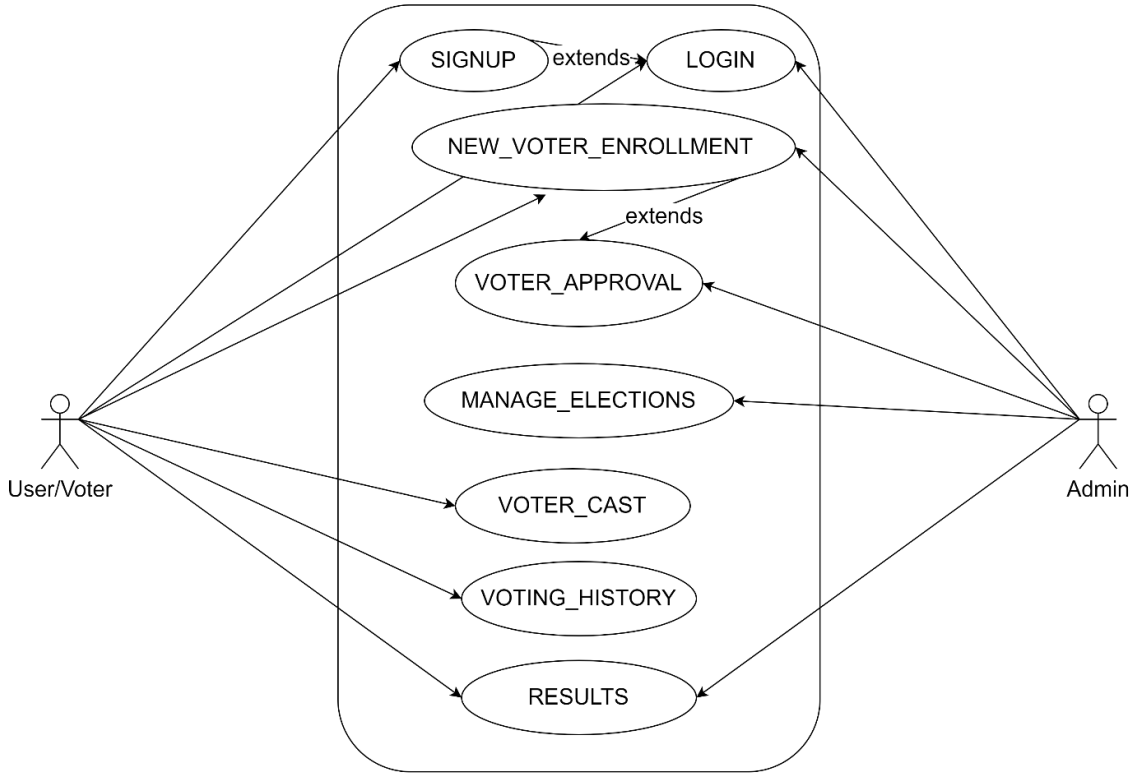


Figure 7: Use Case Diagram for E Voting

The main stakeholder of this system are:

- **Election authority:** It includes authority who has given task to conduct free & fair election. There may be other statutory bodies as well, such as the legislative institutions themselves, security organizations, or local governments that have some responsibility to support election preparations.

- **The contestants:** It includes person who may take direct part in the election which may be belong from a party as well as a group and the main reason to conducting election is to choose a good candidate among all contestants.

- **The electorate or Voter:** It includes the person who have right to votes. It also includes the election authority members as well as contestants. These have a certain eligibility criterion those who have passed that criteria will have the right to vote.

