

BLOCKCHAIN DRIVEN E-VOTING PARADIGM

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Engineering degree in Computer Science and Engineering

By

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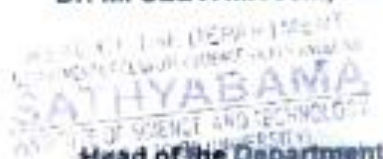
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **DIBYANSHU JAISWAL** (Reg.No - 40110322) and **CHANDAN PATNAIK** (Reg.No - 40110235) who carried out the Project entitled "**BLOCK CHAIN DRIVEN E-VOTING PARADIGM**" under my supervision from November 2023 to April 2024.

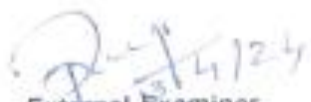

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ABSTRACT

Traditional electoral systems face critical challenges, including concerns related to transparency, security, and centralization. To address these issues and enhance the integrity and efficiency of the voting process, this paper introduces a groundbreaking e-voting paradigm powered by blockchain technology. This innovative approach leverages blockchain's inherent features to provide tamper-proof, immutable recording of every vote, thereby ensuring the utmost transparency. Through this paradigm, each eligible voter obtains a blockchain-based digital identity, creating a secure and verified method for participating in elections. Blockchain's transparency empowers voters to independently verify their votes and confirm the accuracy of their selections. The decentralized architecture eliminates dependence on a single central authority, effectively reducing the risk of fraud and manipulation. Smart contracts play a pivotal role in automating and securing the voting process, minimizing the need for intermediaries and human errors. While this e-voting system presents an exciting prospect for secure, transparent, and accountable elections, it is crucial to address challenges such as voter privacy and coercion prevention, ensuring a fair and robust electoral system for the future. Furthermore, integrating robust encryption methods can further safeguard voter information, ensuring privacy and preventing unauthorized access to sensitive data. Additionally, implementing multi-factor authentication mechanisms can enhance the security of the voting process, preventing unauthorized access to voting platforms and protecting against cyber threats. Moreover, conducting regular audits and assessments can help identify and address any vulnerabilities in the system, ensuring continuous improvement and adaptation to emerging challenges. By incorporating these measures, the proposed blockchain-based e-voting system can not only address existing concerns but also pave the way for a more inclusive, secure, and resilient electoral infrastructure.

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CHAPTER – 1

INTRODUCTION

The act of casting a vote is the cornerstone of any democracy, representing the fundamental right of citizens to have a say in the governance of their nations. However, the traditional electoral systems have long been plagued by challenges, ranging from concerns about transparency, security, and integrity to logistical inefficiencies. In recent years, the emergence of blockchain technology has provided a groundbreaking solution to these problems, ushering in a new era of transparent, immutable, and decentralized electoral systems.

Blockchain, most famous for underpinning cryptocurrencies like Bitcoin, is a distributed ledger technology that offers a novel approach to record-keeping and information security. Its core features, such as decentralization, immutability, and transparency, have the potential to revolutionize the way we conduct elections.

This paper delves into the transformative potential of blockchain-driven e-voting systems, emphasizing the key advantages they bring to the electoral process. It explores how blockchain technology can enhance the integrity of elections by ensuring transparency, preventing tampering with voter data, and enabling secure and accessible voting methods. Additionally, it discusses the implications of this technology on electoral systems and their overall impact on the principles of democracy.

The traditional voting process, which relies on paper ballots and manual counting, is prone to errors, fraud, and inefficiency. Moreover, it often excludes segments of the population, such as expatriates or those with disabilities, who find it challenging to access polling stations. Blockchain-based e-voting promises to address these issues by offering a secure, transparent, and universally accessible alternative.

In this paper, we will delve into the fundamentals of blockchain technology and how it can be applied to modernize and secure the electoral process. We will also explore real-world examples of nations and regions that have embraced blockchain-driven e- voting systems, showcasing their successes and lessons learned.

