Digital Voting System Using Blockchain

A MINI-PROJECT REPORT

submitted by

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to

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SCMS SCHOOL OF ENGINEERING AND TECHNOLOGY

(*Affiliated to APJ Abdul Kalam Technological University*)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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CERTIFICATE

This is to certify that the report entitled '**Digital Voting System Using Blockchain**' submitted by **P GANESHA MURTHY, ROHAN ROY, SOORAJ S, TUSHAR SOJAN** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Bachelor of Technology is a bona fide record of the project work carried out by her under my guidance and supervision.

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ABSTRACT

In an era where digital innovation is paramount, the Digital Voting System with Blockchain Integration project emerges as a beacon of security and transparency in the electoral process. This ground breaking initiative seeks to fortify the trustworthiness of digital voting mechanisms by incorporating the immutable and transparent nature of blockchain technology. The project is anchored in the Ethereum blockchain, which provides a robust platform for the deployment of smart contracts. These contracts are designed to record votes in an unalterable manner, thereby ensuring the integrity of each vote cast. The development environment is a rich ecosystem comprising advanced tools such as Truffle, which streamlines the deployment of smart contracts, and Ganache, which offers a simulated blockchain network for testing purposes. Metamask plays a critical role in securing user interactions within the system. The backend is powered by Node.js, which acts as the conduit for seamless communication between the frontend interface and the underlying blockchain infrastructure.

The project's architecture is meticulously crafted to be user-centric, offering an intuitive interface that simplifies the voting process for users while maintaining the highest standards of security. The integration of blockchain technology not only enhances the system's resistance to tampering but also instils a level of confidence in the electoral system that has been elusive in traditional voting methods. By leveraging the inherent strengths of blockchain, such as decentralization, transparency, and security, the Digital Voting System with Blockchain Integration project stands at the forefront of digital electoral solutions. It promises to redefine the landscape of democratic participation, making the act of voting more accessible, secure, and verifiable. This project is a testament to the transformative potential of blockchain technology in the realm of digital democracy, paving the way for a future where trust in the electoral process is restored and strengthened.

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1.1 INTRODUCTION TO BLOCKCHAIN

Blockchain is a distributed digital ledger technology that allows participants in a network to share and validate transactions in a secure and transparent manner without the need for intermediaries. The technology is designed to be decentralized, meaning that the data is stored on a network of computers instead of a central database. This makes it difficult to hack or manipulate the data, ensuring the integrity and security of the system.

The blockchain technology gained popularity with the emergence of Bitcoin, which was the first decentralized cryptocurrency. However, the technology has since been applied to various industries, including finance, supply chain management, healthcare, and voting, among others.

Blockchain works by creating blocks of data that are linked together in a chain, hence the name blockchain. Each block contains a unique code, known as a hash, that is generated based on the contents of the block. This hash is then used to link the block to the previous one, forming a chain of blocks.

Once a block is added to the blockchain, it cannot be altered or deleted without the consensus of the network participants. This makes the technology immutable, ensuring that the data stored on the blockchain is tamper-proof and transparent.

Overall, blockchain technology has the potential to revolutionize the way we store and share data, making it more secure, transparent, and accessible.

1.2 DECENTRALIZED VOTING USING BLOCKCHAIN

A decentralized voting system built on the Ethereum blockchain has the potential to revolutionize the way we conduct elections. By leveraging the security, transparency, and immutability of blockchain technology, decentralized voting systems can eliminate many of the challenges and risks associated with traditional voting systems.

In a decentralized voting system, each voter has a unique digital identity, and their vote is recorded on the blockchain, ensuring that the vote is tamper-proof and cannot be altered. Decentralized voting systems also eliminate the need for intermediaries, such as government agencies, to oversee the election process, making it more efficient and less susceptible to corruption or manipulation.

Furthermore, decentralized voting systems can increase voter participation by allowing voters to cast their ballots from anywhere in the world, as long as they have an internet connection. This can lead to a more democratic and inclusive electoral process, with greater voter engagement and higher turnout. Overall, a decentralized voting system using the Ethereum blockchain has the potential to bring significant benefits to the electoral process, making it more secure, transparent, and accessible to everyone.

2 LITERATURE REVIEW

Literature survey on Online Voting System Using Blockchain

Authors: Vaibhav Anasune, Pradeep Choudhari, Madhura Kelapure, Pranali Shirke and Prasad Halgaonkar

Implementing a robust online voting system globally requires the adoption of sophisticated security measures. The current centralized approach to elections, where a single entity oversees the process, poses significant risks to both security and transparency. In such systems, the controlling organization's complete authority over the database and infrastructure opens the door to potential data manipulation. This document provides an analysis of various electoral systems previously employed by numerous nations and entities, highlighting their respective methodologies and outcomes.

A Systematic Literature Review and Meta-Analysis on Scalable Blockchain Based Electronic Voting System

Authors: Uzma Jafar, Mohd Juzaiddin Ab Aziz, Zarina Shukur and Hafiz Adnan Hussain

Electronic voting systems face challenges like authentication and data security. Blockchain offers a solution with its inherent transparency and verifiability. Yet, scalability is a major concern, especially for voting. This study examines scalable blockchain voting systems through a systematic literature review of 76 articles from 2017 to 2022. It assesses proposals, verification methods, cryptographic techniques, and performance metrics, highlighting the benefits and challenges of various models. The study also suggests future research directions for creating scalable blockchain voting systems, providing a comprehensive guide for researchers to enhance voting solutions.