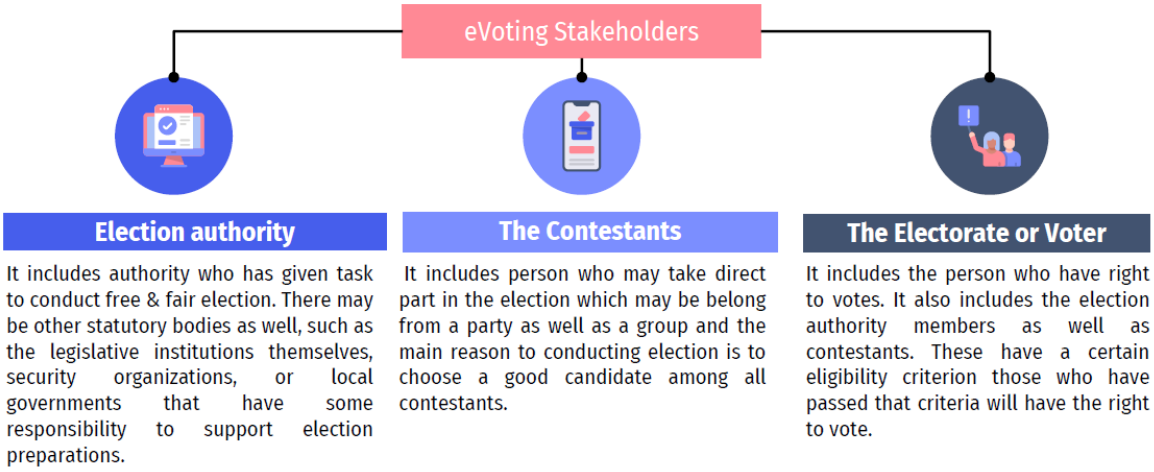


Figure 8: Stakeholders of the Projects

2. 8. Sequence Diagrams

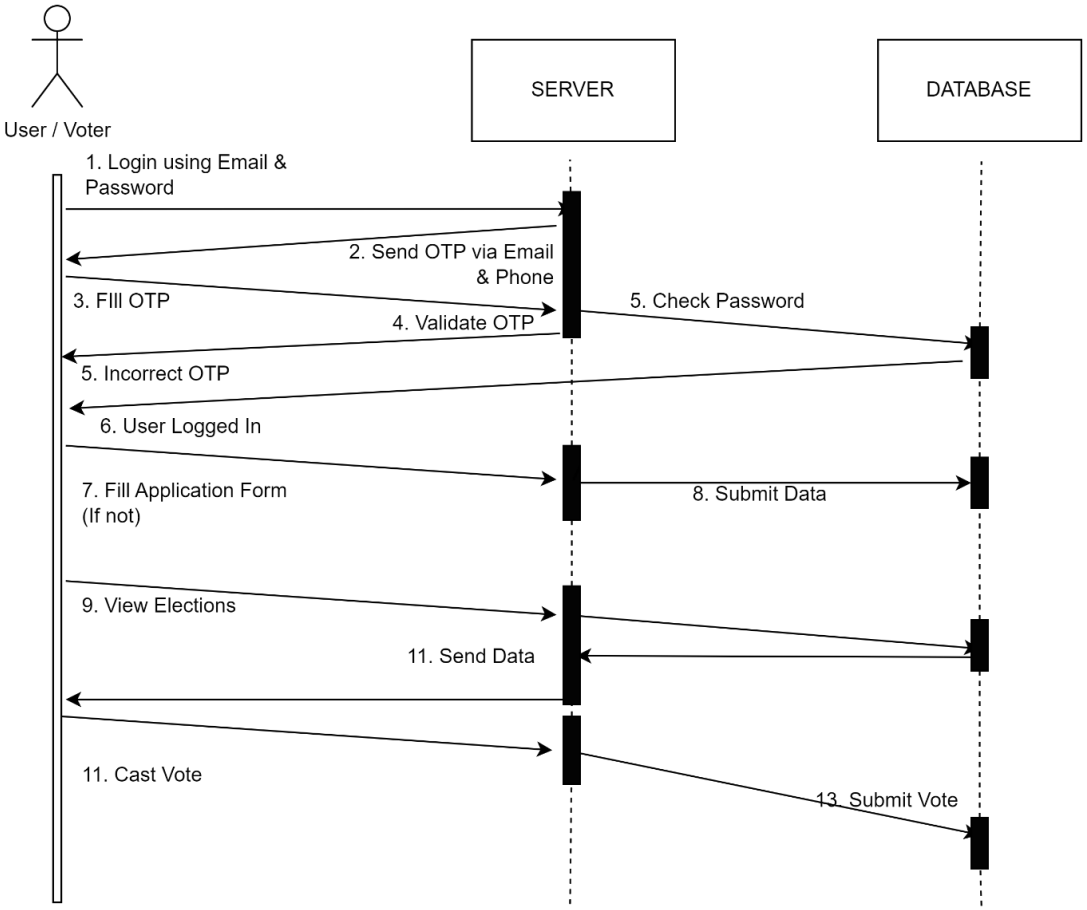


Figure 9: Sequence Diagram for Voter

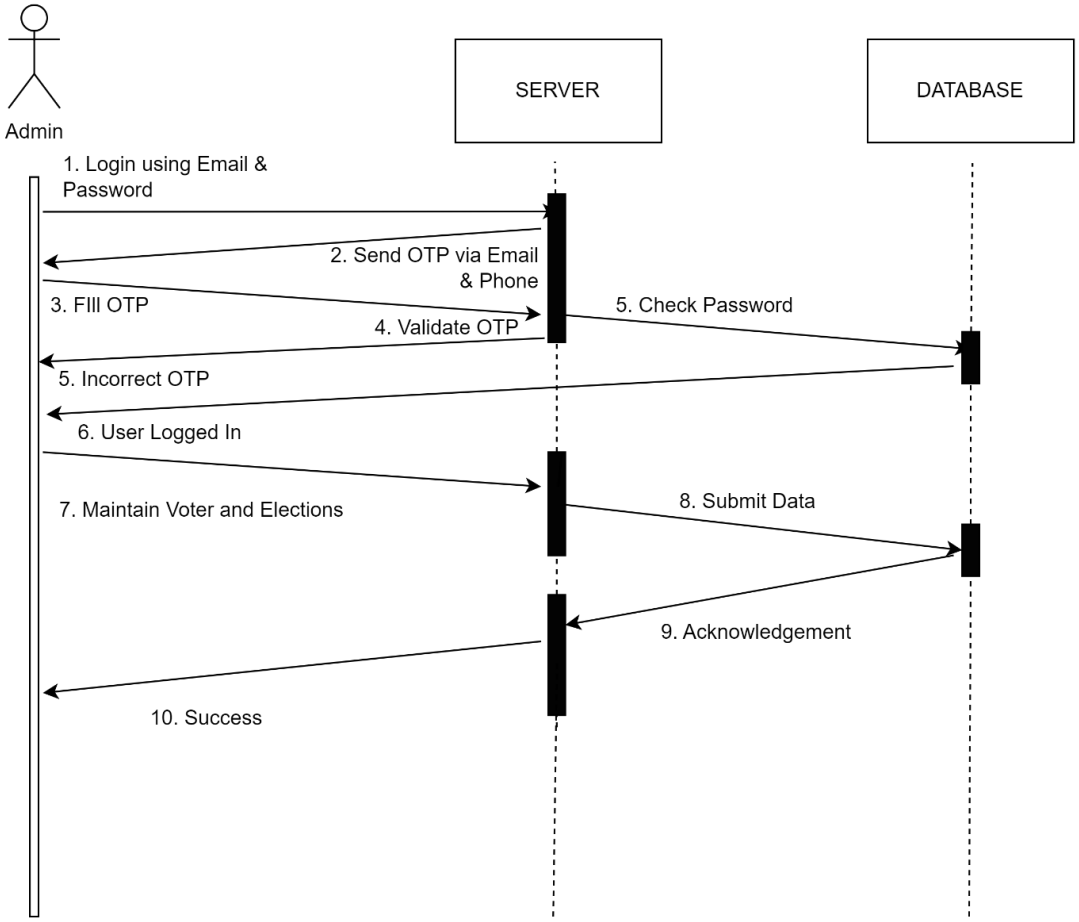


Figure 10: Sequence Diagram for Admin

CHAPTER 3

SYSTEM DESIGN

3. 1. Architecture Diagrams

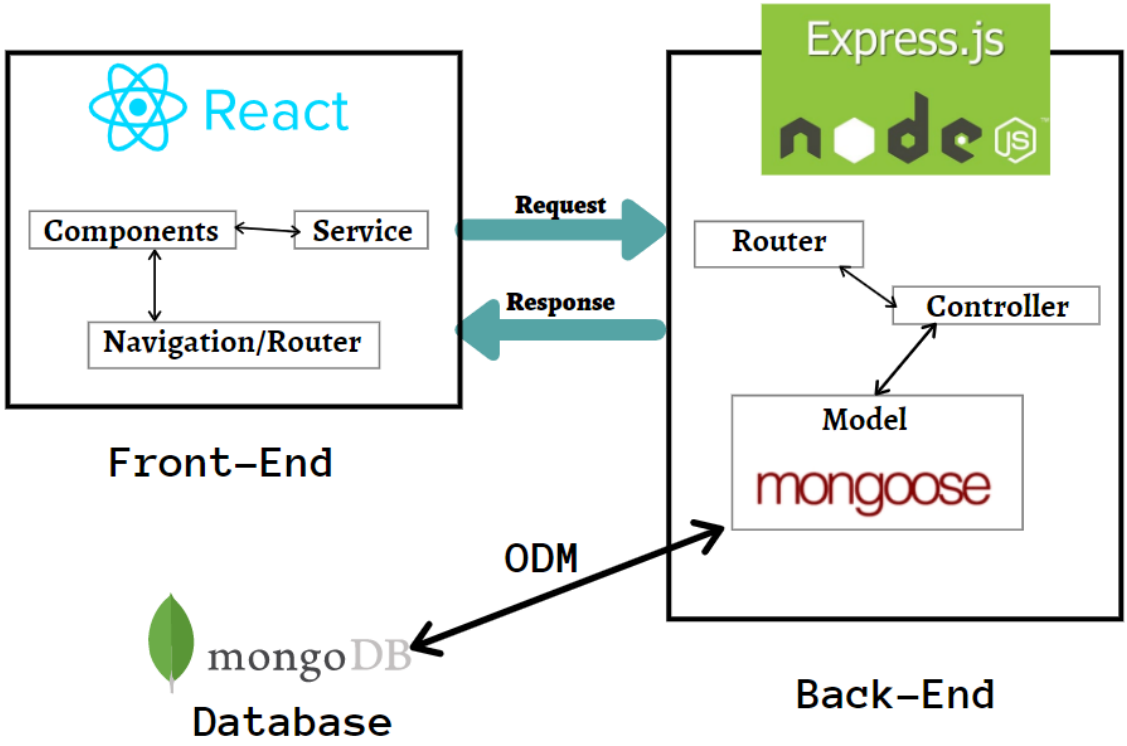


Figure 11: Architecture Diagram for E Voting

3. 2. Data Flow Diagram

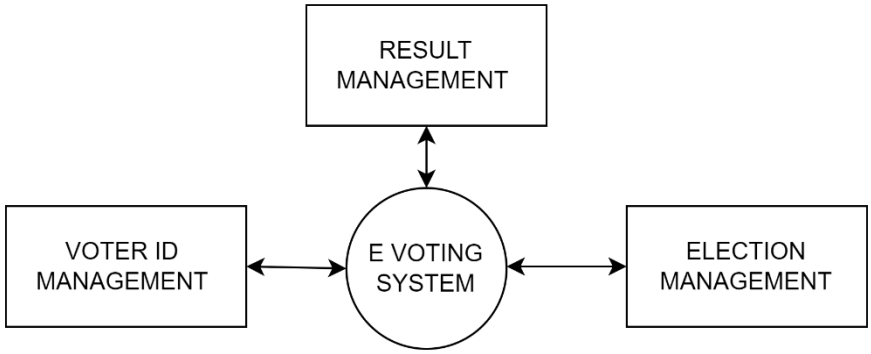


Figure 12: Zero Level DFD for E Voting

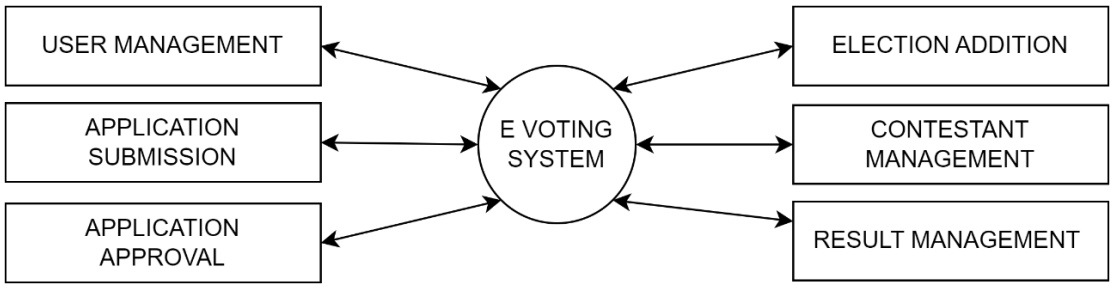


Figure 13: One Level DFD for E Voting

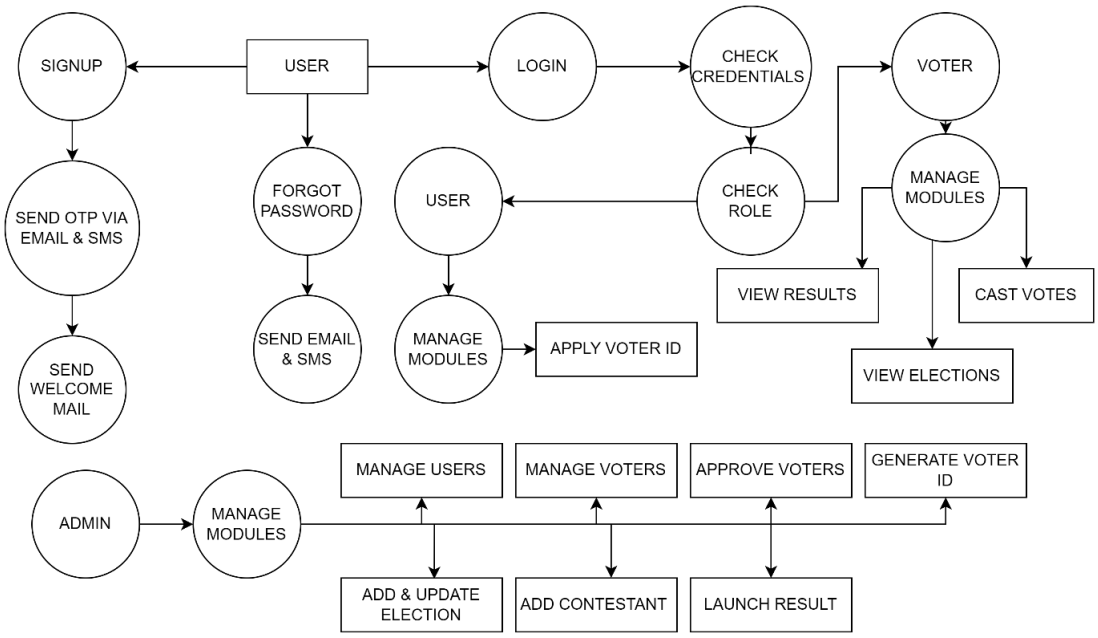


Figure 14: Second Level DFD for E Voting

3. 3. Activity Diagram

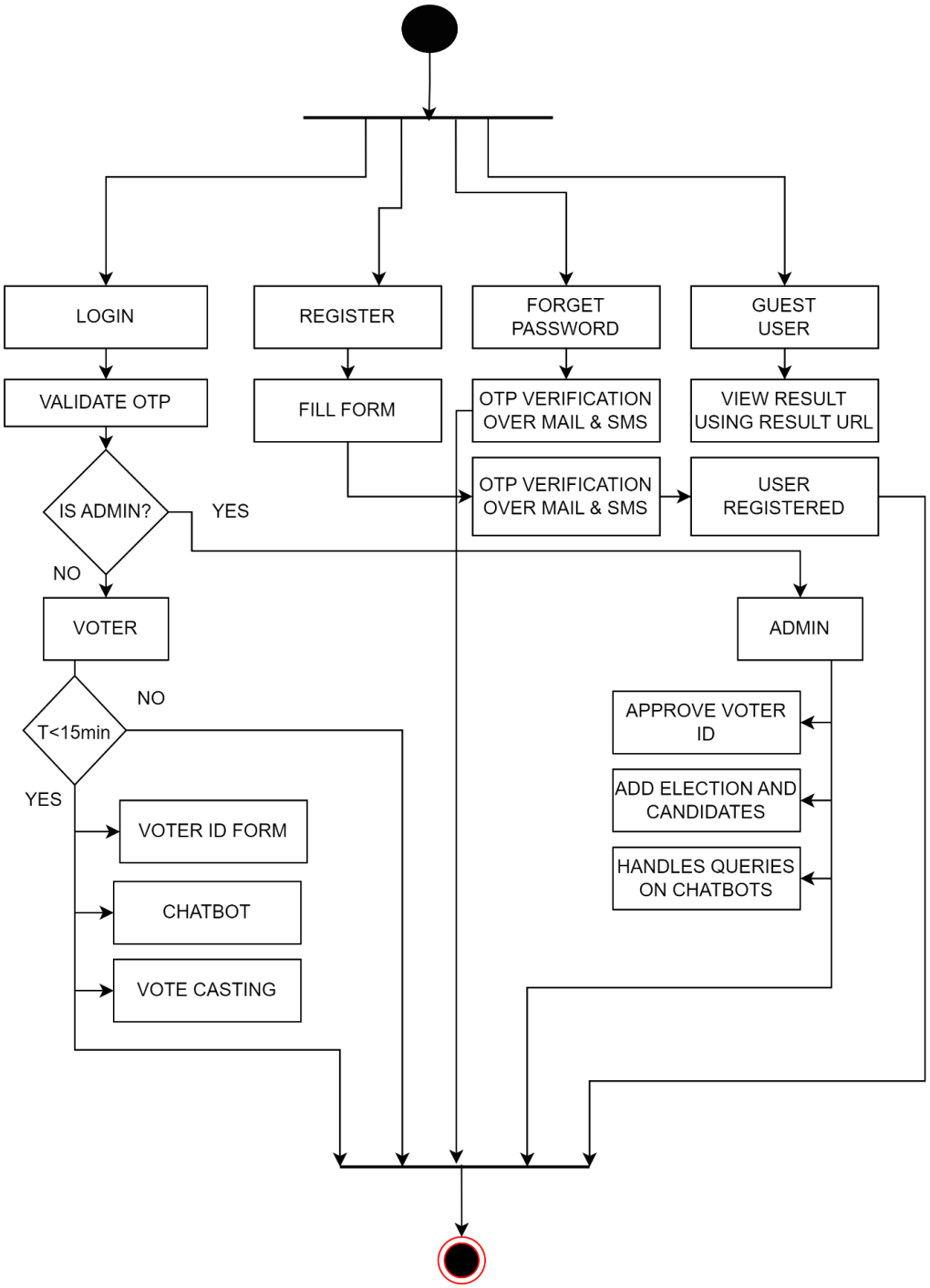


Figure 15: Activity Diagram for E Voting

3. 4. ER Diagrams

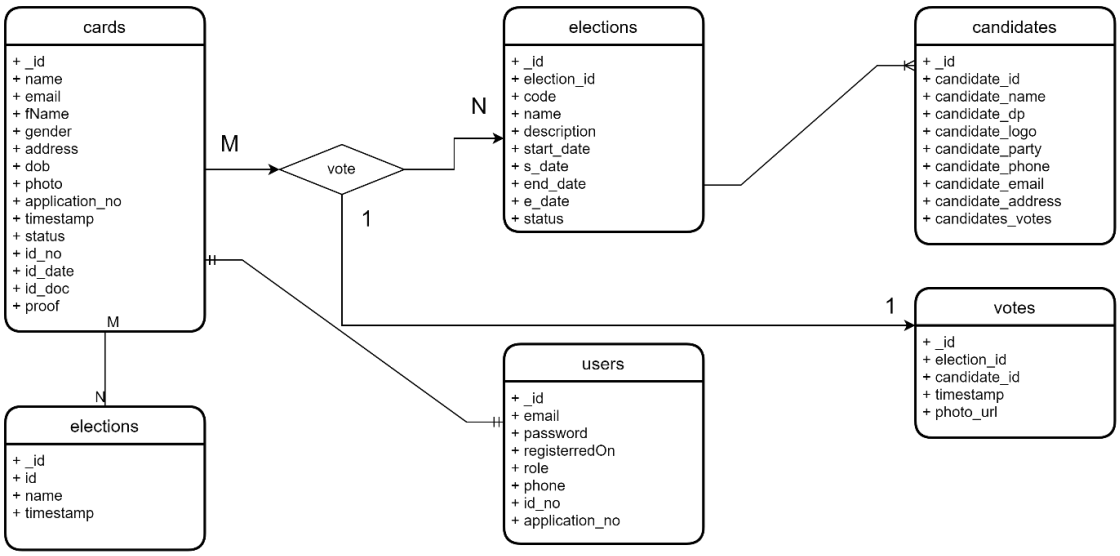


Figure 16: ER Diagram for E Voting System

3. 5. Database schema diagrams

3. 5.1 Users

```
name: { type: String, },
phone: { type: String, },
email: { type: String},
password: { type: String, },
registeredOn: { type: String },
role: { type: String },
id_no: { type: String },
application_no: { type: String },
```

Figure 17: Database Schema for Users Entity

3. 5.2 Cards

```
name: { type: String },
email: { type: String },
fName: { type: String },
gender: { type: String },
phone: { type: String },
address: { type: String },
dob: { type: String },
photo: { type: String },
application_no: { type: String },
timestamp: { type: String },
status: { type: String },
id_no: { type: String },
id_date: { type: String },
id_doc: { type: String },
proof: { type: String },
elections: [
  {
    id: { type: String },
    name: { type: String },
    timestamp: { type: String },
  },
],
```

Figure 18: Database Schema for Cards Entity

3. 5.3 Votes

```
election_id: { type: String },
candidate_id: { type: String },
timestamp: { type: String },
snapshot: { type: String },
```

Figure 19: Database Schema for Votes Entity

3. 5.4 Elections

```
election_id: { type: String },
code: { type: String },
name: { type: String },
description: { type: String },
start_date: { type: String },
s_date: { type: String },
end_date: { type: String },
e_date: { type: String },
status: { type: String },
candidates: [
  {
    candidate_id: { type: String },
    candidate_name: { type: String },
    candidate_dp: { type: String },
    candidate_logo: { type: String },
    candidate_party: { type: String },
    candidate_phone: { type: String },
    candidate_email: { type: String },
    candidate_address: { type: String },
    candidate_votes: { type: Number },
  },
],
```

Figure 20: Database Schema for Elections Entity

CHAPTER 4

IMPLEMENTATION AND RESULTS

4. 1. Software and Hardware Requirements

Hardware Requirements:

This Basic Hardware Required to develop and run this trustworthy system are:

- Processor: Minimum 1.6 GHz; Recommended 2GHz or more
- Ethernet connection (LAN) OR a wireless adapter (Wi-Fi)
- Hard Drive: Minimum 32 GB; Recommended 64 GB or more
- Memory (RAM): Minimum 1 GB; Recommended 4 GB or above
- Hosting:
- Backend: Recommended Online Server with NodeJS Environment like Localhost, Heroku, Cyclic etc.
- Frontend: Recommended Online Hosting like Vercel, Firebase, GitHub Pages, Firebase etc.

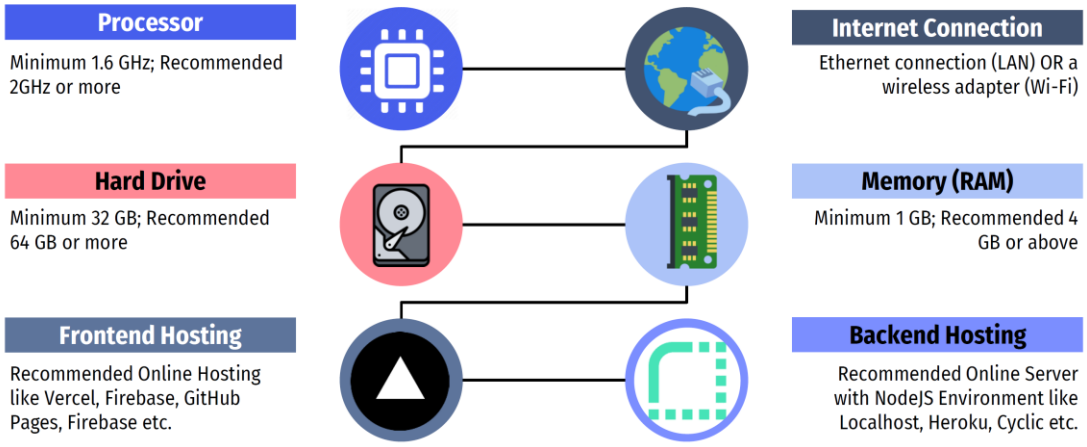


Figure 21: Hardware Requirements

Software Requirements:

This Basic Hardware Required to develop and run this trustworthy system are:

- Operating System:
  OS X El Capitan (10.11+)
  Windows 8.0, 8.1 and 10, 11 (32-bit and 64-bit)
  Linux (Debian): Ubuntu Desktop 16.04, Debian 9
  Linux (Red Hat): Red Hat Enterprise Linux 7, CentOS 7, Fedora 34

- Web Browser (Latest version of Google Chrome, Microsoft Edge, Mozilla Firefox etc.).
- A Code Editor (Recommend VS Code by Microsoft)
- Git or GitHub Desktop
- Ganache PC App
- NodeJS Installed on System.

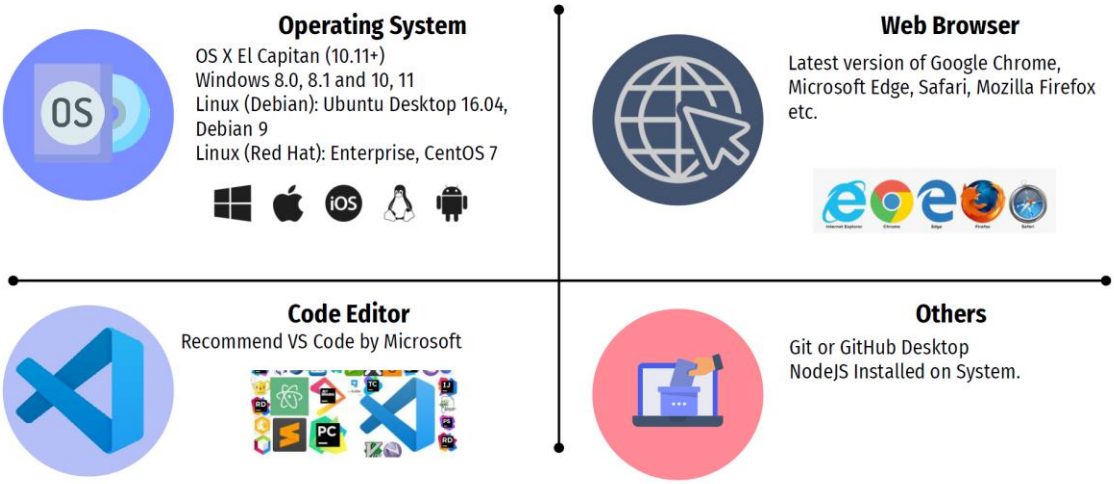


Figure 22: Software Requirements

4. 2. Assumptions and dependencies

Assumptions:

- Each voter has a valid Email and Phone no for authentication.
- Each voter has an internet accessed Device (i.e., Mobile Phone or a computer)
- Voter has a good Internet Connectivity.
- The system should be user-friendly so that it is easy to use for the users
- This Application is Error Free

Dependencies:

- Database and File Storage is limited so it can't be scalable but it can be scalable with Money.
- SMTP Mail API has a limit of 200 Mails per Day.
- Free Mobile SMS API has a certain limit and can be send to registered mobile number.
- AWS S3 Free Plan is valid only for 12 Months after that it starts money.
- Free NodeJS Server hosting has also limits of 750hrs (Render Hosting) and it makes server offline to save time.

4. 3. Constraints

The main constraints in this system are:

- The Free database (MongoDB) has a certain limit of 512 MB.
- The file storage AWS S3 has also limit of 10GB.
- The Free server hosting makes our server sleep so that it takes some time in seconds to start server till than API calls does not work.
- Ethereum Blockchain used is based on Ganache
- The admin panel is accessed by Admin Email Address with Password and OTP.

4. 4. Implementation Details

This section discusses the layout, creation, and functionality of the E-Voting application. Depending on their demands, both the admin and the user can utilize this application.

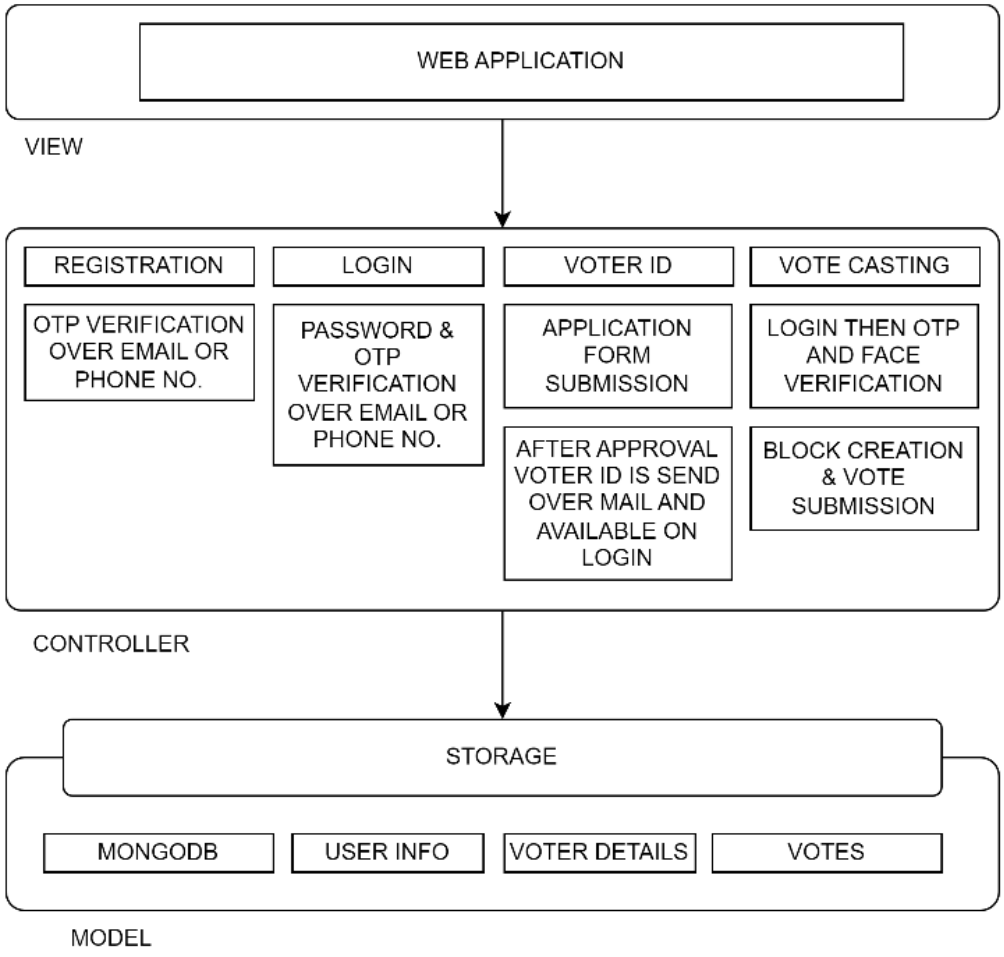


Figure 23: MVC Architecture of System

The program may be accessed from the host site by both the user and the administrator. The administrator can allocate an election or poll to the registered user and approve an application from a first-time voter. The user can vote and register to vote.

User-Driven Modules:

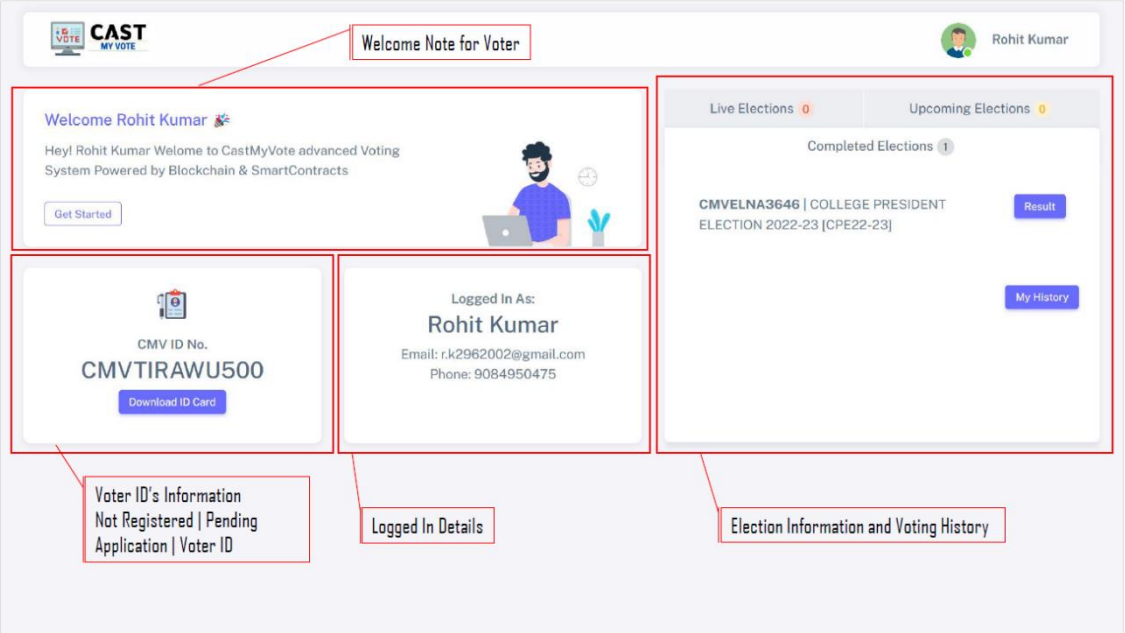


Figure 24: User Dashboard

Signup Module: By giving basic information such their name, phone number, email address, and password, voters can register themselves in this module. Once they have registered, voters can get an OTP through email when the system has generated a verified voter account for them.