The implications of this paradigm shift extend beyond the technology itself. The adoption of blockchain-driven e-voting systems raises profound questions about the relationship between governments and their citizens, the role of intermediaries, and the overall structure of democracy in the digital age. We will examine the broader implications of this technological transformation and the challenges that must be overcome to ensure its successful integration into electoral systems.

As we journey through the possibilities and challenges of this blockchain-driven e- voting paradigm, it becomes evident that a future where elections are transparent, immutable, and decentralized is not only within reach but is, in fact, rapidly approaching.

CHAPTER – 2

LITERATURE SURVEY

2.1 LITERATURE REVIEW

A literature survey for a research paper on the topic of "Blockchain-Driven E-Voting Paradigm: Pioneering Transparent, Immutable, and Decentralized Electoral Systems" would require an in-depth examination of relevant academic papers, articles, and resources. Below is a list of key areas and resources you can consider for your literature review:

2.1.1 Votereum: An Ethereum-based E-voting system: Linh Vo-Cao-Thuy, Khoi Cao- Minh, Chuong Dang-Le-Bao and Tuan A. Nguyen, 2019

"Votereum, An Ethereum- based E-voting system", University of Information Technology Vietnam National University HCMC, Vietnam, it reviews the requirements and then propose Votereum, an electronic voting system that utilizes the blockchain technology. The proposed system is empowered by Ethereum platform, including one server manages the entire system and the other handles all blockchain-related requests.

2.1.2 Online Voting: Voting System Using Blockchain: Vaibhav Anasune, Pradeep Choudhari, Madhura Kelapure and Pranali Shirke Prasad Halgaonkar

"Online Voting System Using B-chain", 2019, article gives a short review on various methodologies that are used in current voting. The paper will help to build a system that will face the present and upcoming challenges and will remove drawbacks from these previous architectures.

2.1.3 Decentralized Voting Platform Based on Ethereum Blockchain: David Khoury, Elie F. Kfoury, Ali Kassem and Hamza Harb, 2018

"Decentralized Voting Platform Based on Ethereum Blockchain", Department of Computer Science American University of Science and Technology, we propose a novel approach for a decentralized trustless voting platform that relies on Block-chain technology to solve the trust issues. The main features

of this system include ensuring data integrity and transparency, and enforcing one vote per mobile phone number for every poll with ensured privacy. To accomplish this, the Ethereum Virtual Machine (EVM) is used as the Blockchain runtime environment.

2.1.4 Survey on Blockchain Based E-Voting Recording System Design: G Bhavan, I

“Survey on Blockchain Based E-Voting Recording System Design”, 2018, By adopting blockchain in the distribution of databases on e-voting systems can reduce one of the cheating sources of database manipulation. For encrypting data fetched from fingerprint sensor we are going to use AES algorithm. This research discusses the recording of voting result using blockchain algorithm from every place of election.

2.1.5 Blockchain-Based E-Voting: System: Friðrik Þ. Hjálmarsson , Gunnlaugur K. Hreiðarsson

“Blockchain-Based E-Voting System”, 2018, School of Computer Science Reykjavik University, Iceland, this paper evaluates the potential of distributed ledger technologies through the description of a case study, namely the process of an election and implementing a blockchain-based application which improves the security and decreases the cost of hosting a nationwide election.

2.1.6 Blockchain Based E-Voting Recording System Design: Rifa Hanifatunnisa and Budi Rahardjo, 2017

“Blockchain Based E-Voting Recording System Design”, this recording system occurs when the vote is over. Blockchain technology can be one solution to solve the problems that often occur in the electoral system. Signatures makes the system more reliable. The use of the sequence proposed in the blockchain creation process in this system considers that in an electoral system not required for mining as in the Bitcoin system because the voter data and numbers are clear and are not allowed to select more than once, the proposed sequence which is legally connected and can avoid collision in transportation.