A Survey of Blockchain Based on E-voting Systems

Authors: Yousif Osman Abuidris, Rajesh Kumar and Wang Wenyong

Blockchain technology, recognized for its decentralized and distributed ledger capabilities within peer-to-peer networks, has been the focus of increasing interest. It employs a chain of linked blocks and relies on a secure consensus protocol to synchronize changes in data, thereby creating a resilient digital infrastructure for the secure storage and exchange of information. Blockchain's

potential extends to various interactive online systems, including the Internet of Things, supply chain management, and electronic voting platforms. This survey aims to illuminate recent advancements addressing security and privacy concerns in blockchain-based e-voting systems. Concluding this paper, we offer a comparative analysis of the security and privacy specifications of current blockchain-based e-voting solutions**.**

Survey on Voting System using Blockchain Technology

Authors: Mayur Shirsath, Mohit Zade, Riteshkumar Talke, Praful Wake and Maya Shelke

Information technology has revolutionized various sectors, including e-voting, which exemplifies modern democratic practices. While research often focuses on e-voting's technical and legal aspects, its societal benefits are significant. Traditional voting methods are susceptible to security issues, which are exacerbated by logistical challenges. This paper proposes an internet-based e-voting system enhanced with blockchain technology, ensuring secure and user-friendly voting. The system aims to increase voter engagement and revolutionize election processes through a blockchain-based platform.

A Survey on Smart Electronic Voting System Using Blockchain Technology

Authors: Naina Nagesh Dhepe and Dr. Pathan Mohd Shafi

India's vast democracy is embracing technology to connect its over a billion citizens to their government. Despite the push for tech in elections, current systems have security flaws. Electronic voting, aimed at increasing participation and reducing costs, still needs improvement in voter authentication and tamper-proofing. This paper discusses a new blockchain-based voting machine designed to enhance security and transparency in the electoral process.

2.1 INFERENCE

The integration of blockchain technology in electronic voting systems presents a transformative potential for enhancing the security, transparency, and integrity of elections. The surveys indicate a consensus on the need for advanced technological solutions to address the vulnerabilities of traditional voting mechanisms. Blockchain's decentralized nature and cryptographic security offer promising avenues to mitigate these concerns. However, scalability remains a critical challenge that requires further research and innovation. The literature

underscores the importance of developing scalable blockchain solutions that can accommodate the vast number of transactions an electronic voting system would entail. Additionally, the surveys highlight the necessity for user-friendly systems that ensure voter anonymity and verifiability without compromising on ease of use. Future research directions are geared towards refining blockchain's application in e-voting to meet these complex demands, with the ultimate goal of achieving a secure, transparent, and accessible voting process for all.

3 PROBLEM STATEMENT

In the context of India's vast and diverse electorate, the current voting system is hampered by significant challenges that undermine the democratic process. These include security vulnerabilities, lack of transparency, logistical inefficiencies, and susceptibility to manipulation. Despite the potential of electronic voting to address these issues, existing e-voting solutions are plagued by concerns over voter authentication, data integrity, and scalability. The project at hand seeks to devise a blockchain-based electronic voting system that not only resolves these concerns but also enhances voter accessibility and turnout. The objective is to create a decentralized, secure, and user-friendly platform that ensures the integrity of each vote and the verifiability of the overall electoral process, thereby reinforcing the foundations of democratic participation in the world's largest democracy.

3.1 OBJECTIVE

- **Secure Elections:** Create a tamper-proof, transparent blockchain system for reliable election results.
- **Voter Transparency:** Allow voters to track the voting process end-to-end.
- **Accessibility:** Facilitate remote voting to increase turnout.
- **Efficiency:** Streamline elections to save time and reduce costs.
- **Trust:** Build confidence with a clear, immutable voting record.

3.2 FUTURE SCOPE:

- **Evolving Security:** Develop security protocols that adapt to new cyber threats.
- **Global Standards:** Work towards international standards for blockchain voting systems.
- **Integration with Civic Platforms**: Plan for integration with other civic engagement platforms to create a unified system for various public services.

4 SYSTEM DESCRIPTION

4.1 SYSTEM ARCHITECTURE

The system uses MetaMask for user authentication, distinguishing between admins and voters. Admins can start elections, add candidates, and end voting. Voters, verified against a database, cast votes on a secure page. All votes are blockchain transactions, ensuring security and transparency. After voting, admins stop the election and results are tallied.