Voter Registration Module: Voters may get their voter ID with this module by filling out a form with basic information including their DOB, address, and photo. The voter will receive an Application ID after submitting the form, which will show the status of the application. Additionally, they will get mail about the application, and it will appear on the voter dashboard.

Login Module: Voters can access all services in this module by logging into their accounts. The voter's registered email gets emailed an OTP when they submit their email address and password. The voter may access their dashboard if the OTP is confirmed, and a login token is produced with a 15-minute time restriction after which the voter will immediately sign-out.

Voter ID Module: The voter ID card is available via this module. An ID card may be made available once the registration form has been approved by the admin. The information described above is included on this voter card, which is in the.pdf file format, along with a Voter ID Card Bar Code for future use.

Voting Module: By choosing Election through Name and then a participant from the list that displays, voters in this module can cast their votes. The voter simply makes their selection and uploads their ballot with face verification using their registration photo, OTP verification, and voter selfie. Following the voter's vote's successful submission, a thank-you note was sent to them.

User Login > Choose Election (with Live Status) > OTP Verification over Mail and by SMS > Choose Candidate > Submit > Success.

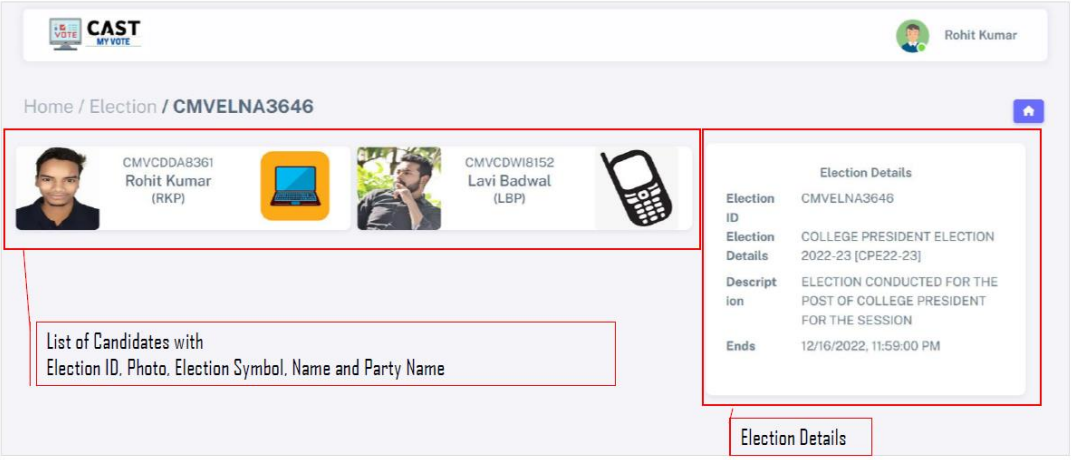


Figure 25: Voting Module

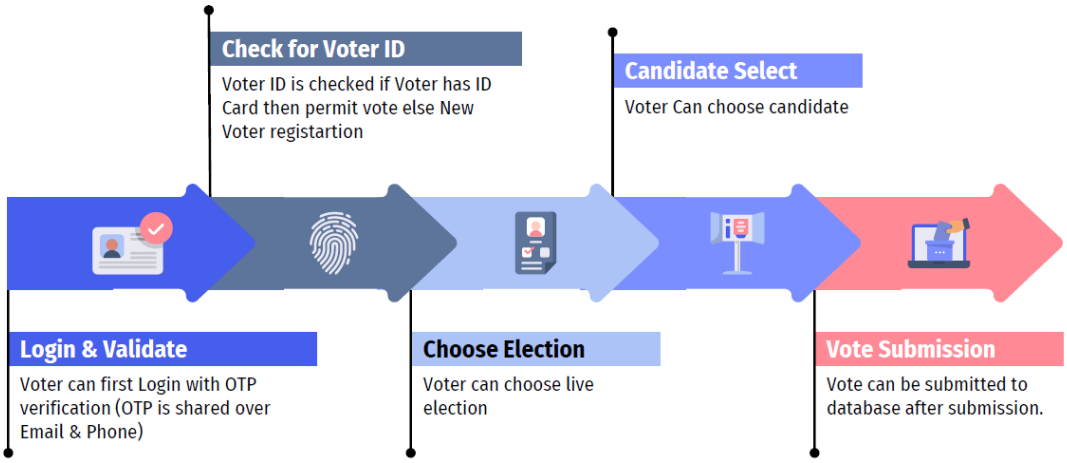


Figure 26: Voting Process

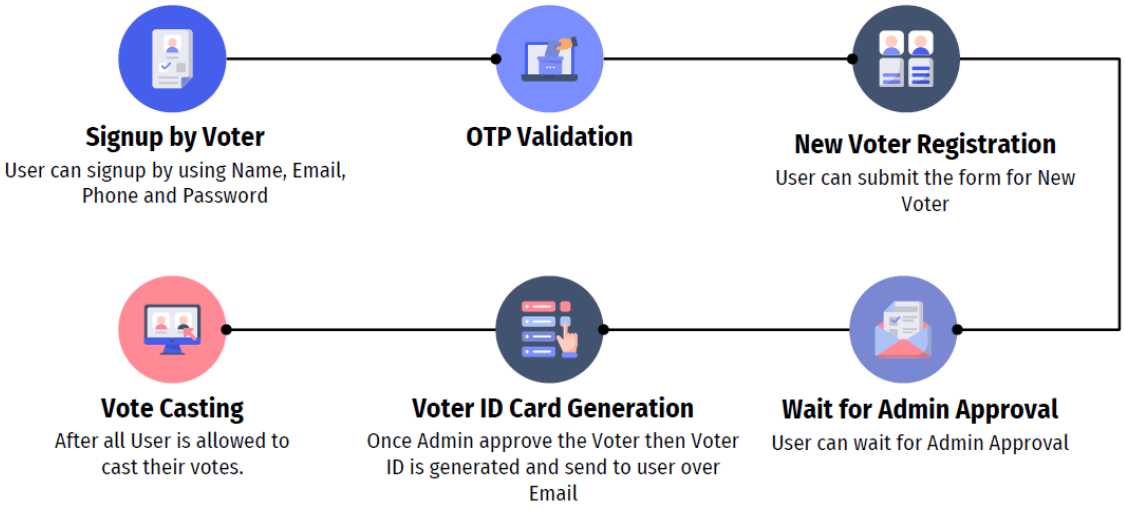


Figure 27: New Voter Process

Admin-Driven Modules:

In the following section, some admin-driven modules are described.

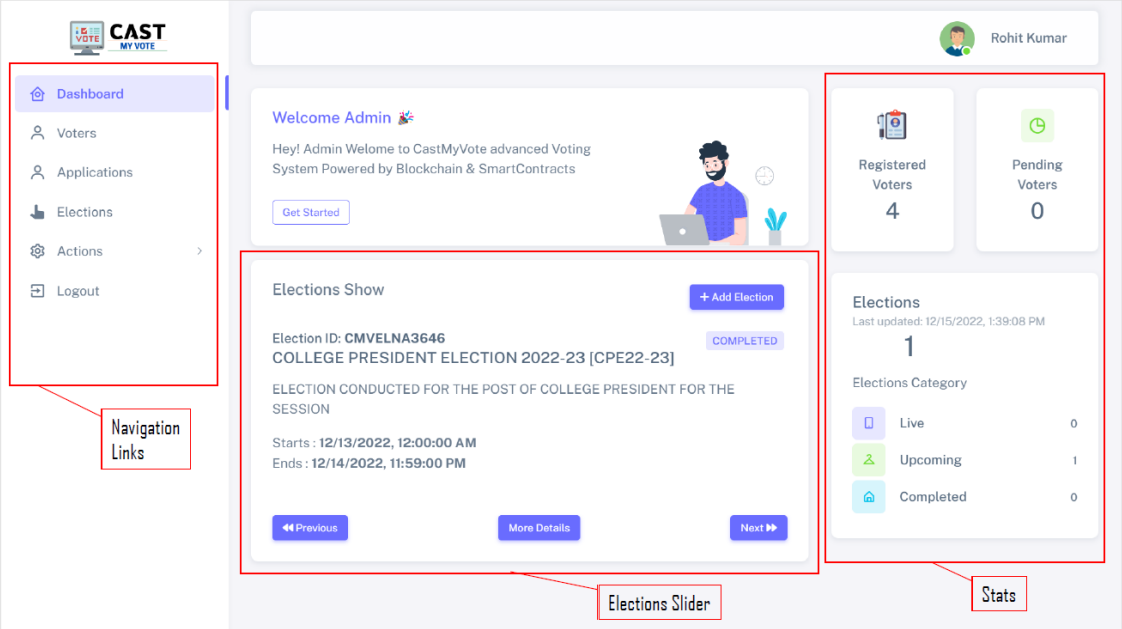


Figure 28: Snapshot of Admin Dashboard

Application Module: The Applications submitted by Users will be shown in this module, where Admin may examine the submitted form and any accompanying documents. A user may accept or reject the application from this point on. When an application is rejected, a trash mail is given to the user along with the rejection justification. When an application is granted, a new voter ID is issued, and the user is then able to cast a ballot after receiving an email with the voter ID attached as an attachment and an SMS with the relevant information.

Election Module: In this module, the administrator may make a new election with a name and a unique code after sending a voting invitation email to all voters with some basic election information and a link to the preliminary candidate list. After the election has been added, the administrator may add, update, and delete candidates up to the election's start time. Anyone cannot update election-related information once voting has begun. Applicants, etc.

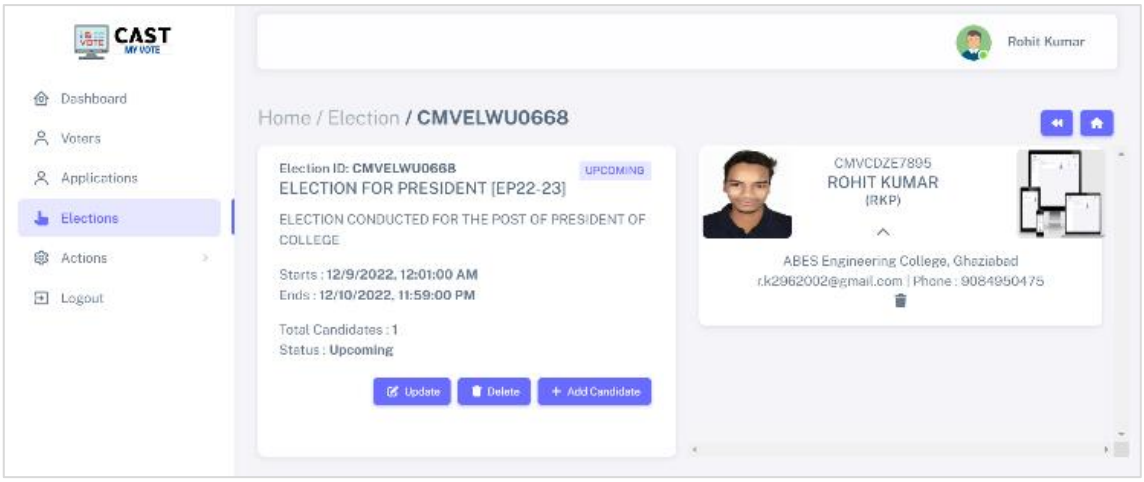


Figure 29: Snapshot of Election Module

Common Modules:

Result Module: This module prepares the election results. When the election is over, the system will check all the blocks on the blockchain network and tally the results. The results are shown on the administrator and voter login pages when all votes have been tallied, and a letter with the results is issued to everyone. The results are also displayed on the Results URL provided with the thank-you note for the election.

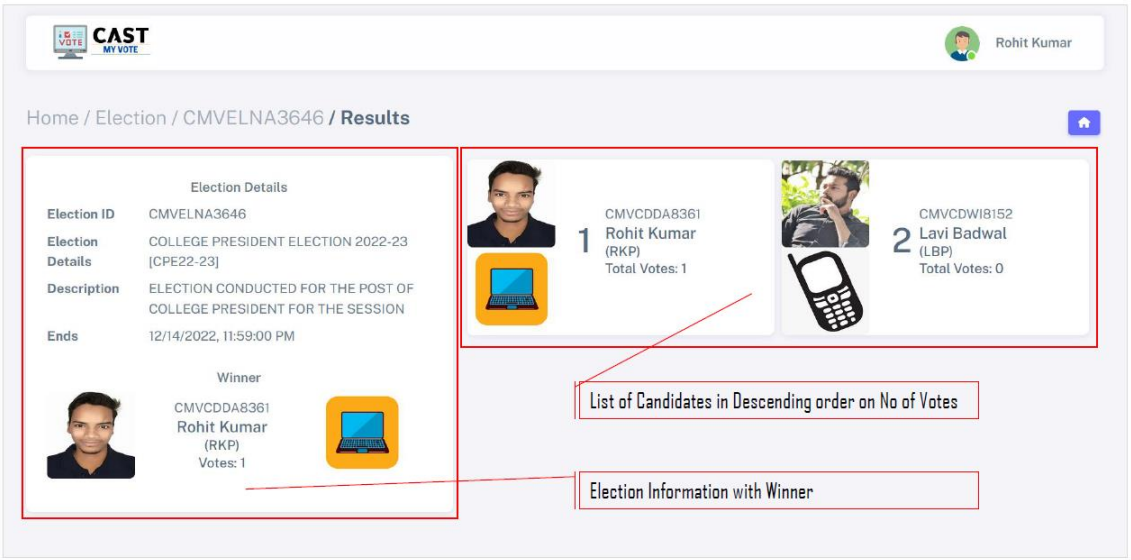


Figure 30: Results Module

Database: MongoDB Atlas, a non-SQL database, houses all of the records, including User Login Records, Voter IDs, and Election Details.

Authentication: OTPs can be used to validate admin and user logins and are used to increase system security. OTPs are necessary for a number of system functions.

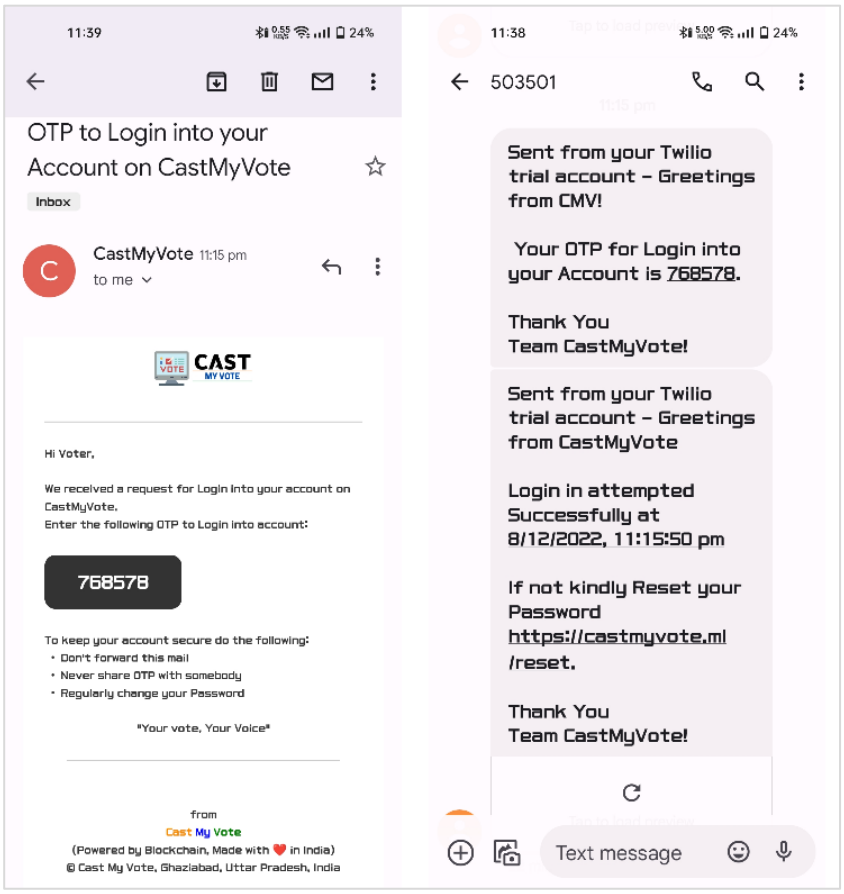


Figure 31: OTP Authentication

Blockchain Network: Blockchains set up in a decentralized network are used to store all voting-related data.