2.2 INFERENCES FROM LITERATURE SURVEY

2.2.1 Growing Interest in Blockchain for E-Voting:

All the surveys indicate a growing interest in using blockchain technology for electronic voting systems. Blockchain is seen as a potential solution to address various issues in traditional voting systems, such as security, transparency, and trust.

2.2.2 Security and Transparency Emphasis:

The surveys highlight the importance of security and transparency in e-voting systems. Blockchain technology is viewed as a means to enhance the security and transparency of the voting process. It can help prevent fraud, tampering, and ensure the integrity of the voting data.

2.2.3 Blockchain's Role in Data Integrity:

The surveys emphasize the role of blockchain in maintaining data integrity. By storing voting records on a blockchain, it becomes extremely difficult to alter or delete these records without detection. This contributes to the overall trustworthiness of the system.

2.2.4 Use of Ethereum Blockchain:

Many of the surveys mention the use of the Ethereum blockchain in their proposed e-voting systems. Ethereum's smart contract capabilities are often leveraged to create decentralized and automated voting processes.

2.2.5 Decentralization and Trustlessness:

Decentralization and trustlessness are recurring themes in these surveys. Blockchain-based e-voting systems aim to reduce the need for centralized authorities, ensuring that no single entity has control over the entire process. Trust is established through the inherent properties of the blockchain.

2.2.6 Efficiency and Cost Reduction:

Some surveys suggest that blockchain-based e-voting systems can potentially

reduce the cost and administrative overhead associated with traditional voting processes. The efficiency of blockchain technology is seen as a benefit.

2.2.7 Privacy and Authentication:

The surveys highlight the importance of voter privacy and authentication. Blockchain-based systems are often designed to ensure that each voter can only cast one vote and that their identity remains confidential.

2.2.8 Use of Cryptographic Techniques:

Several surveys mention the use of cryptographic techniques, such as AES encryption and digital signatures, to enhance the security of the voting process.

2.2.9 Case Studies and Real-world Applications:

Some surveys describe practical implementations or case studies of blockchain-based e-voting systems. These real-world applications help demonstrate the feasibility of such systems.

In summary, these surveys collectively suggest that blockchain technology has the potential to address some of the key challenges in electronic voting, such as security, transparency, and trust. However, the implementation of such systems must carefully consider factors like privacy, authentication, and the choice of the specific blockchain platform to ensure their success.

2.3 OPEN PROBLEMS IN EXISTING SYSTEM

2.3.1 Security Concerns:

Existing voting systems, especially those based on paper ballots or electronic voting machines, are vulnerable to various security threats. One of the primary concerns is the potential for vote manipulation and hacking. Electronic voting machines can be susceptible to malware or tampering, while paper ballots may be subject to fraudulent practices such as ballot stuffing or mishandling. These vulnerabilities raise significant doubts about the integrity of elections. Even though measures like paper trails and security protocols are in place, the risk of cyberattacks and manipulation remains a critical issue. Security

breaches can undermine public confidence in the electoral process, as voters may question the fairness and accuracy of the results.

2.3.2 Trust Issues:

Trust is a fundamental aspect of any electoral system. Many voters, especially in the digital age, have concerns about the trustworthiness of existing election systems. The perceived vulnerabilities and lack of transparency in these systems contribute to these trust issues. Lack of transparency can refer to the inability of voters to verify whether their votes were counted correctly and whether the overall election results are accurate. It can also include concerns about the handling of personal voter data. These trust issues can lead to decreased voter turnout and can potentially erode the public's faith in the democratic process.

2.3.3 Limited Accessibility:

Traditional voting methods, such as in-person paper balloting, may not be accessible to everyone. This limitation can affect individuals with disabilities who may have difficulty physically reaching a polling place or marking a paper ballot. Remote voters, such as those living abroad or in remote areas, also face accessibility challenges. Inaccessible voting systems can lead to disenfranchisement and are inconsistent with the principles of inclusivity and equal representation in a democratic society. Newer voting methods, including electronic and online voting, aim to address some of these accessibility issues but also come with their own security and privacy challenges.