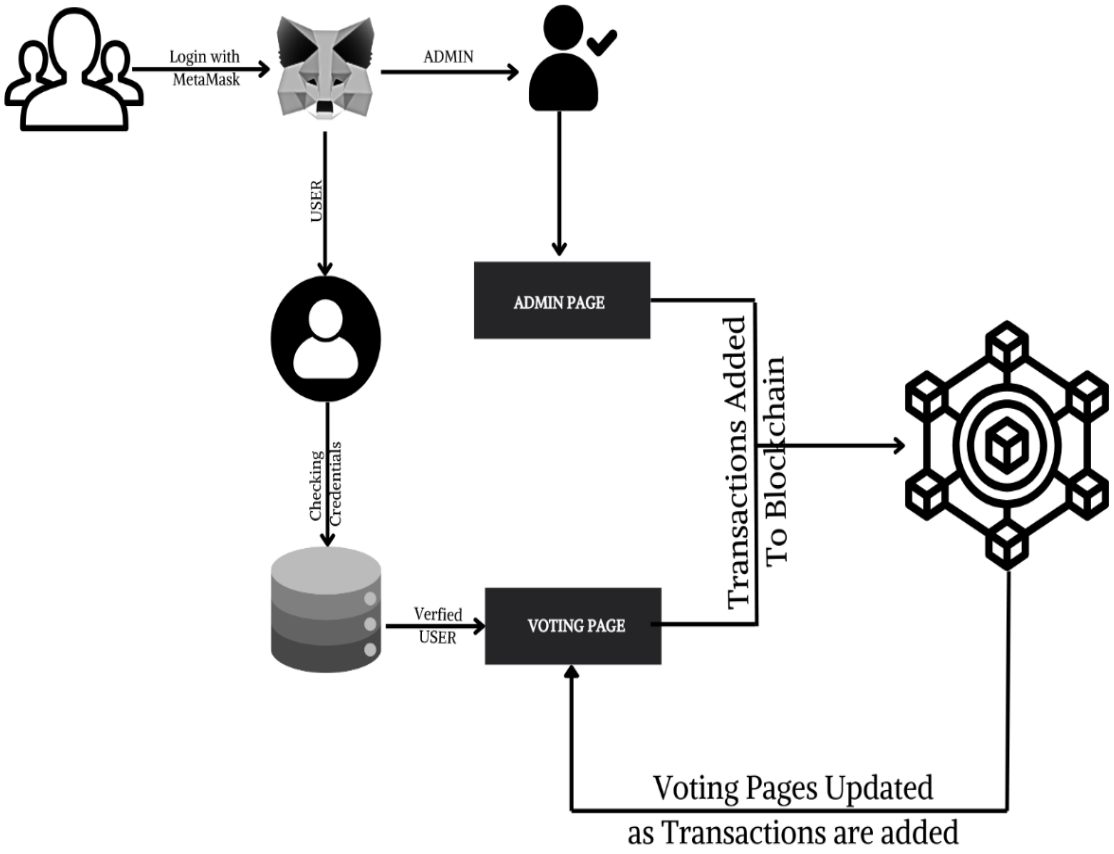

Fig 1 System Block Diagram

1. Voter - The voter module is designed for individuals who are eligible to participate in the voting process. It provides functionalities related to the voting experience and ensures the integrity and security of the votes. The main features of the voter module include:

a. Voters can securely authenticate themselves to access the voting system using their unique credentials.

b. Voters can access information about the candidates running for various positions,

such as their names, parties, and other relevant details.

c. Voters can verify the status of their votes and ensure that their choices are accurately recorded in the blockchain.

2. Admin - The admin module is designed for administrators or election officials responsible for managing and overseeing the voting system. It provides functionalities to configure and monitor the voting process. The main features of the admin module include:

a. Admins can set up the system parameters, such as defining the start and end dates of the voting period, candidate registration, and other administrative settings.

b. Admin can manually verify the candidate and can start the voting process.

4.2 SOFTWARE

4.2.1 SOFTWARE REQUIREMENTS

- **Truffle v5.11.5**: Ethereum development framework for DApps.
- **Ganache v7.9.1**: Personal blockchain for Ethereum development.
- **Solidity v0.5.16**: Programming language for smart contracts.
- **Node v20.11.1**: JavaScript runtime for server-side scripting.
- **Web3.js v1.10.0**: Ethereum JavaScript API for DApps.
- **Metamask**: Browser extension for Ethereum wallets.
- **MySQL Database**: Relational database management system.
- **Google Firebase**: Platform for mobile and web applications.
- **VS Code**: Code editor for developers.
- **React JS**: JavaScript library for user interfaces.
- **CSS**: Style sheet language for web design.
- **Express JS**: Web application framework for Node.js.
- **Windows**: Operating system by Microsoft.