4. 4.1 Snapshots of Interfaces

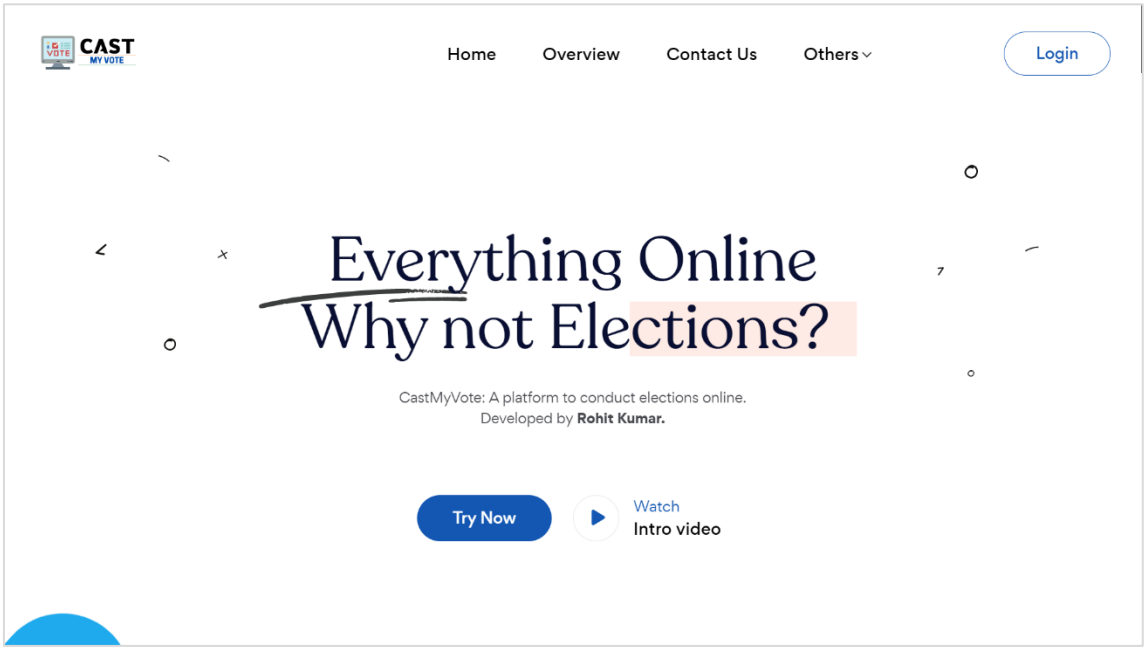


Figure 32: Snapshot for Landing Page

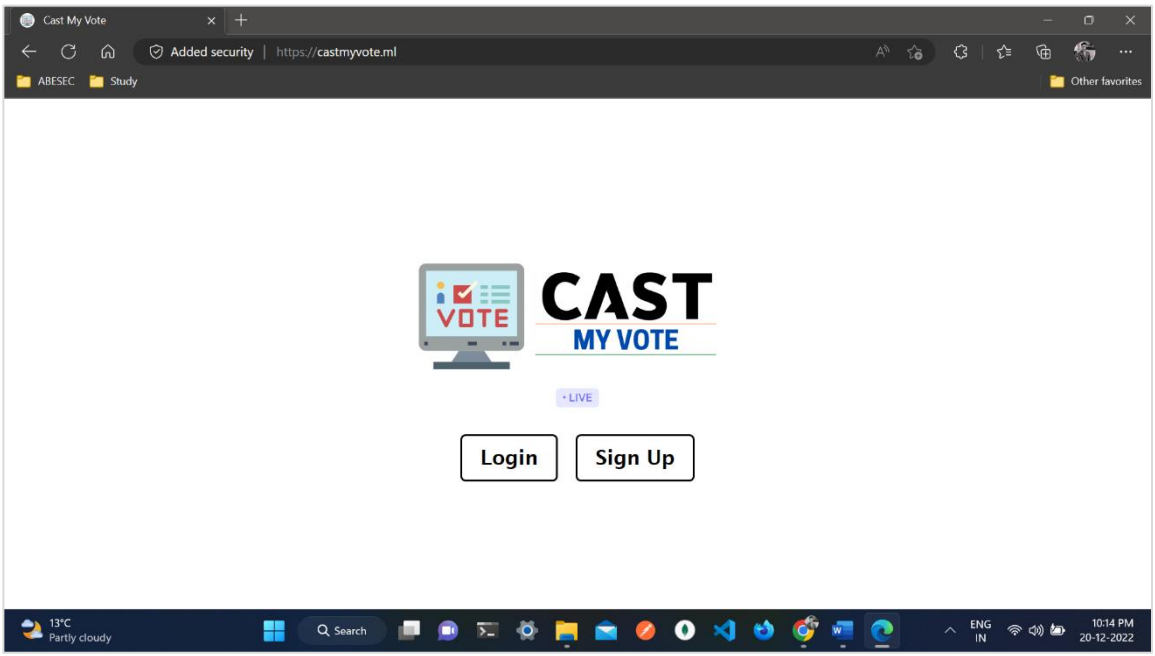


Figure 33: Snapshot for Home Page

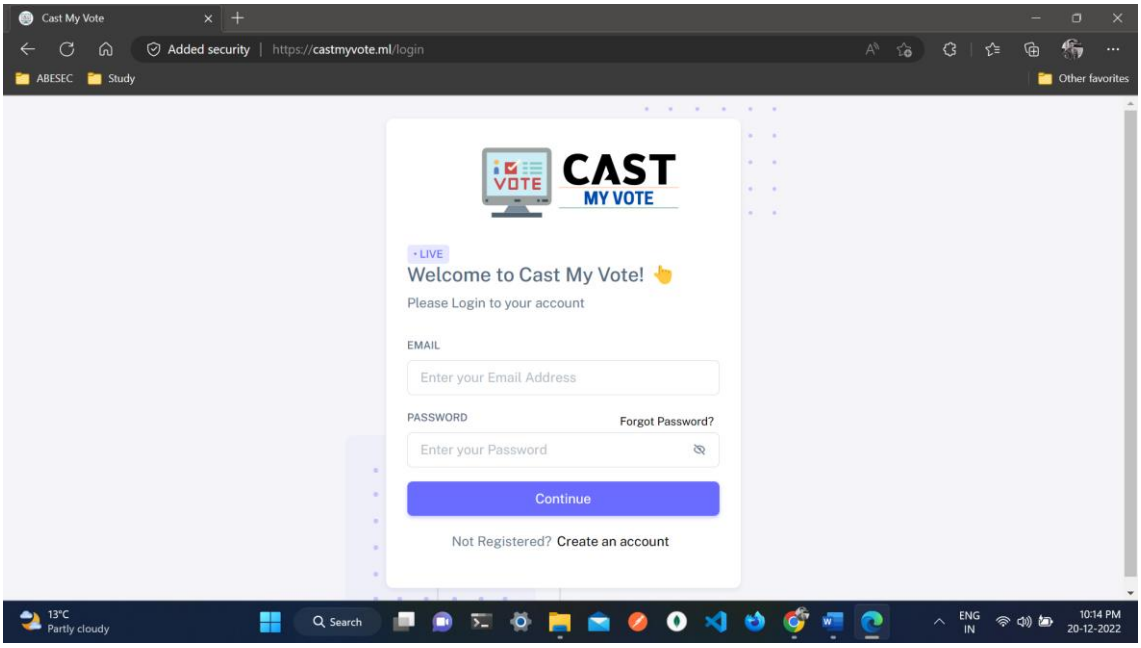


Figure 34: Snapshot for Login Page

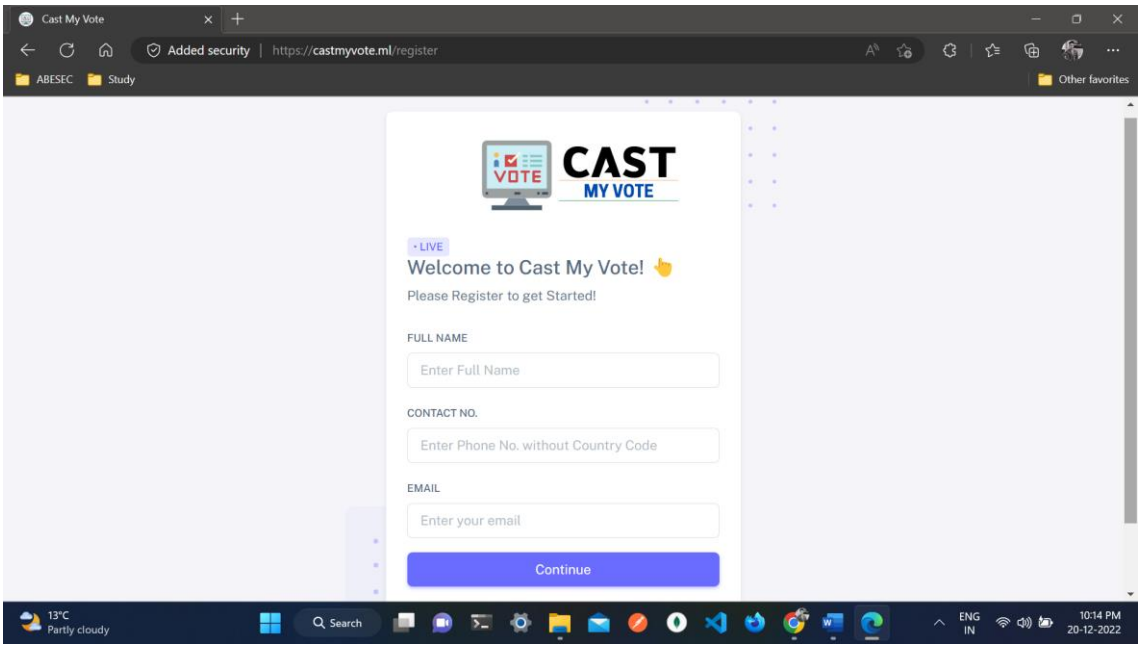


Figure 35: Snapshot for Signup Page for Voter

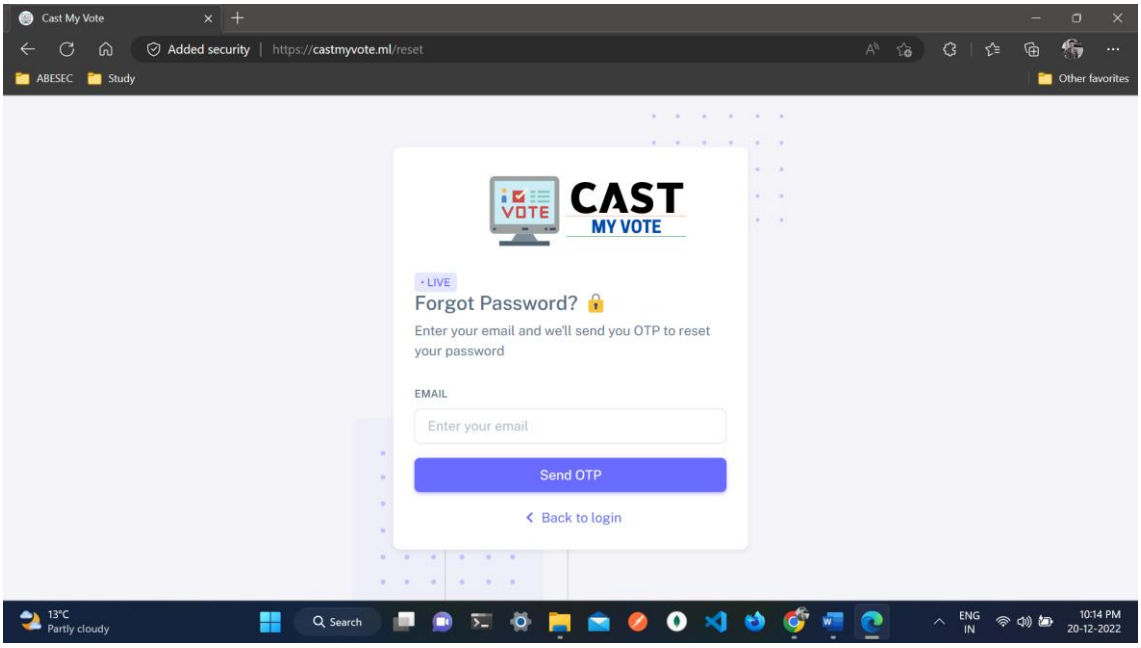


Figure 36: Snapshot for Forget Password Page

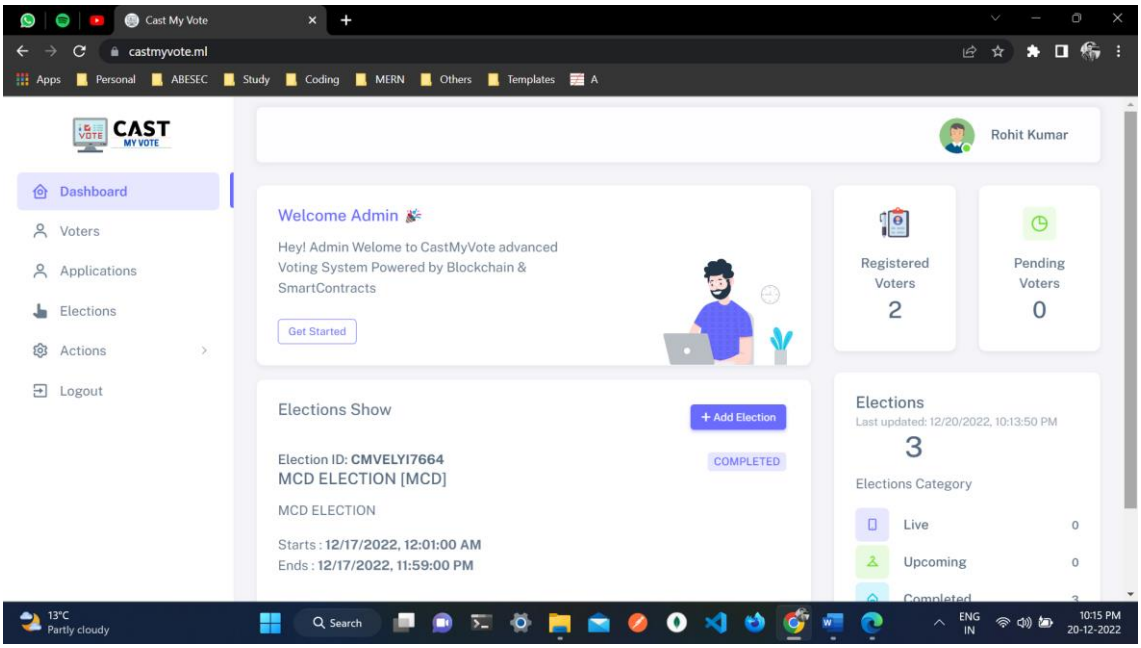


Figure 37: Snapshot for Admin Dashboard

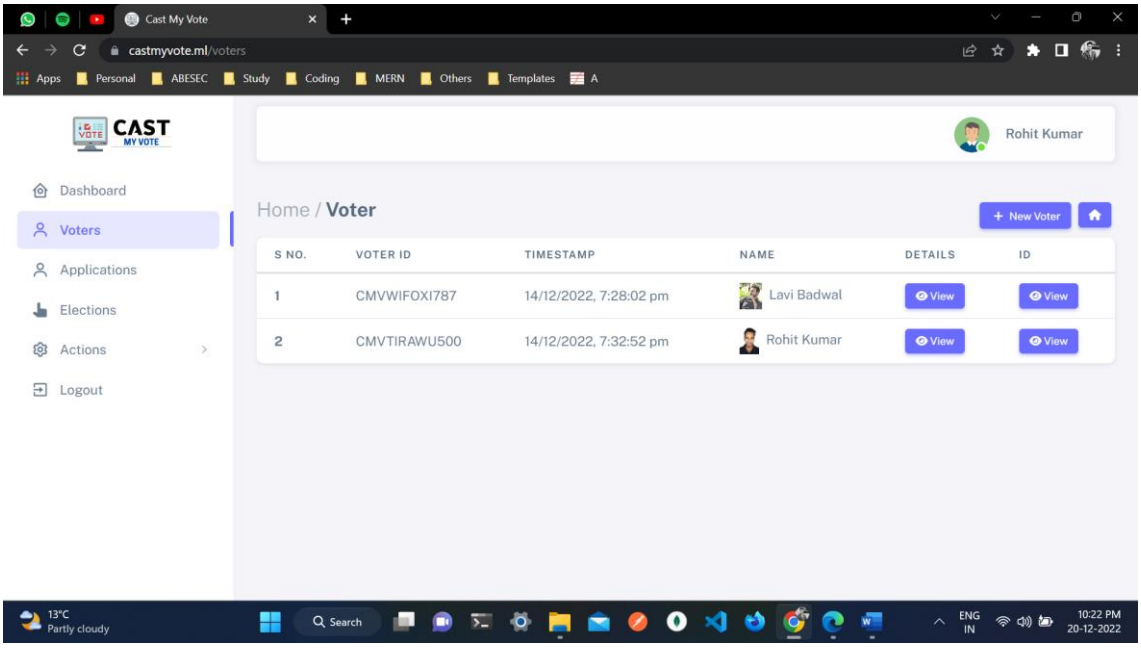


Figure 38: Snapshot for Voter's Record

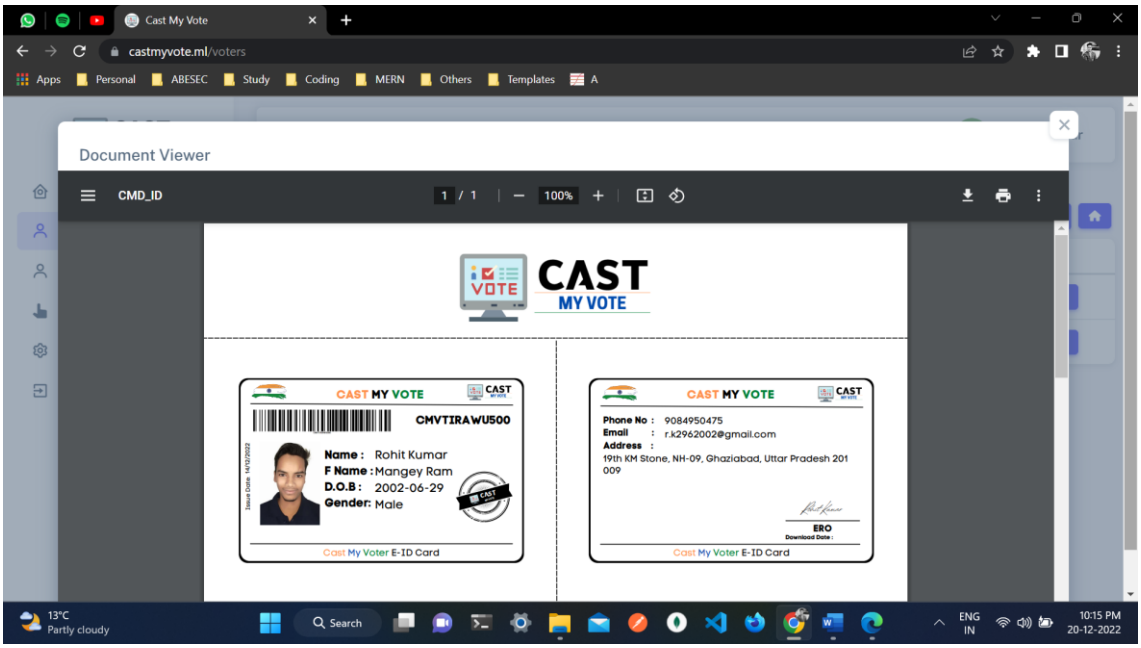


Figure 39: Snapshot for Voter ID Card Popup

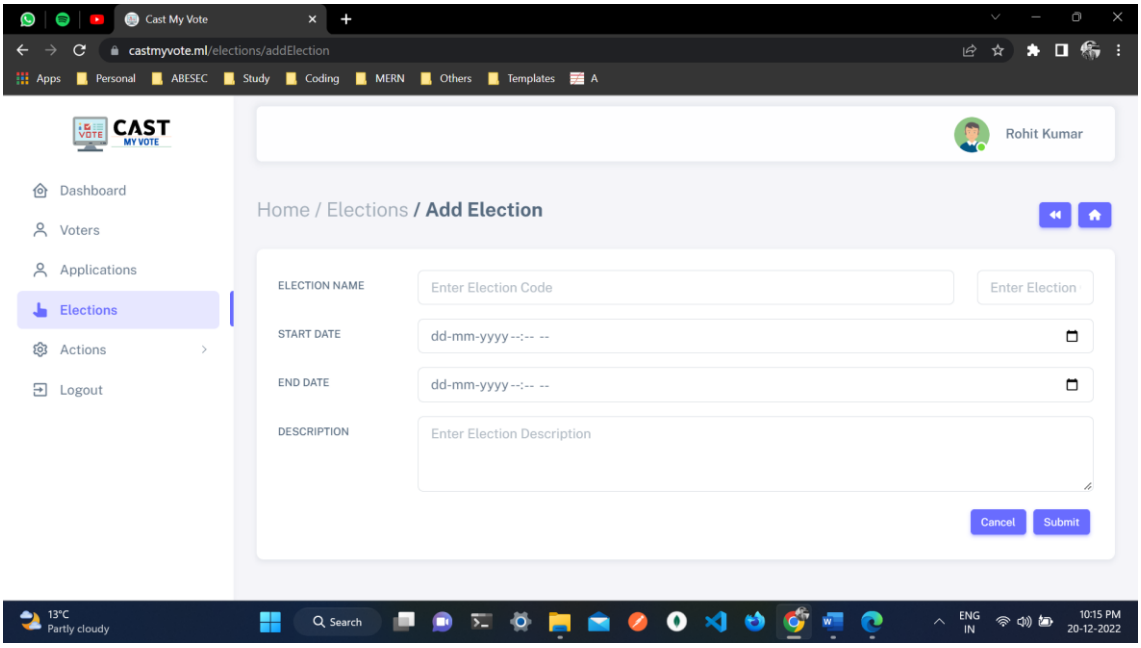


Figure 40: Snapshot for New Election Form Page

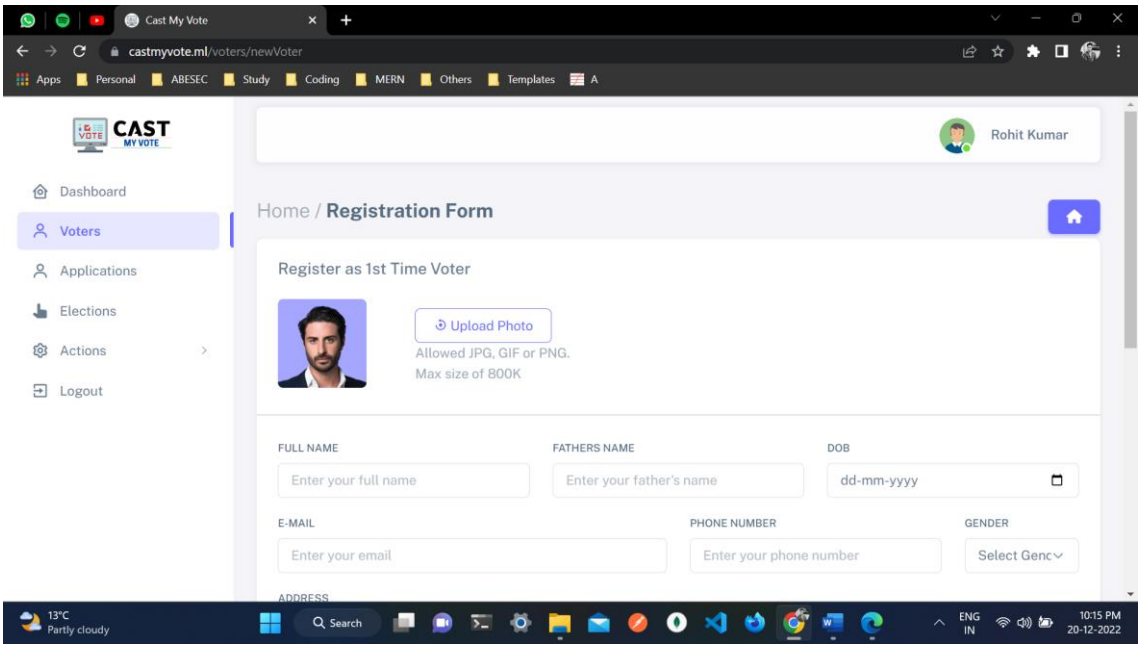


Figure 41: Snapshot for New Voter Form through Admin

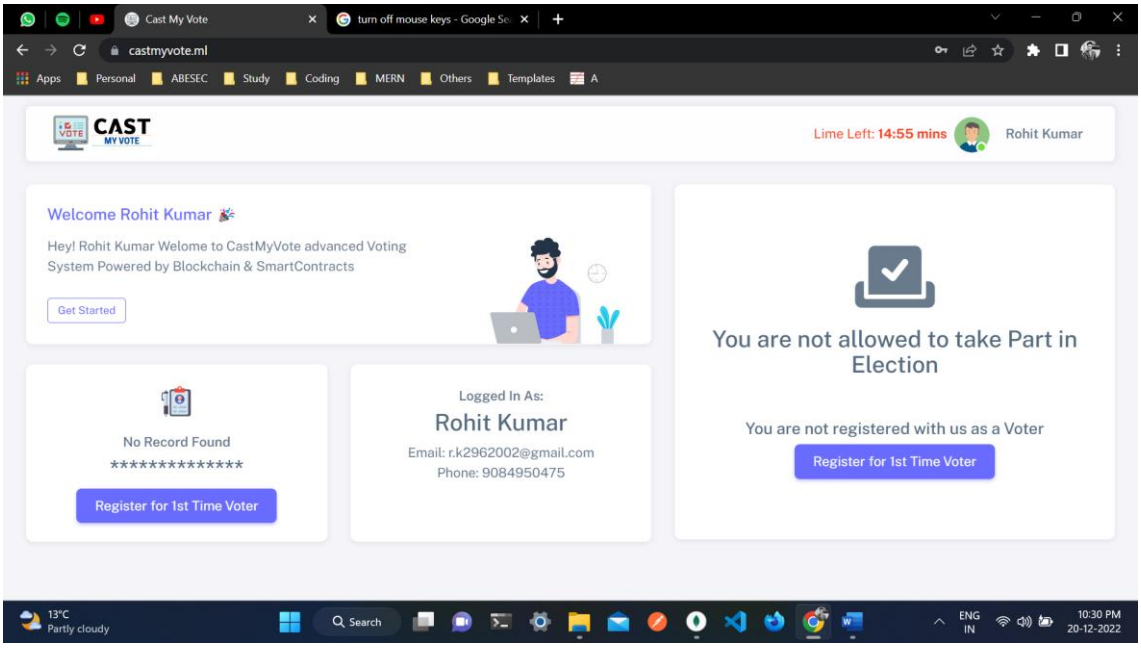


Figure 42: Snapshot for User Dashboard when Signup

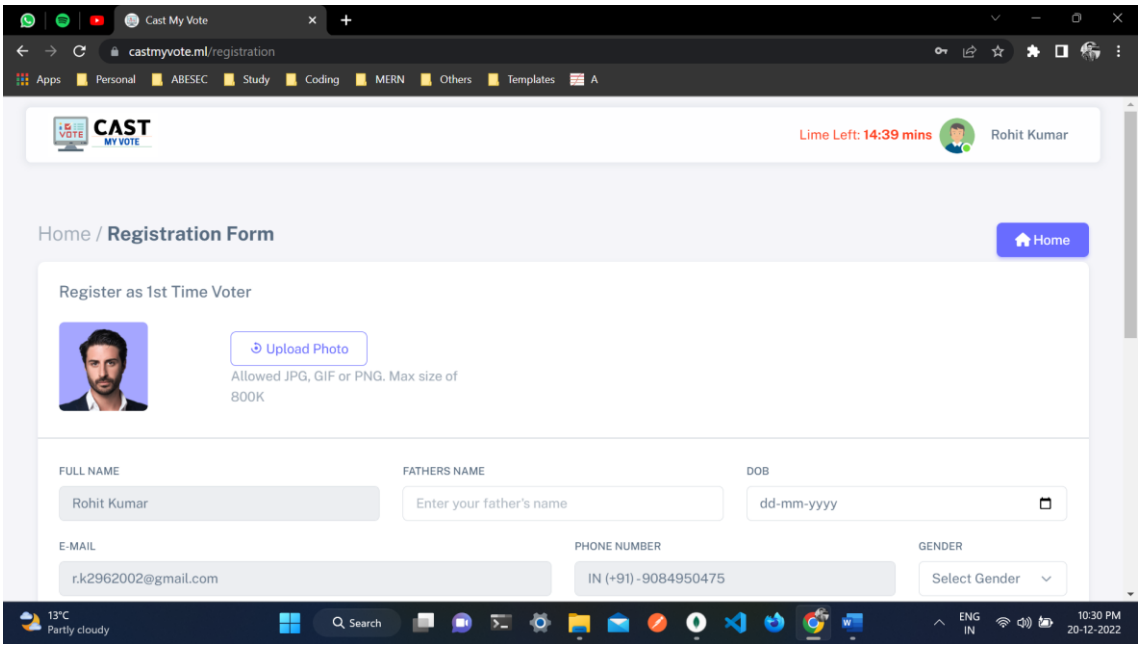


Figure 43: Snapshot for New Voter Enrollment Form

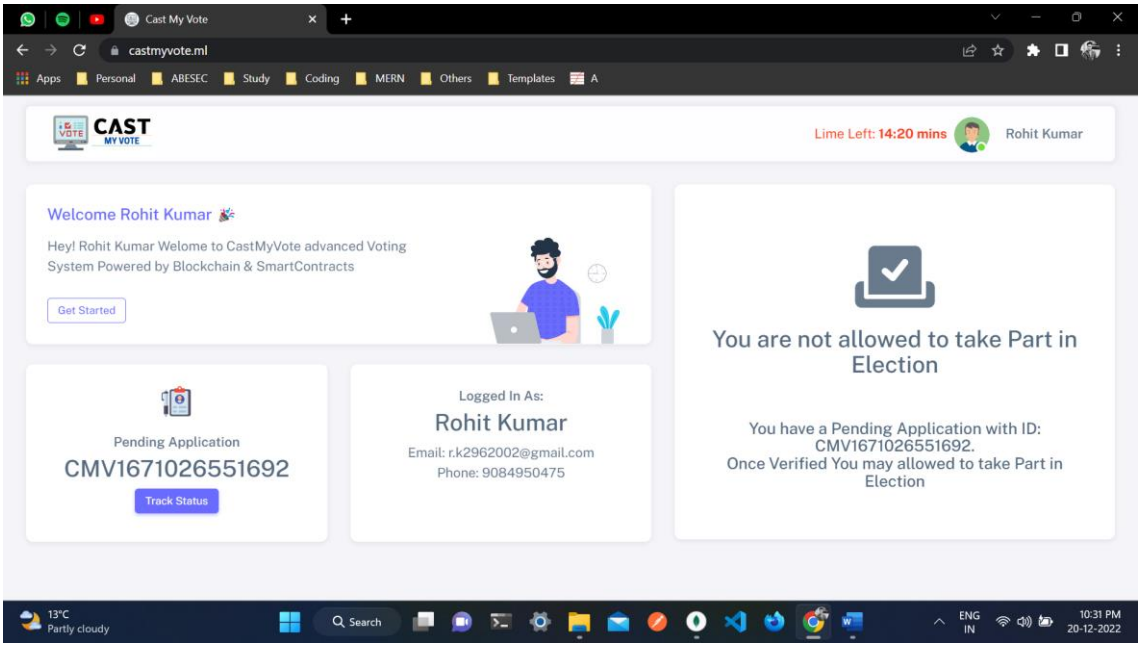


Figure 44: Snapshot for User Dashboard with New Voter Application

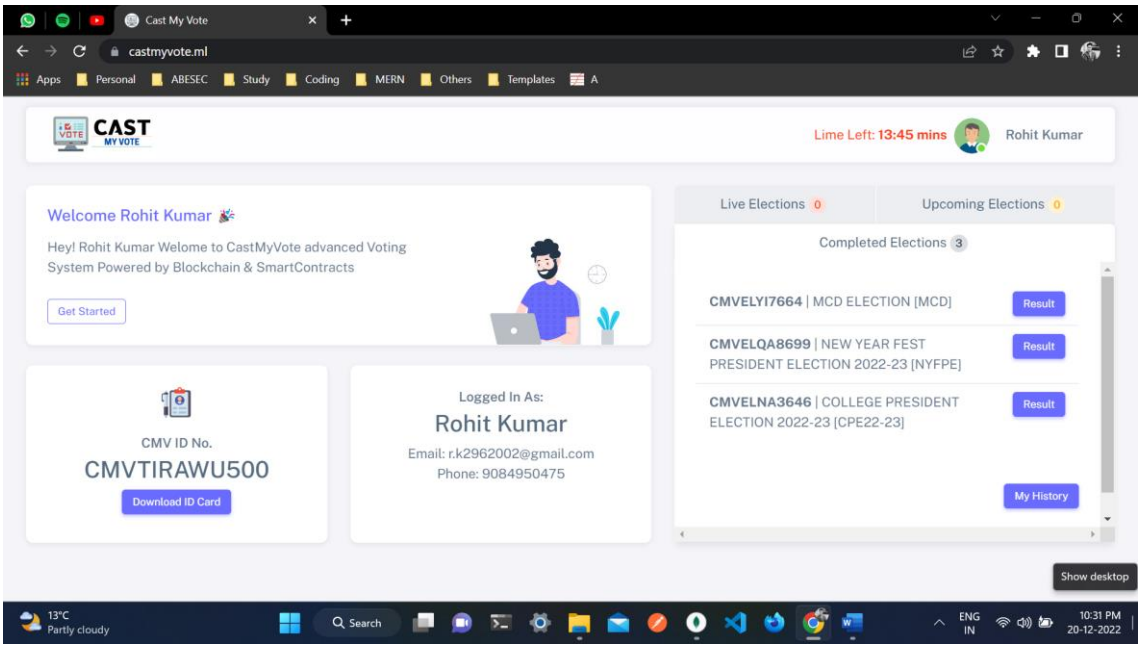


Figure 45: Snapshot for User Dashboard with Voter ID

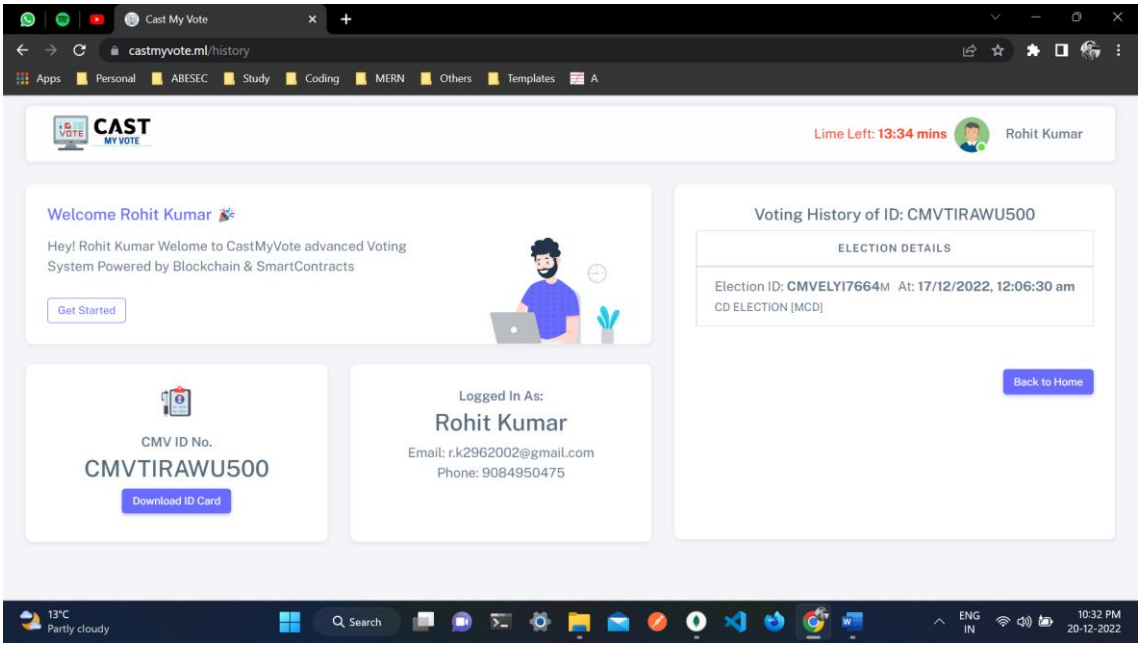


Figure 46: Snapshot for User Voting History

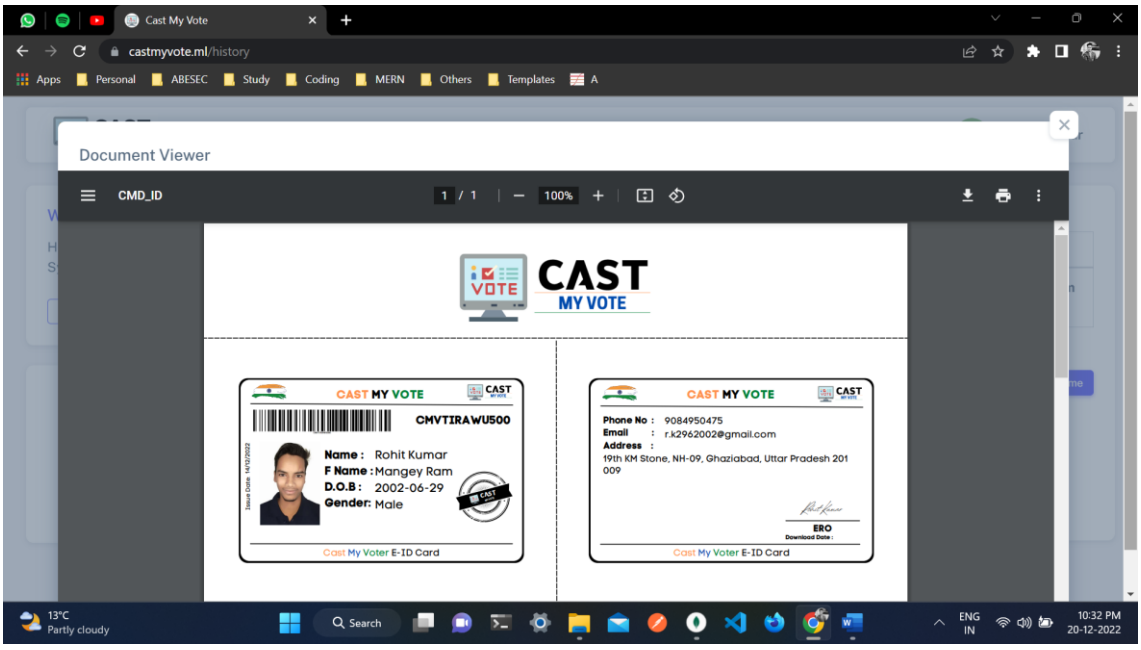


Figure 47: Snapshot for User Voter ID Card

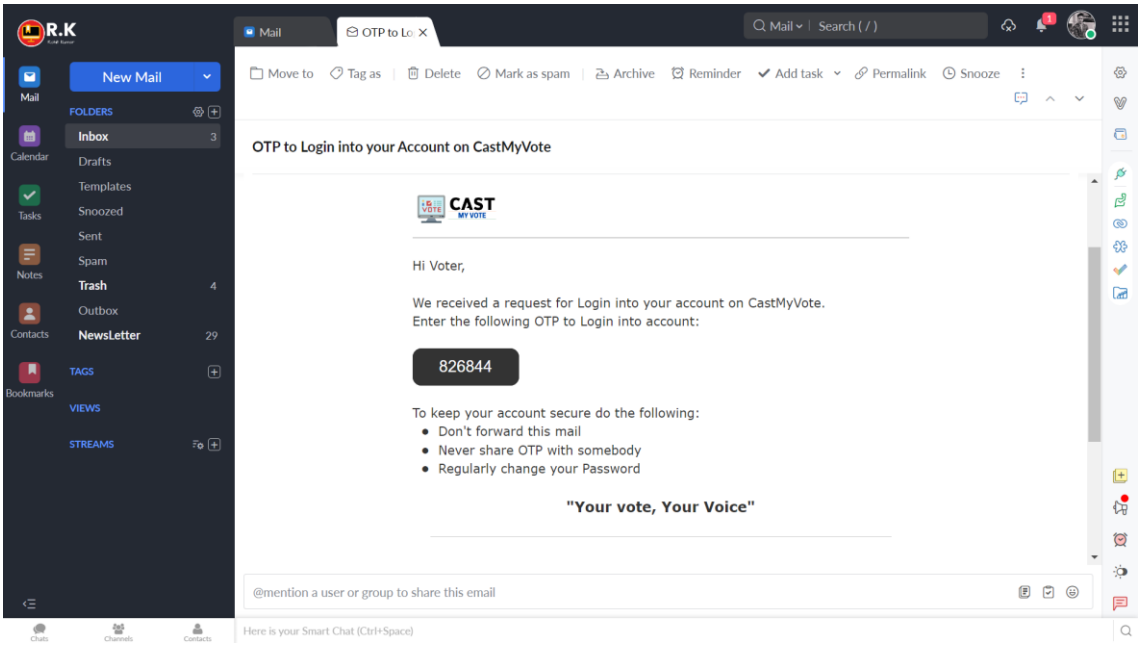


Figure 48: Snapshot for OTP Mail

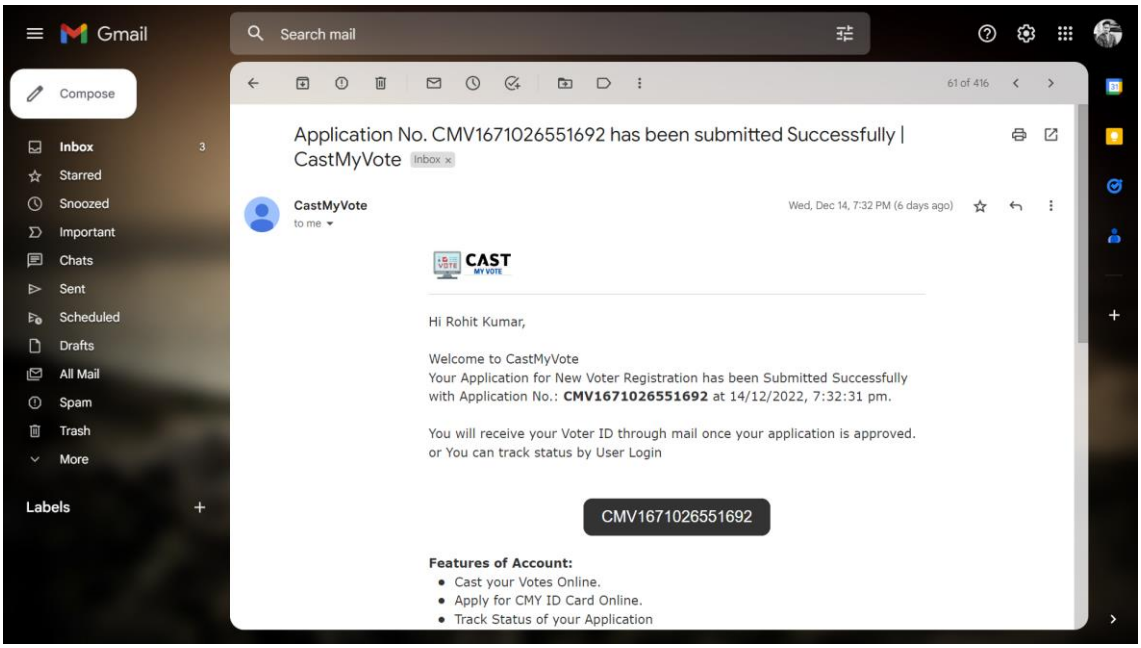


Figure 49: Snapshot for Application Submission Mail

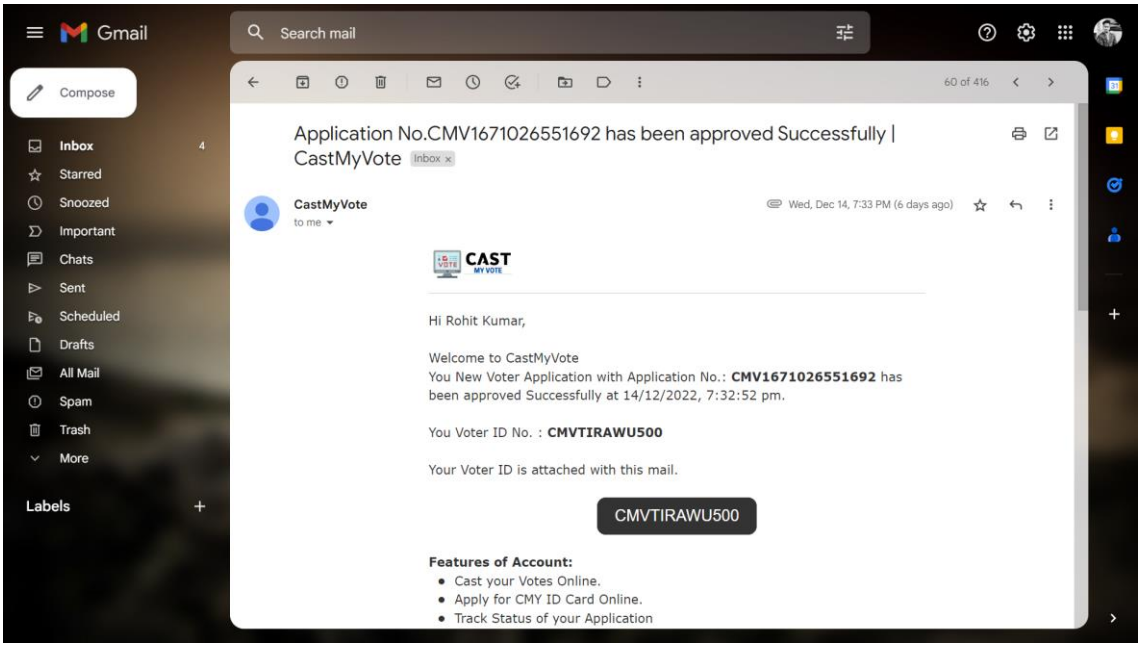


Figure 50: Snapshot for Application Approval Mail (1)

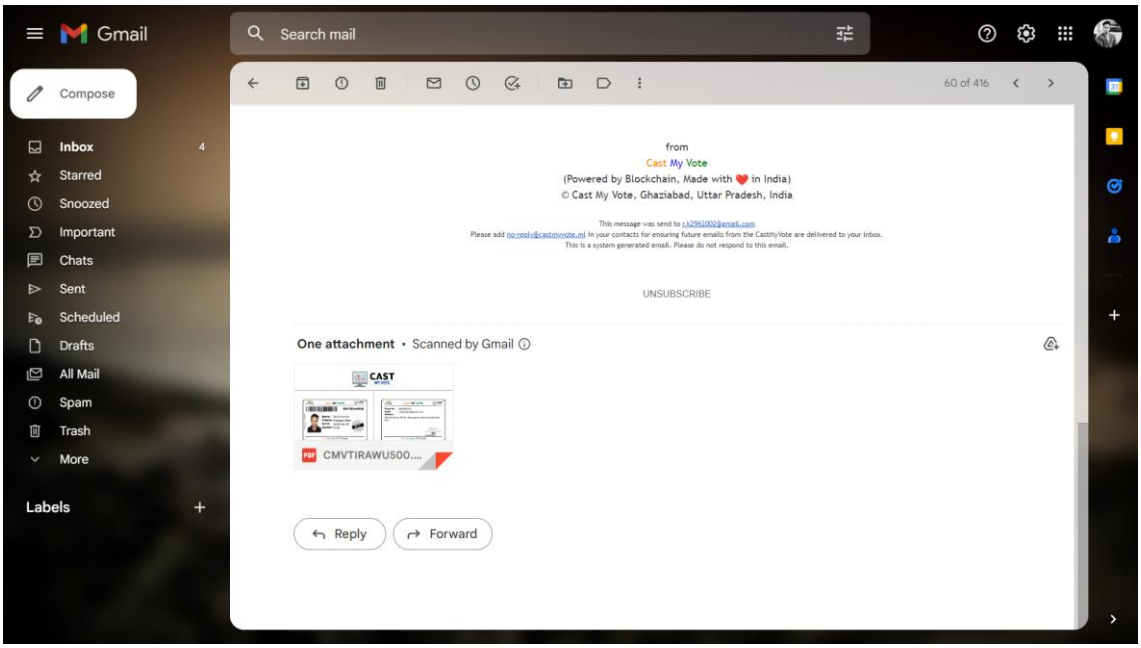


Figure 51: Snapshot for Application Approval Mail (2)

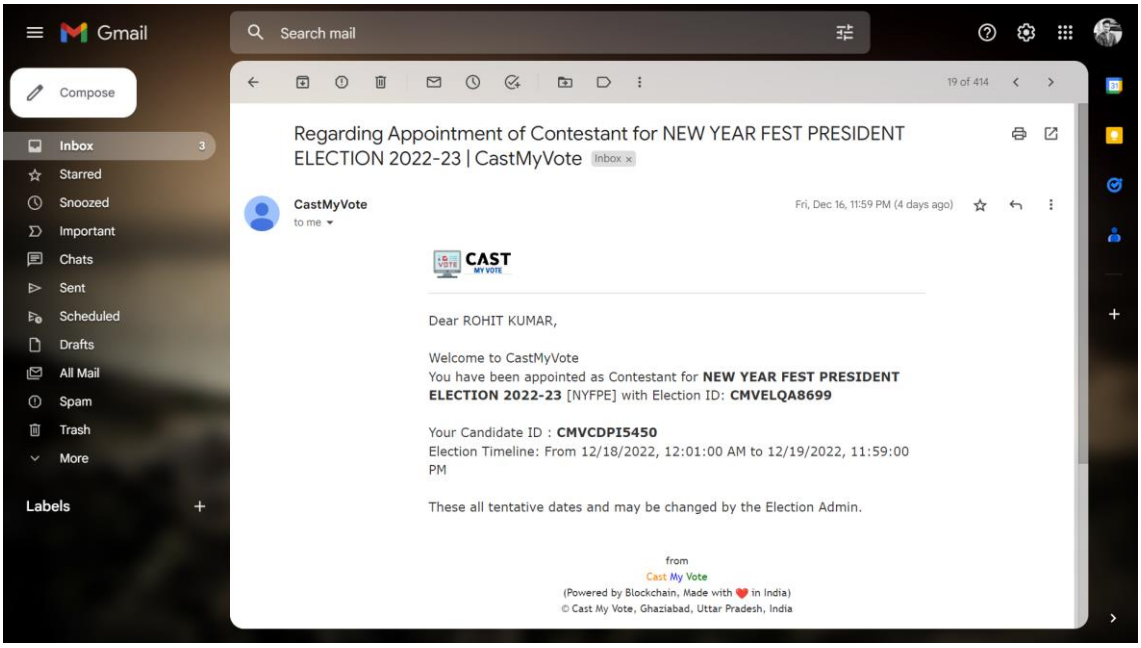


Figure 52: Snapshot for Contestant Appointment Mail

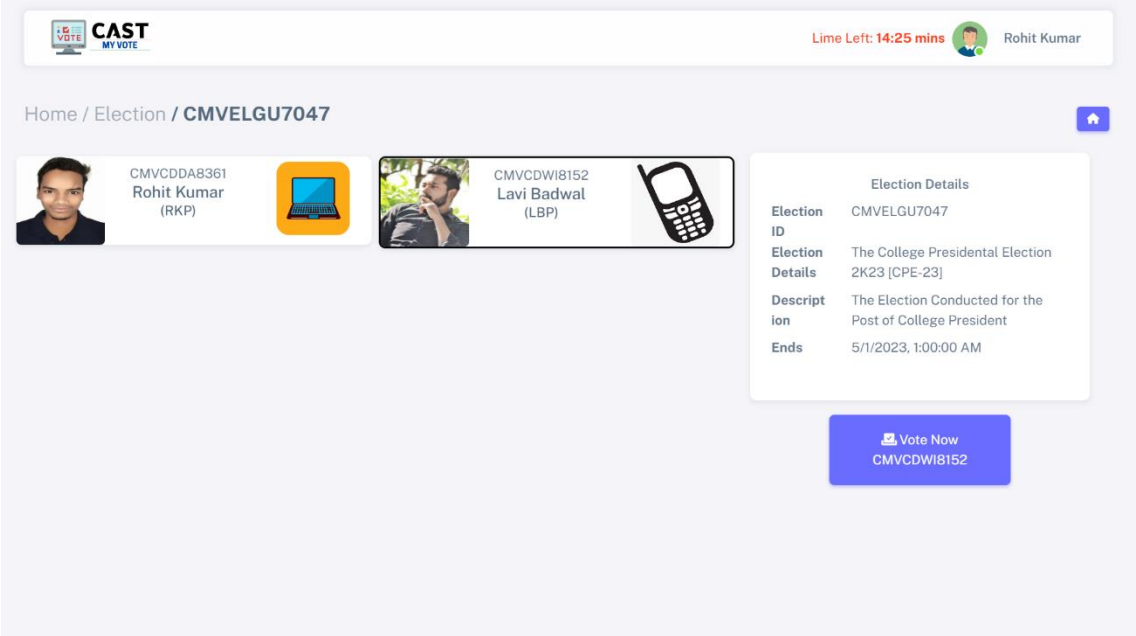


Figure 533: Snapshot for Voter ballot

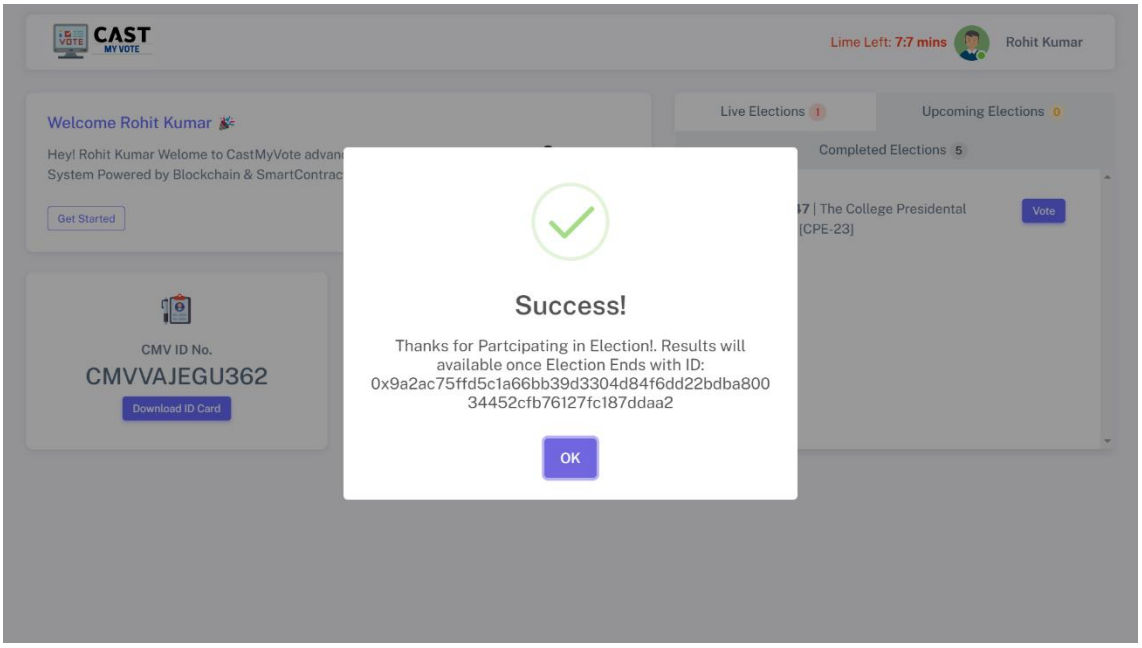


Figure 544:Snapshot for Voter Submission Alert

CAST MY VOTE

Election Report

Election Information

Election ID	CMVELGU7047
Election Details	The College Presidental Election 2K23 [CPE-23]
Description	The Election Conducted for the Post of College President
Ends	5/1/2023, 1:00:00 AM

Election Details

Status	Completed
Starts	4/30/2023, 2:30:00 PM
Ends	5/1/2023, 1:00:00 AM
Total Votes	60

List of Candidates & Winner

S NO.	CANDIDATE ID	CANDIDATE NAME & PARTY	VOTES	PHOTO	SYMBOL
1 WINNER	CMVCDDA8361	Rohit Kumar (RKP)	5		
2	CMVCDWI8152	Lavi Badwal (LBP)	25		

Instructions

- All the information in this report is based on the data provided by the server.
- All the information are correct to the best of our knowledge.
- This is a report of the election conducted on CastMyVote
- This report contains the details of the election and the winner of the election.

Acknowledgement

We would like to express our gratitude to everyone who votes. We recognize the importance of the information contained in this report and will make every effort to ensure its dissemination to relevant stakeholders.