4.2.2 FLOW CHART

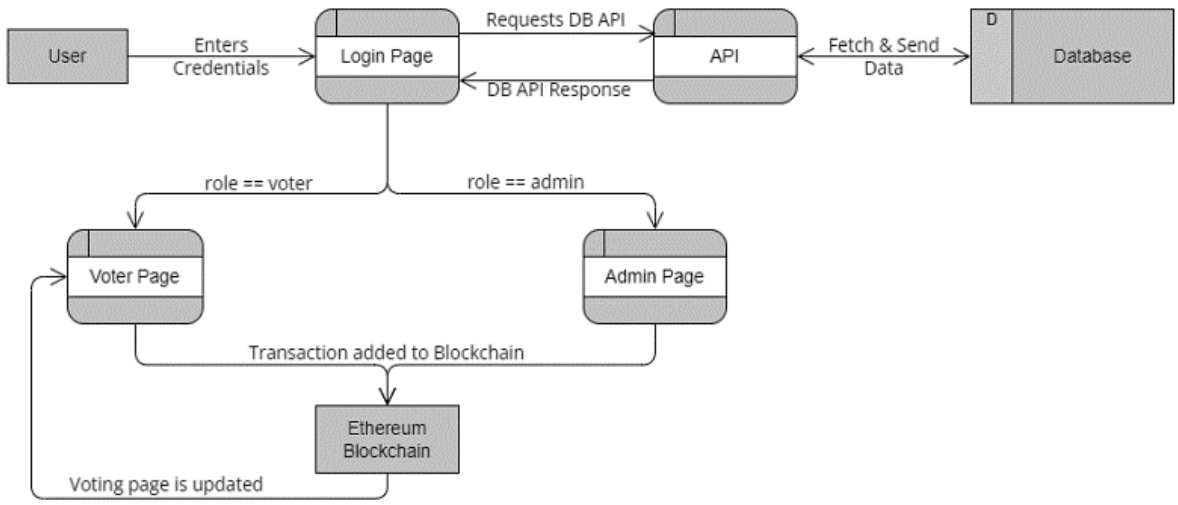

Fig 2 Flow Chart

4.2.3 ALGORITHM

VOTING.SOL

Initialization: Initialize contract variables: admin: Address of the contract deployer.

candidateCount: Number of candidates initially set to 0.

voterCount: Number of voters initially set to 0.

start: Boolean flag indicating whether the election has started, initially set to false.

end: Boolean flag indicating whether the election has ended, initially set to false.

Constructor: Set admin as the address of the contract deployer.

Initialize candidateCount, voterCount to 0.

Set start and end flags to false.

Modifiers: onlyAdmin: Ensures that only the contract admin can execute certain functions.

Candidate Structure:Define a struct Candidate to represent candidate details including candidateId, header, slogan, and voteCount.

Use a mapping candidateDetails to store candidate information keyed by candidateId.

Election Details Structure:Define a struct ElectionDetails to store information about the election such as adminName, adminEmail, adminTitle, electionTitle, and organizationTitle.

Functions: addCandidate: Allows the admin to add a new candidate with a header and slogan.

setElectionDetails: Allows the admin to set details of the election.

getElectionDetails: Retrieves election details.

getTotalCandidate: Returns the total number of candidates.

getTotalVoter: Returns the total number of registered voters.

registerAsVoter: Allows a user to register as a voter by providing their name and phone number.

verifyVoter: Allows the admin to verify a registered voter.

vote: Allows a verified voter to cast their vote for a candidate.

endElection: Allows the admin to end the election.

getStart and getEnd: Retrieve the status of the election (start and end flags).

4.2.4 WORKING OF THE PROJECT

Authentication with MetaMask:

Users access your platform and log in using their MetaMask wallet. MetaMask provides a secure and decentralized way to authenticate users via their Ethereum accounts.

User Roles:

Upon authentication, the system determines whether the user is an administrator or a regular user.

Administrators have additional privileges, such as adding candidates, starting and stopping elections, and viewing verified users.

Admin Functions:

Adding Candidates: Administrators can add candidates to the election pool. This information is stored in your database.

Starting Election: Admins initiate the election process, making it accessible for users to cast their votes.

Viewing Verified Users: Admins have access to a list of verified users who have completed the registration process.

User Registration:

Regular users need to register before they can participate in the voting process.

The registration process involves validating the user's phone number and blockchain

address against your MySQL database.

Firebase is used for OTP verification, ensuring the authenticity of user registrations.

Voting Process:

Once registered, users can cast their votes within the designated voting period.

Each user can only vote once, ensuring the integrity of the election process.

The system tracks votes securely, preventing duplicate or fraudulent votes.

Results and Voting Session Closure:

After the voting session ends, the administrator can stop the election.

Results of the election are then published and made accessible to users.

Users can view the voting results to see the outcome of the election.