Rohit Kumar
(Chief Election Officer)

from
Cast My Vote
(Powered by Blockchain & Smart Contracts, Made with ❤ in India)
© Cast My Vote, Ghaziabad, Uttar Pradesh, India

Figure 55: Election Report

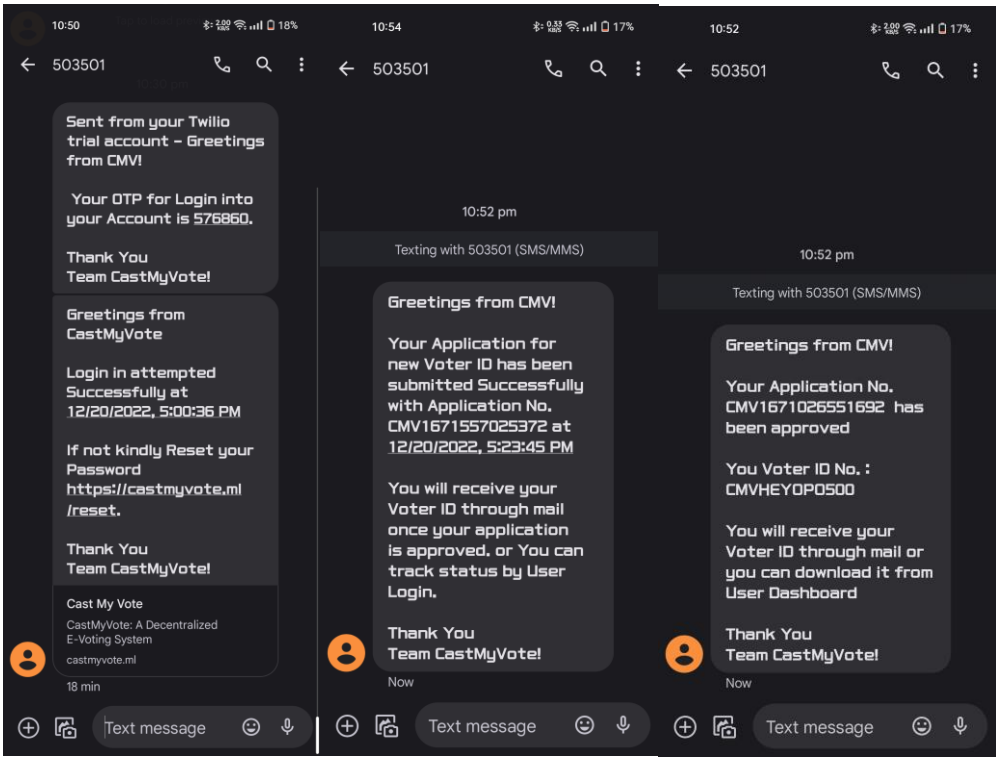


Figure 56: Snapshot of SMS Send to User/Voter

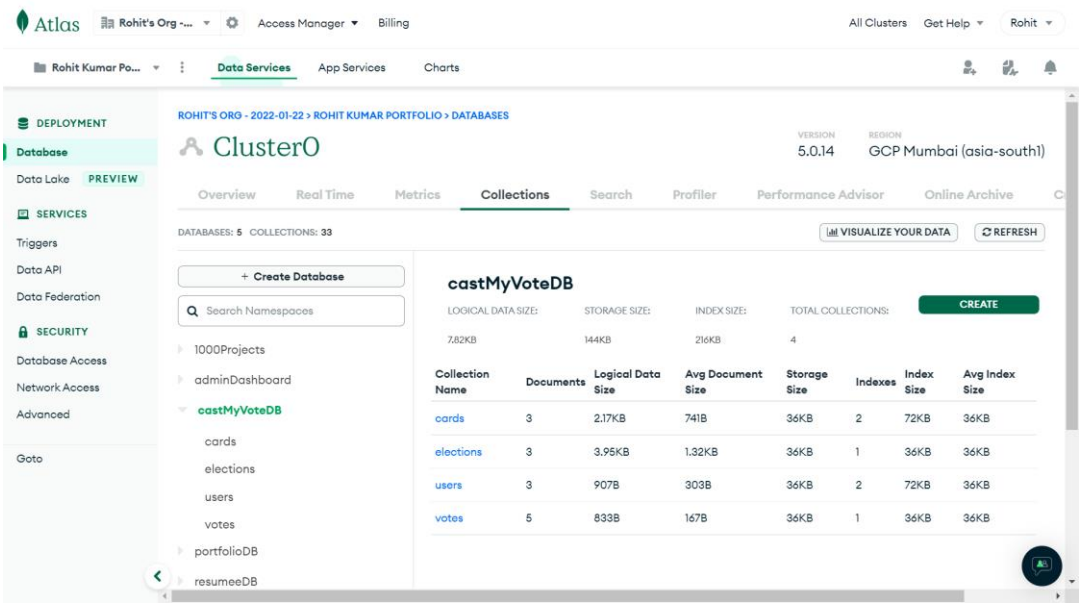


Figure 57: Snapshot for MongoDB Console

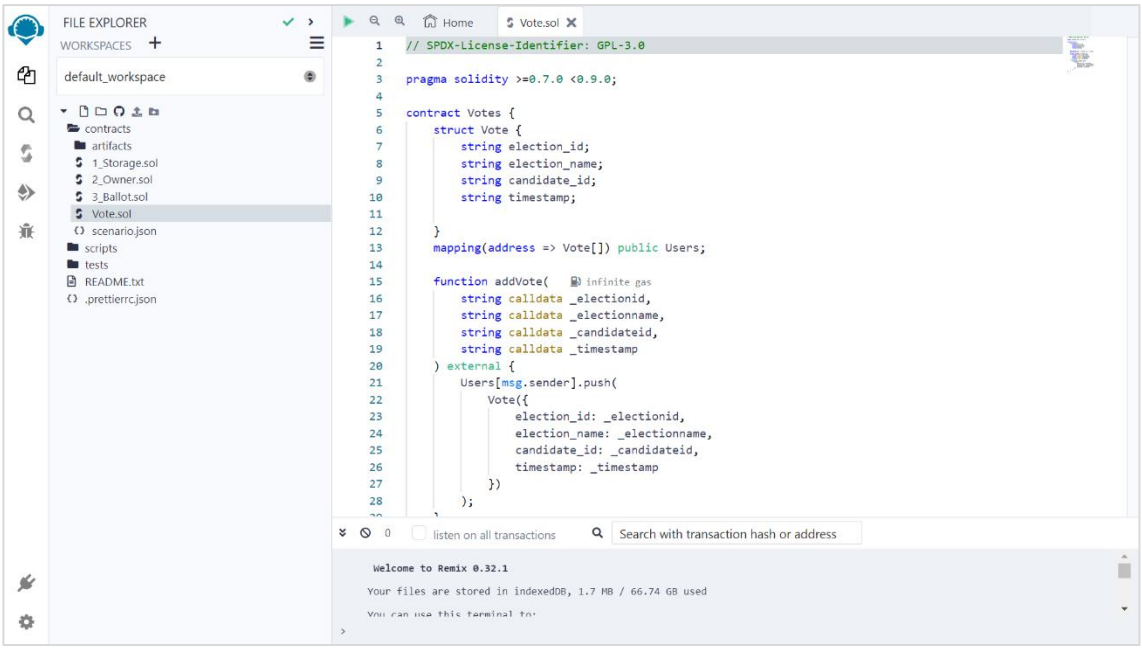
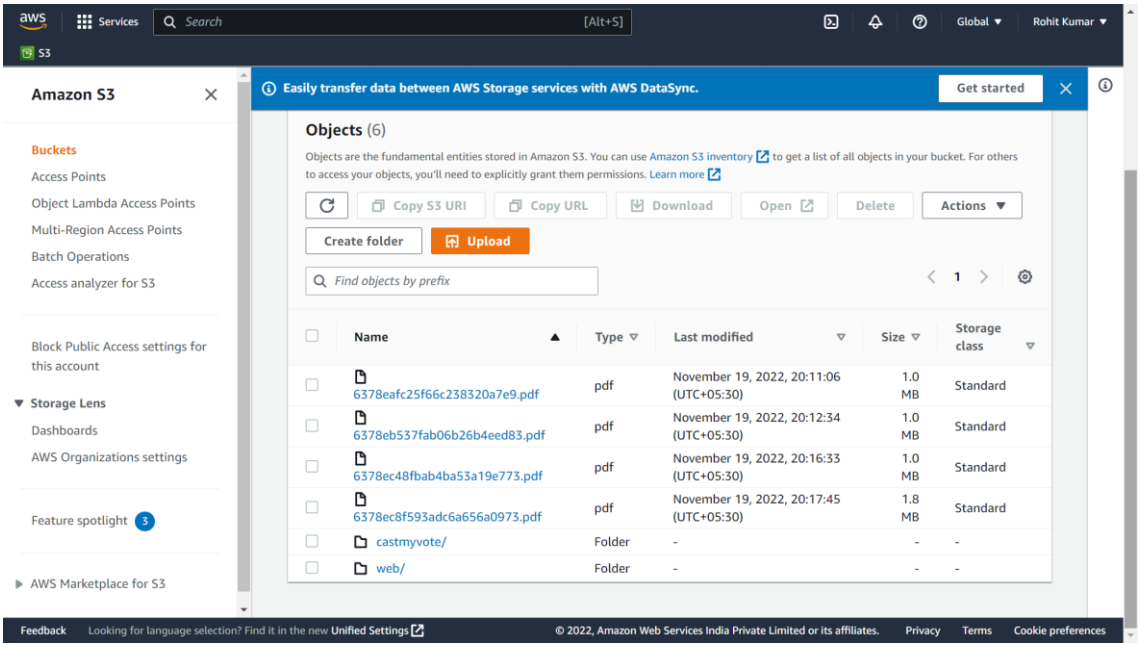


Figure 58: Snapshot for Vote Smart Contract on Remix IDE



S

Figure 59: Snapshot for AWS S3 Bucket

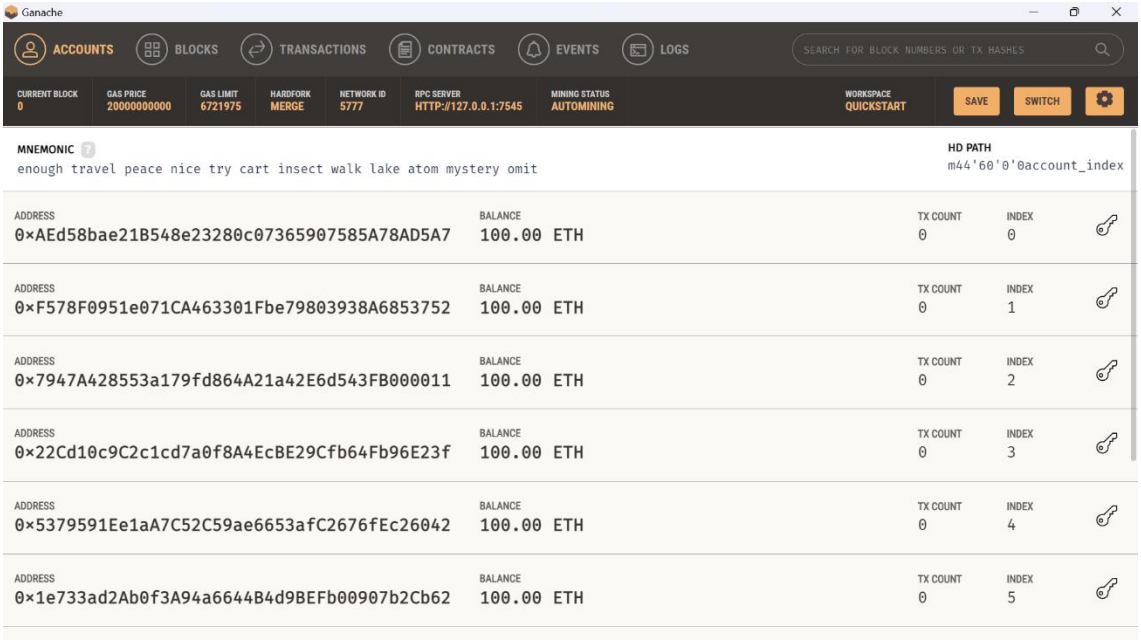


Figure 60: Snapshot for Ganache

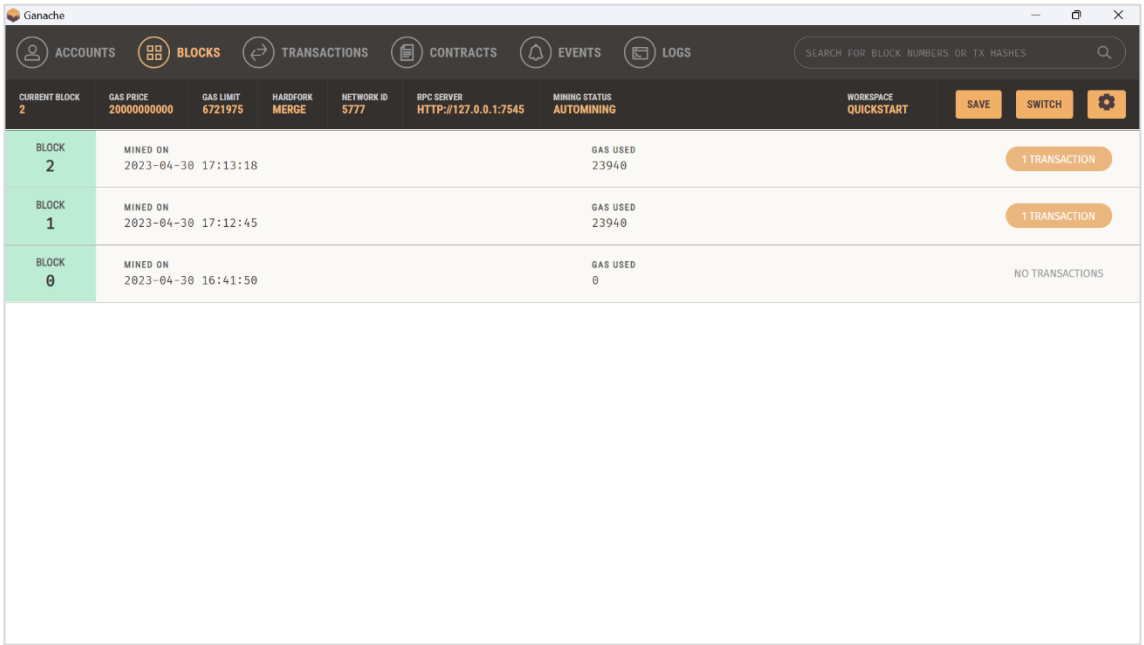


Figure 61: Snapshots for List of Blocks

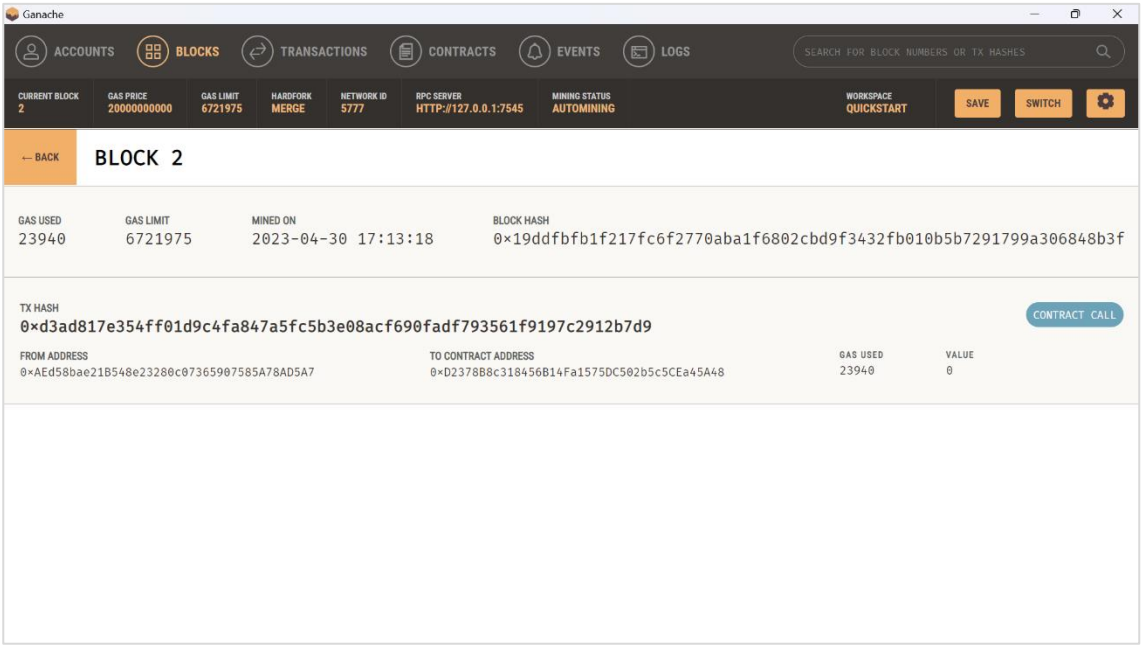


Figure 62: Snapshot for a Blockchain Block

4. 4.2 Test Cases

Each module underwent unit testing upon successful completion. Prior to being integrated with the entire system, each module was evaluated independently. Integration testing was carried out to ensure that each module was properly integrated with the system after integration.

Black-box testing of these entire system was done after all integrations were finished to make sure it functions properly. Black box testing of the system's primary functions

1. Login & Signup Process
   Case (i) Voter entered unregistered email in login form.
   The error message “User not Found” appears on the screen as Output.
   Case(ii) User entered an Incorrect OTP
   The error message “Invalid OTP” displayed on the screen.
   Case (iii) Voter is registering through already registered Email Address
   The error message “User Already Exists!” displayed on the screen.

2. Voter Section
   Case (i) The voter has no voter ID

The System shows error that you are not registered and also shows link for voter registration.

Case (ii) The voter has no voter ID but have a pending application
The System shows that user have a pending application with application no shown on the screen and also shows status on that.

Case (iii) Voter try to submit vote again.
The System will show alert that you have already voted and prevent duplicate vote.

3. Admin Section

Case (i) The admin tries to change running or completed election.
The system did not permit to change election once it goes live or completed.

Case (ii) Election Table Buttons
The System will show equivalent button with respect to election state.

4. 4.3 Results

At the end the system will working fine and we have successfully hosted an election that it all works fine.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

In this project report, we have described a blockchain based online voting system which becomes a promising solution to the challenges faced by old means of voting system.

Detailed information is given on a cutting-edge electronic voting system based on blockchain technology that guarantees secure and effective elections while protecting voter privacy. Recent Blockchain technology has undergone a thorough analysis that has led to the conclusion that it offers democratic nations a new opportunity to replace antiquated voting processes like the EVM and ballot system with an electronic voting system that is more effective and time-efficient, while also enhancing the security features of the current system and creating new opportunities for transparency. This paper proposes a MERN-based blockchain-based voting architecture that makes use of smart contracts to safeguard voter privacy while providing secure and affordable elections. The blockchain offers the ability to significantly improve electronic voting above and above the current blockchain-based voting systems.

5.1. Performance Evaluation

This Project works fine as per discussed in this report and some evaluation is as below:

iii. Increase User Satisfaction with Best Features and Best UI Interface.
iv. Best Loading Speed and work on low Bandwidth.
v. We have data backup we any data is deleted we can recover the data
vi. It is available 24*7

5.2. Comparison with existing State-of-the-Art Technologies

This project is best because it used modern technologies like ReactJS. NodeJS which is in current trend and does not require additional treatment and these technologies are highly secure because it use 3-tier model.

5.3. Future Directions

This project is extended to higher level if we have a time and budget in the following ways:

iv. AI Implementation during Voting Procedure.
v. Candidates Enrollment through it.
vi. To make this system Highly scalable so that a large-scale election can be conducted on that.

APPENDIX – A

CODE SAMPLES

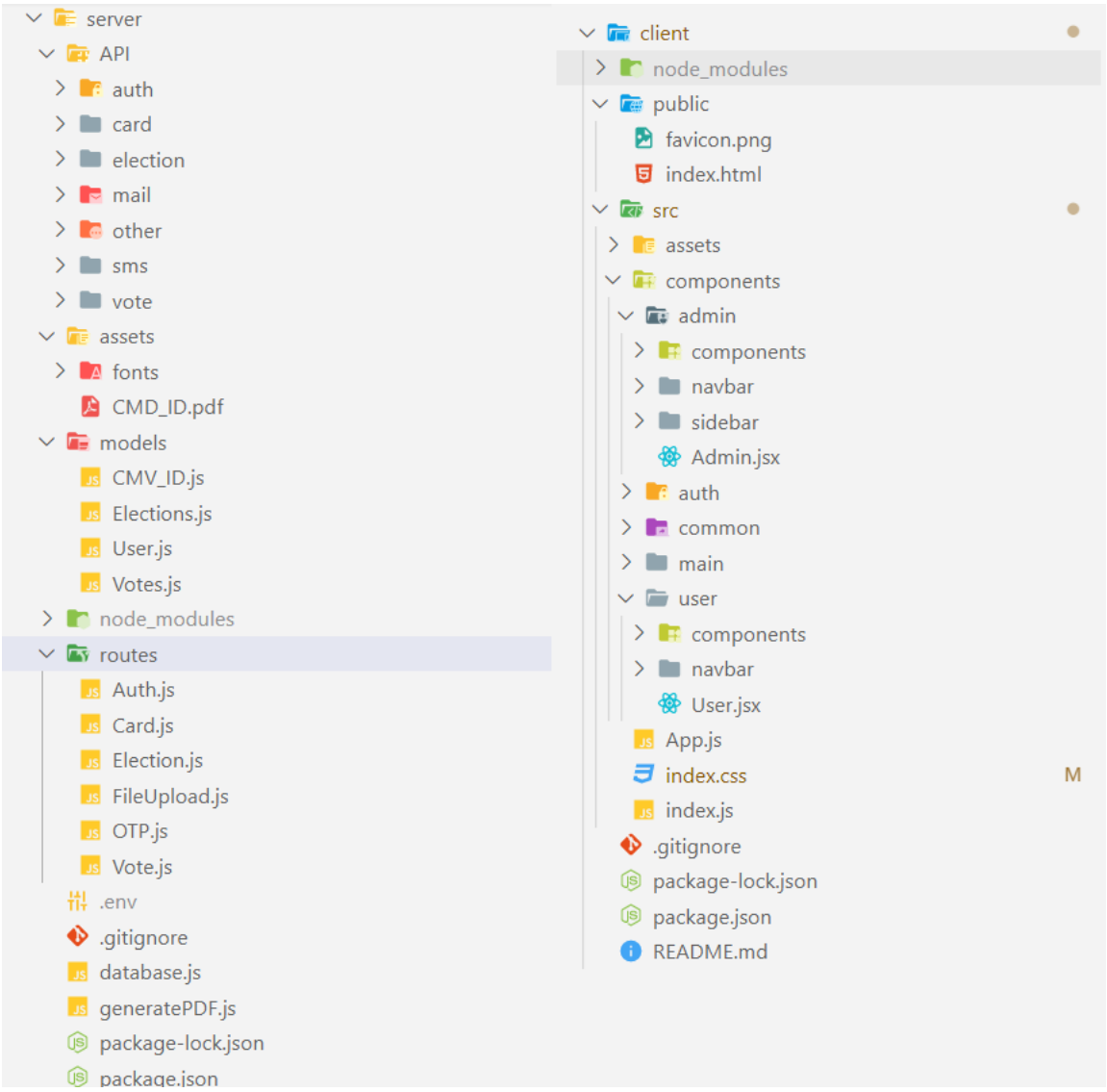


Figure 63: Directory Structure of Our System

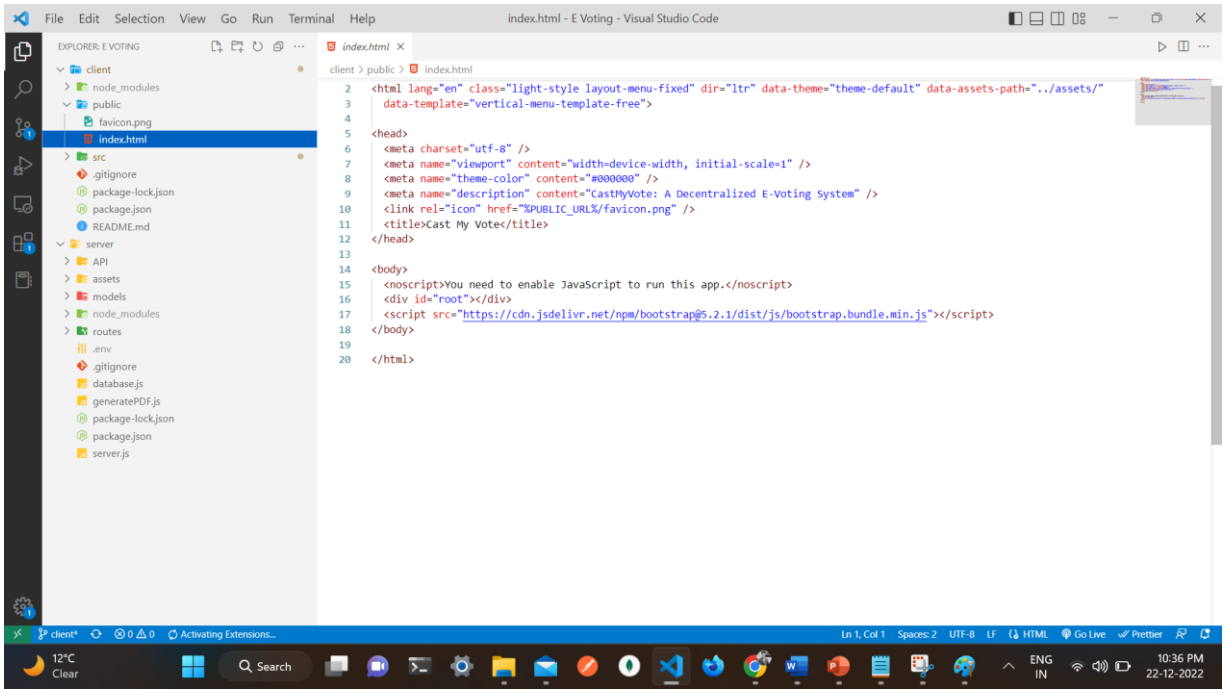


Figure 64: Snapshot for our main .html file

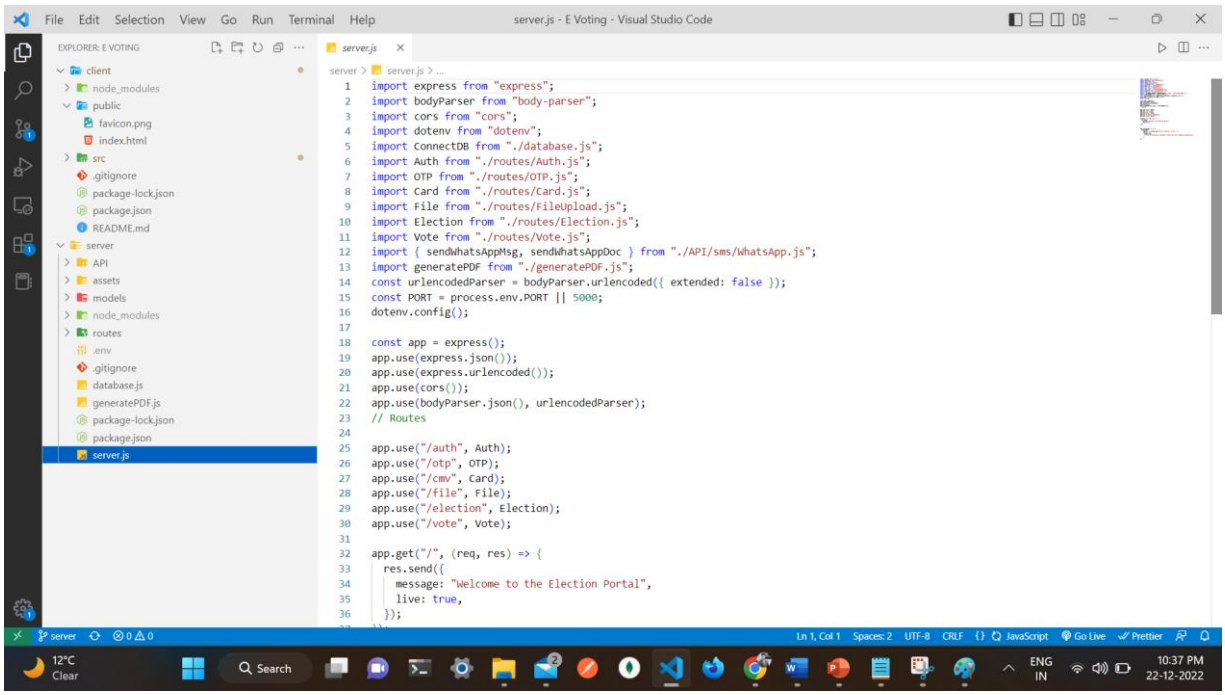


Figure 65: Snapshot for Our Server.js File

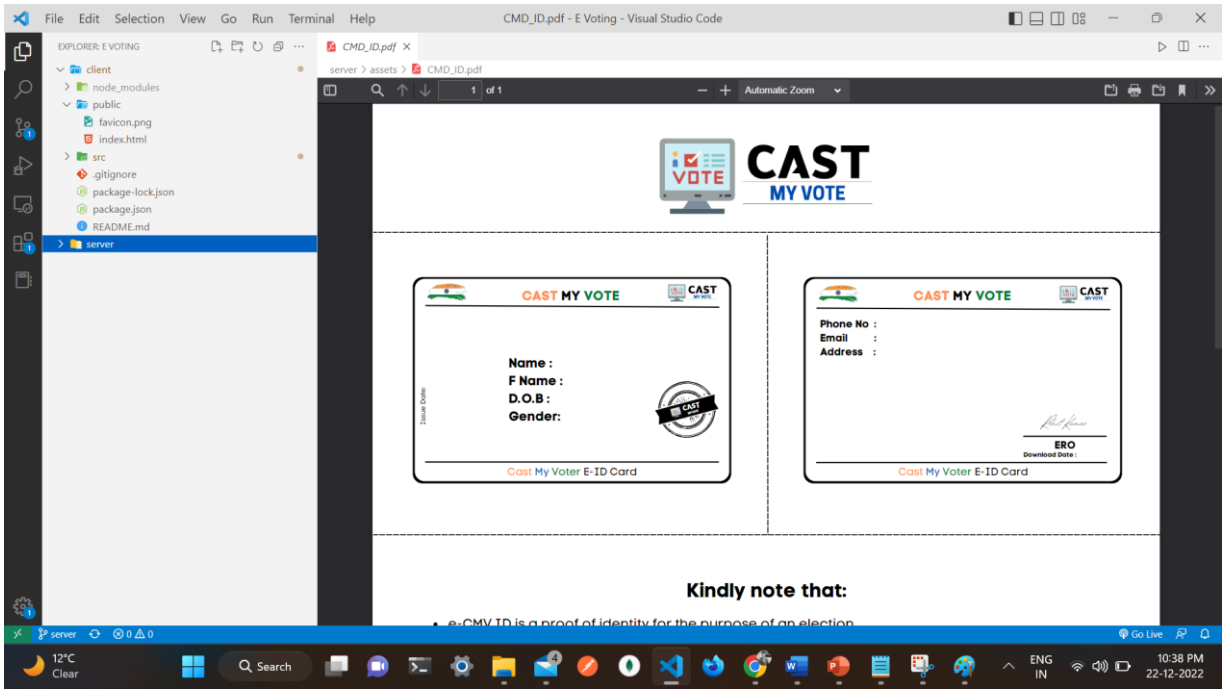


Figure 66: Snapshot for Our Empty Voter ID Card

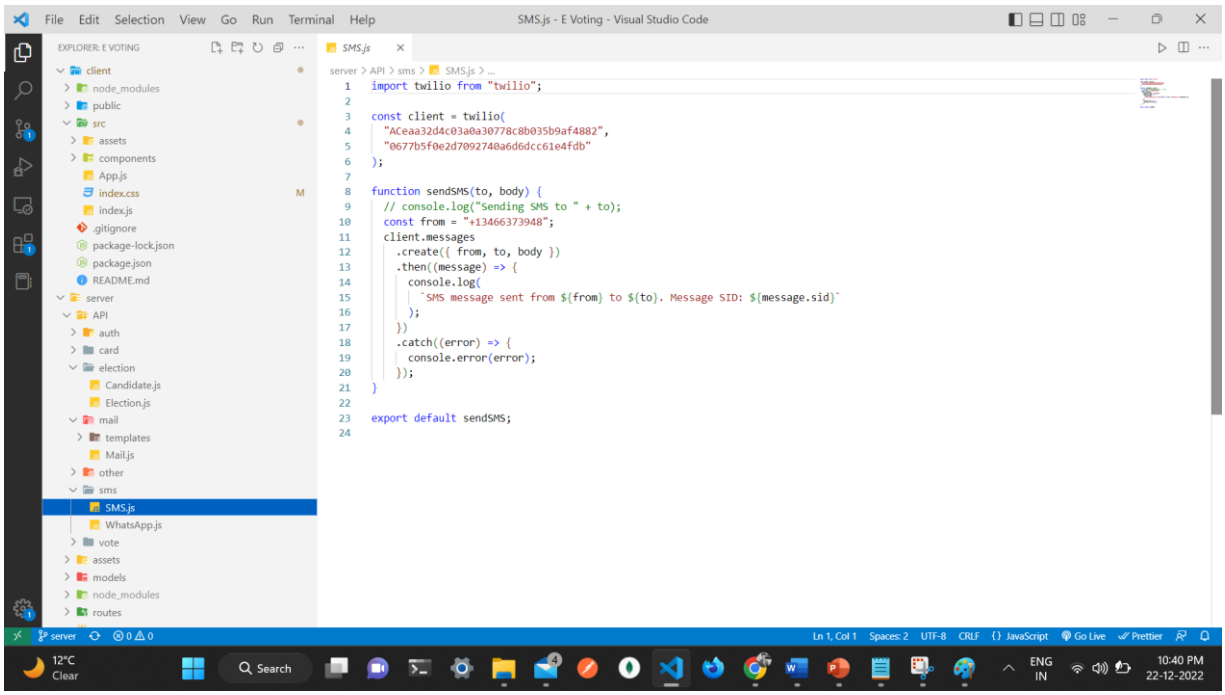


Figure 67: Snapshot for SMS Sender Function

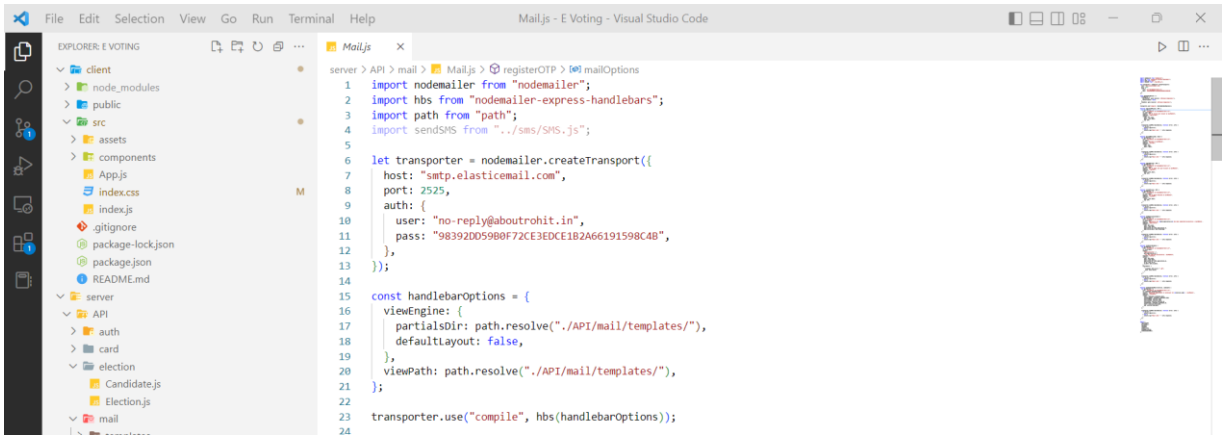


Figure 68: Snapshot for Mail Sender Function

Figure 69: Snapshot for User and Admin Components

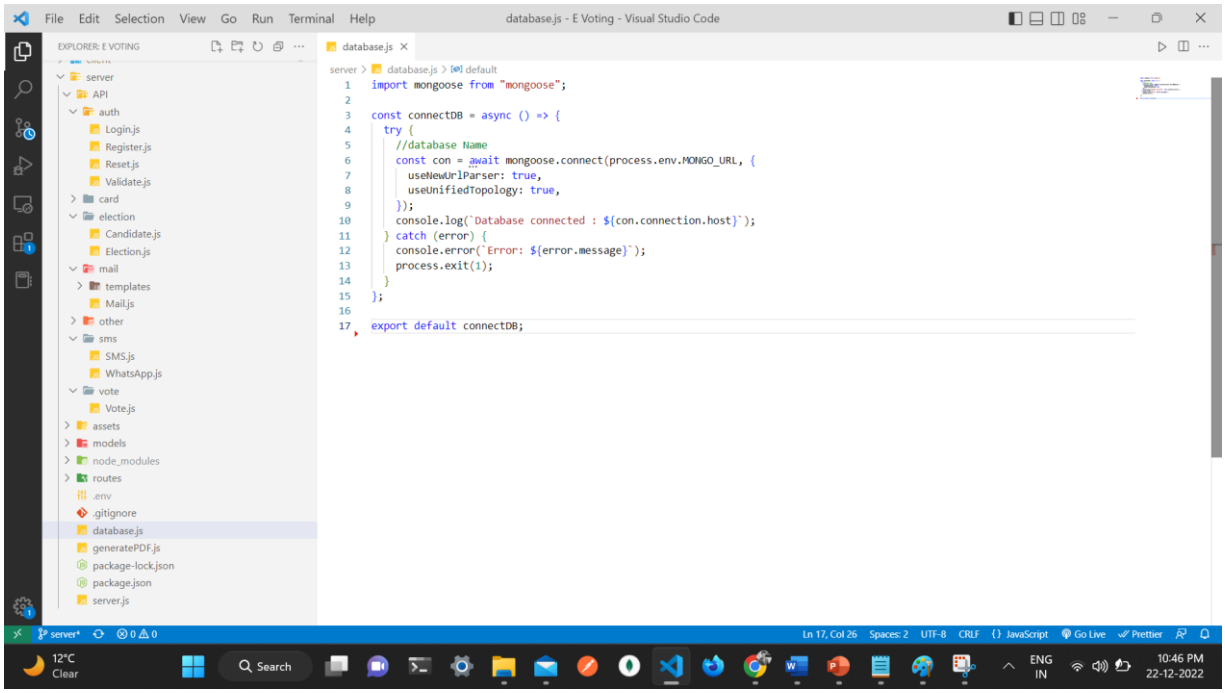


Figure 70: Snapshot for Database Connection File

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CERTIFICATE OF PARTICIPATION

This is to certify that Dr./Mr./Ms. Rohit Kumar

from ABES Engineering College Ghaziabad has presented research paper on

A Secure Decentralized E-Voting with Blockchain and Smart Contracts

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Conference Chair, Confluence-2023
HoD (CSE),
Amity School of Engineering & Technology
Amity University Uttar Pradesh, Noida, India

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