5 RESULTS

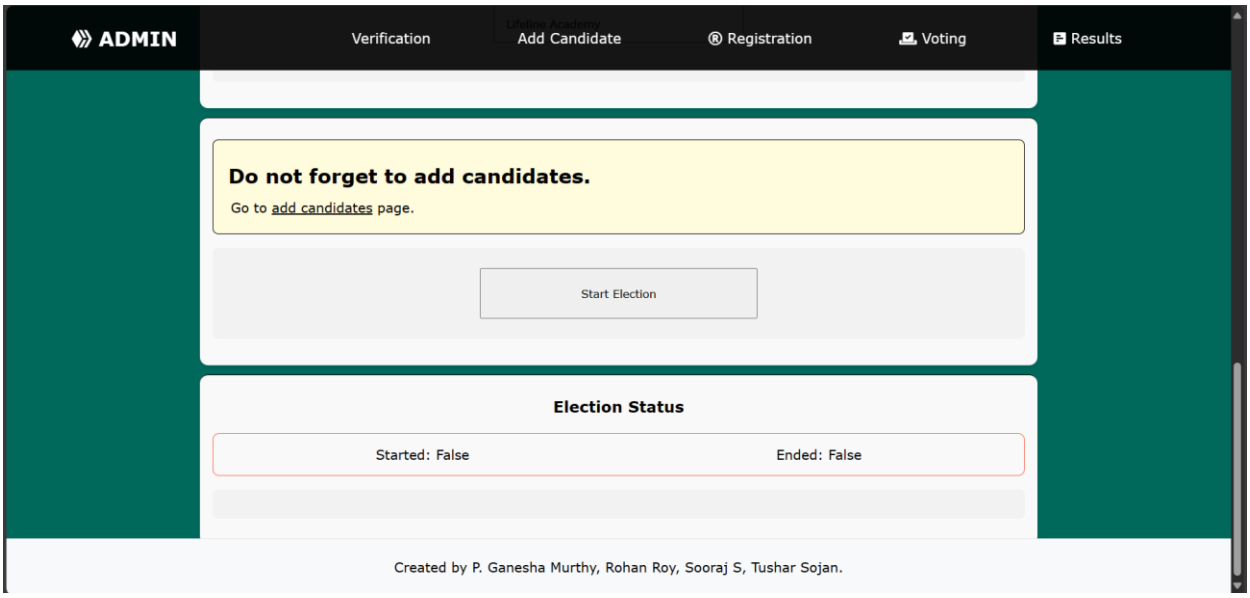

Fig 3 Voting Start Admin Page

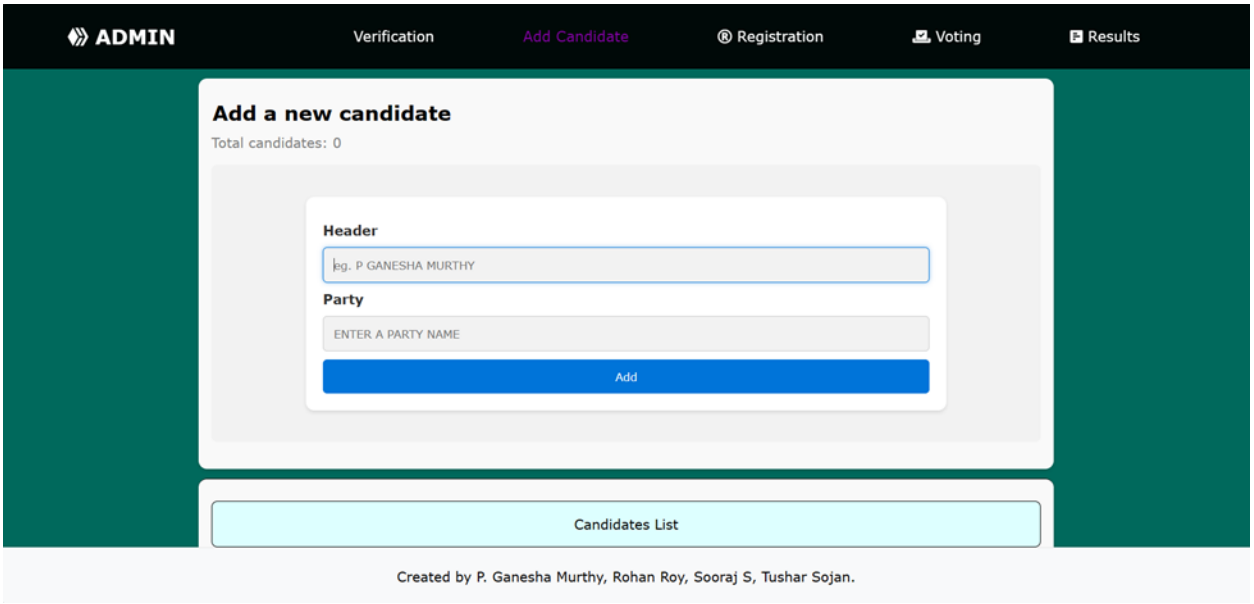

Fig 4 Add Candidate Page

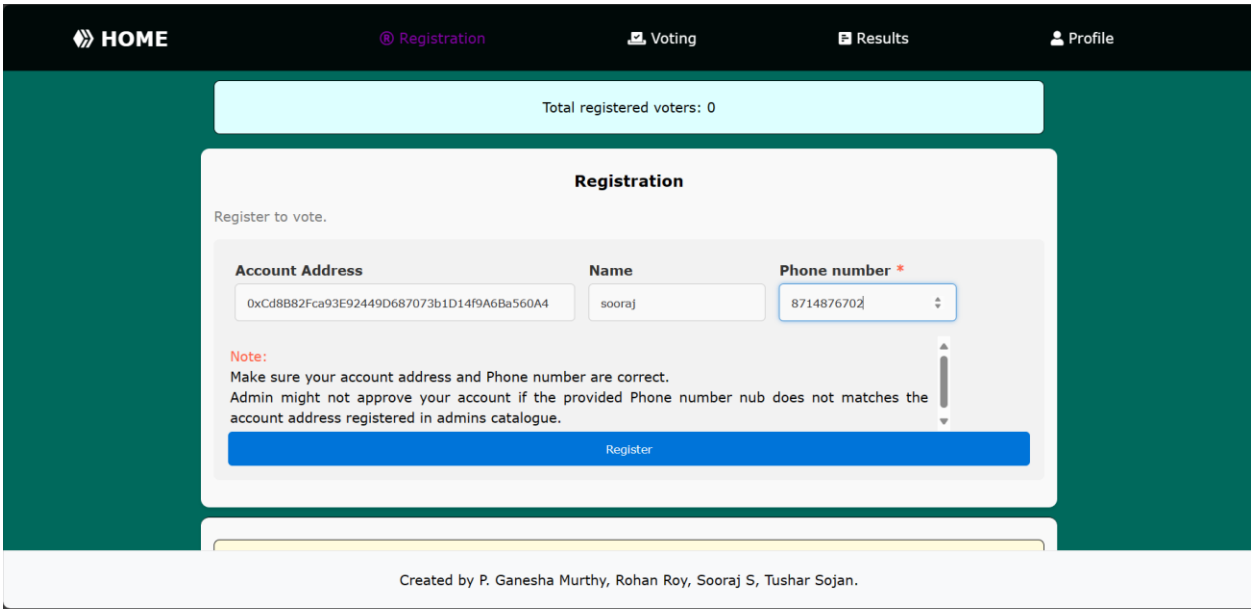

Fig 5 Voter Registration Page

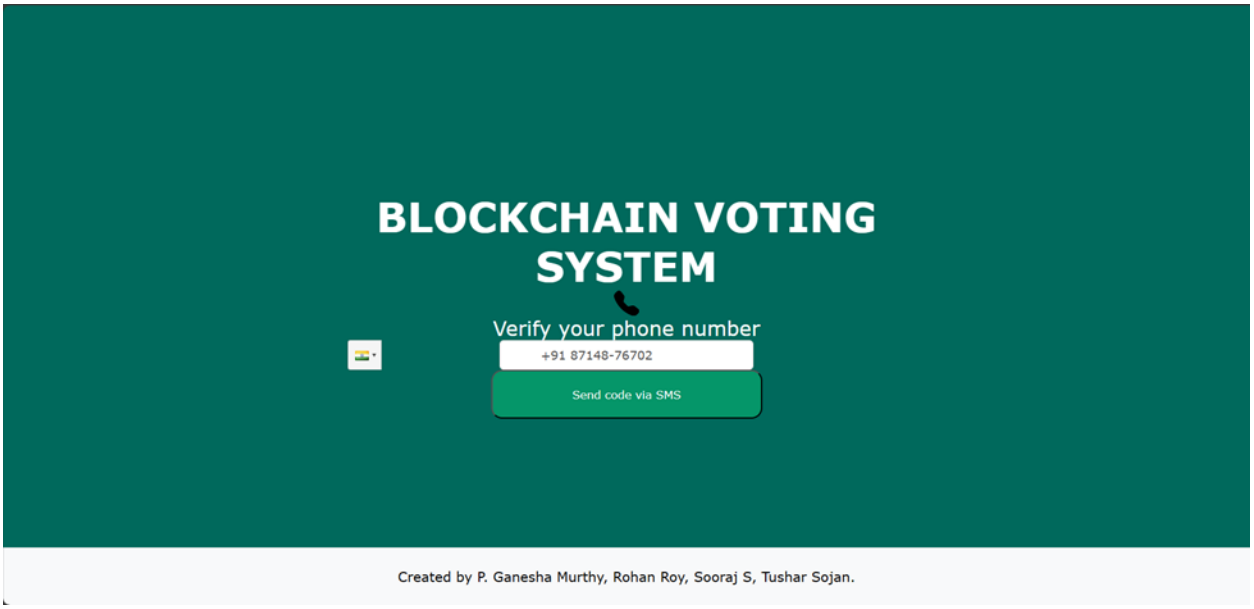

Fig 6 OTP Verification

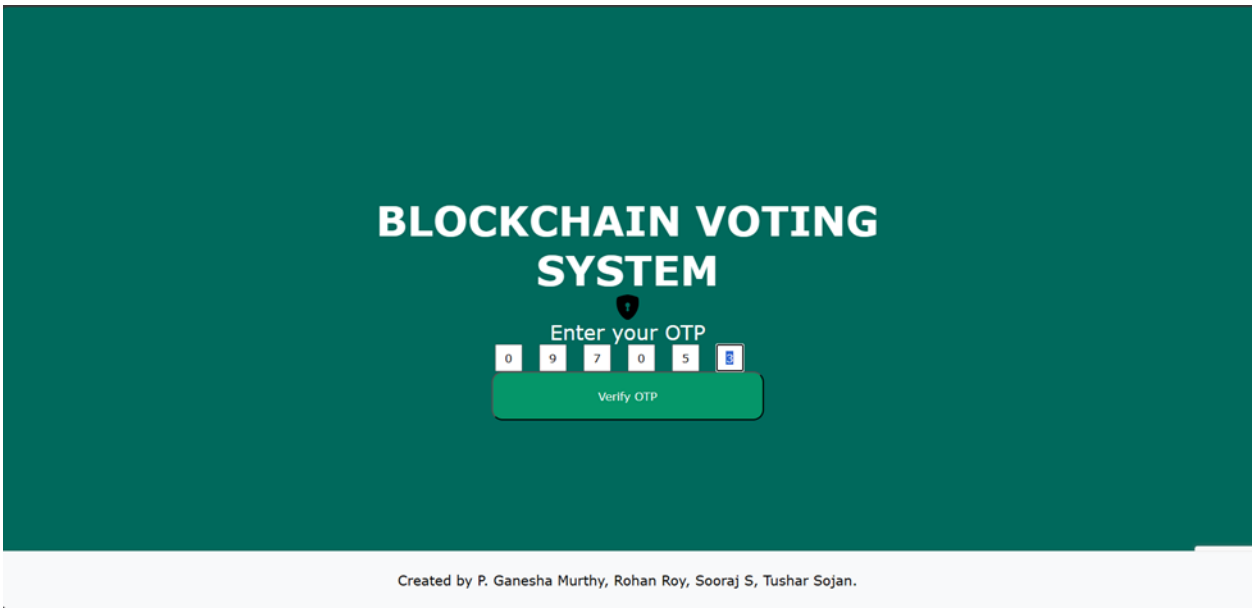

Fig 7 OTP Entering Page

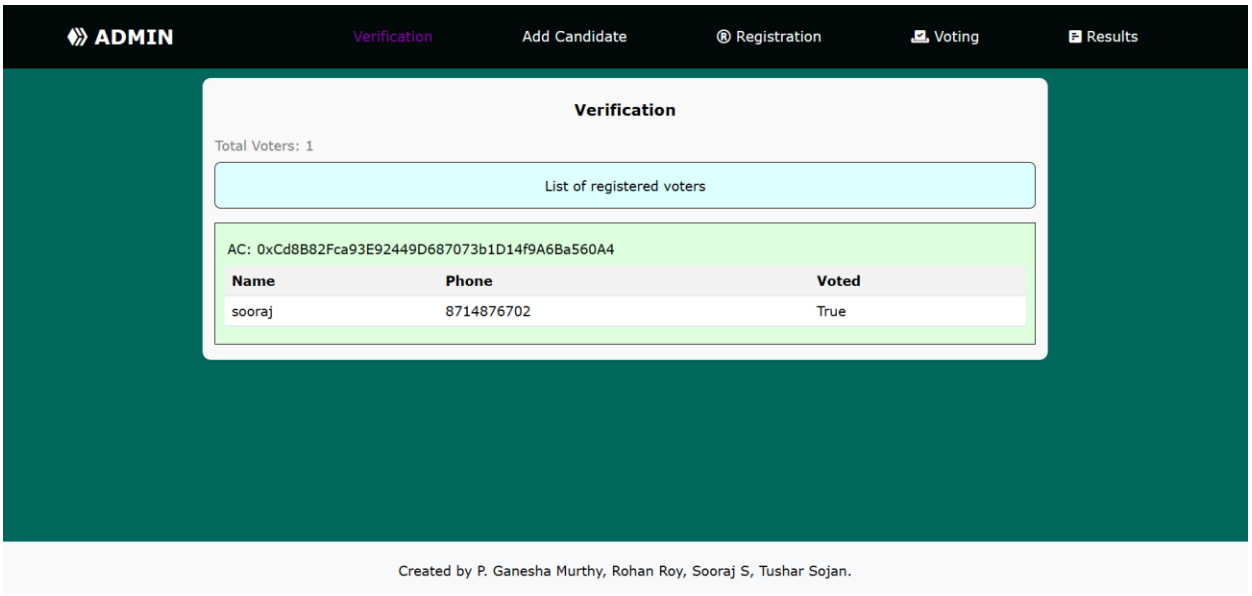

Fig 8 Verified User List

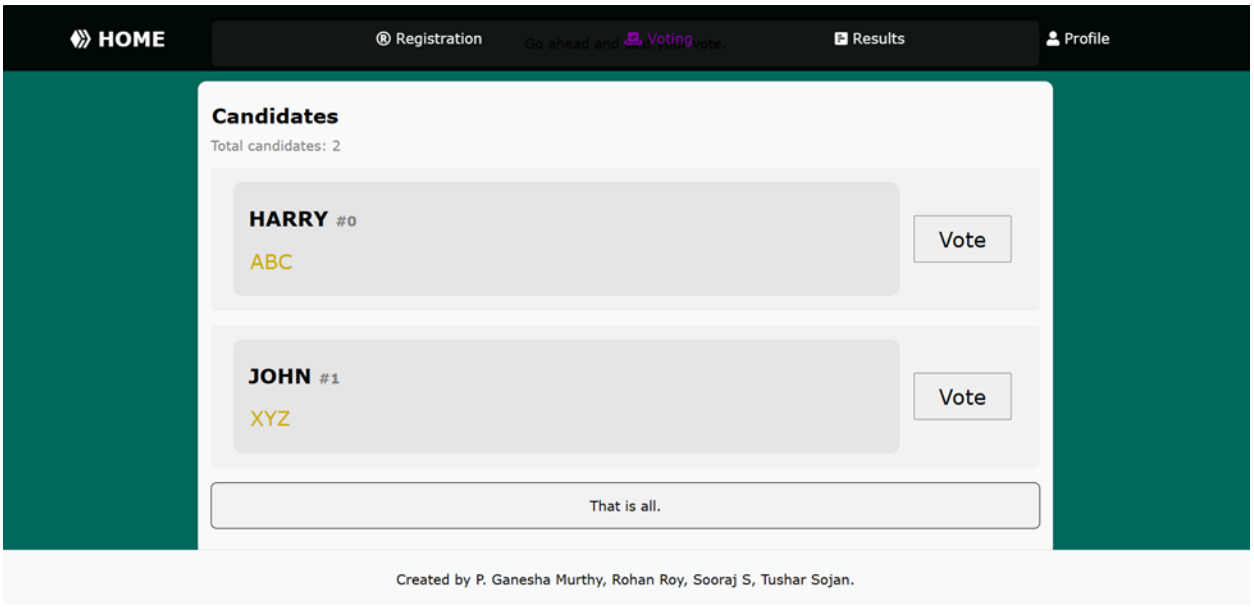

Fig 9 Voting Page

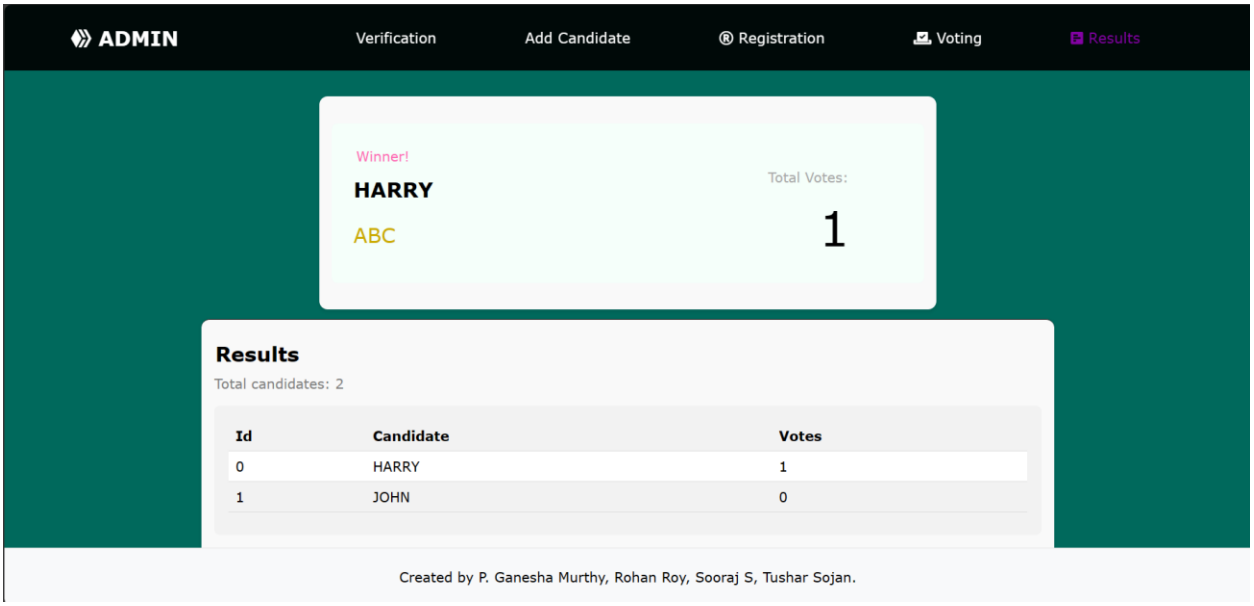

Fig 10 Results Page

6 CONCLUSION & FUTURE SCOPE

6.1 CONCLUSION

The advent of Decentralized Voting using the Ethereum Blockchain marks a transformative era in the realm of electoral processes. This innovative approach harnesses the inherent strengths of blockchain technology to foster a voting environment that is not only secure and transparent but also resilient against fraudulent activities. The immutable nature of blockchain ensures that once a vote is recorded, it is virtually impossible to alter, thereby upholding the sanctity of each individual's vote.

As we continue to refine this technology, we anticipate significant advancements in user experience, making the voting process more intuitive and accessible for all. Scalability solutions are also on the horizon, poised to accommodate a growing electorate without compromising speed or security. Moreover, the integration with emergent technologies such as biometric verification and AI-driven fraud detection systems will further cement the reliability of Decentralized Voting. The potential of this technology extends beyond the mere act of casting a vote; it is a leap towards enhancing civic engagement and participation. By providing a platform that is both trustworthy and efficient, we are empowering citizens to exercise their democratic rights with confidence. The Ethereum Blockchain is not just a tool for voting; it is a beacon for a more engaged, informed, and proactive citizenry.

In conclusion, Decentralized Voting with Ethereum Blockchain is not merely an alternative to traditional voting mechanisms; it is a cornerstone for building a democratic society that values integrity, accountability, and inclusivity. As we embrace this technology, we are taking a significant stride towards a future where every vote is not just counted, but also counts towards the greater good of society.

6.2 FUTURE SCOPE

In shaping the future of decentralized voting on the Ethereum blockchain, our project envisions a streamlined and transparent electoral process through a range of enhancements. Real-Time Vote Counting stands out as a foundational feature, providing immediate updates on election results to bolster transparency and engage voters with timely outcomes.

Secure Voter Identification complements this by employing multi-factor authentication and digital IDs to ensure the integrity of each vote, safeguarding against unauthorized access and preserving the sanctity of the electoral process.

Data Analytics will offer invaluable insights into voting patterns and behaviors, empowering decision-makers with data-driven foundations for policy formulation and campaign strategies. Simultaneously, the integration of AI and Biometrics will fortify fraud detection and voter verification, leveraging cutting-edge technology to uphold the integrity of the vote.

Our project is committed to scalability and user experience enhancements, vital for accommodating a growing electorate and fostering widespread adoption. Government collaboration and legislative advocacy will be pivotal in aligning regulatory requirements and enacting supportive laws and policies for blockchain-based voting systems.

Public education initiatives will demystify the technology, while the development of international standards ensures global interoperability and sets benchmarks for blockchain voting systems worldwide. Inclusivity, environmental considerations, regular security updates, exploration of DAOs for Governance, blockchain interoperability, and post-election analysis will collectively establish a secure, transparent, and inclusive voting system—a beacon of democratic innovation for the future.

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