2.3.4 Manual Processes:

Many existing voting systems rely on manual processes for tasks such as vote counting and verification. Manual processes can be time-consuming and labor-intensive, often leading to delays in announcing election results. Additionally, they are susceptible to handwriting or ensuring that votes are accurately transcribed can be challenging. These manual processes can introduce into the election process, potentially undermining the credibility of the results and causing disputes.

CHAPTER – 3

REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

A feasibility study and risk analysis for a blockchain-driven e-voting paradigm focused on pioneering transparent, immutable, decentralized electoral systems is a crucial step in ensuring the success and security of such a project. Below is a comprehensive outline of how you can approach this:

The project encompasses a comprehensive array of crucial components that demand meticulous attention and strategic planning. Firstly, it's imperative to embark upon a journey of clear definition, meticulously outlining the goals and scope of the endeavor. This entails a thorough examination of the desired level of transparency, immutability, and decentralization sought to be achieved within the framework of the proposed e-voting paradigm.

Following this foundational step, a rigorous evaluation of the blockchain technology earmarked for utilization becomes paramount. Whether it be Ethereum, Hyperledger, or any other variant, a meticulous scrutiny of its suitability and scalability vis-à-vis the project's requirements is indispensable. This assessment extends to the holistic examination of the requisite technology stack, encompassing smart contract development and integration intricacies.

The legal and regulatory landscape presents a labyrinth of complexities that necessitate careful navigation. Thus, a granular analysis of the prevailing legal and regulatory requirements governing e-voting systems within the relevant jurisdiction becomes imperative. Moreover, a comprehensive comprehension of potential legal obstacles is crucial to ensure seamless compliance with stringent data protection and privacy laws, thereby fortifying the integrity of the entire process.

Stakeholder engagement emerges as a pivotal facet, necessitating the identification and cultivation of key stakeholders. This eclectic mix may encompass governmental entities, electoral commissions, and, most importantly, the electorate itself.

Understanding their perspectives, gauging their interests, and elucidating the potential benefits of adopting a blockchain-driven e-voting system are instrumental in fostering widespread acceptance and endorsement.

Infrastructure assessment assumes paramount significance in laying the groundwork for a robust and resilient e-voting ecosystem. A meticulous evaluation of the technical infrastructure requisite to support the envisaged system is imperative. Concurrently, a judicious allocation of human and financial resources, both for development and ongoing maintenance, becomes indispensable to sustain the system's longevity and operational efficacy.

The financial viability of the project demands a meticulous estimation of the budgetary requirements. This entails a comprehensive analysis encompassing not only the development costs but also the myriad operational expenses that ensue post-implementation. Additionally, a discerning examination of potential revenue streams or cost-saving avenues assumes significance in ensuring the project's sustainability and long-term viability.

Security considerations loom large in the realm of e-voting systems, necessitating a proactive stance towards fortification. Robust security measures, including but not limited to encryption, multi-factor authentication, and regular security audits, are imperative to thwart potential threats and fortify the system's resilience against malicious actors. A meticulous risk analysis, encompassing potential threats and vulnerabilities inherent in blockchain technology, serves as the bedrock for formulating a comprehensive risk mitigation strategy.

User experience emerges as a pivotal determinant in fostering widespread adoption and acceptance of the e-voting system. Thus, paramount emphasis must be laid on ensuring a seamless, intuitive, and user-friendly interface that caters to the diverse needs of the electorate. Accessibility considerations, including provisions for individuals with disabilities, further underscore the imperative of designing an inclusive and accessible system that leaves no voter behind.

Scalability and performance assessment assumes paramount significance in ensuring the robustness and efficacy of the e-voting system, especially in the face of burgeoning electoral participation. A meticulous evaluation of the chosen blockchain platform's scalability prowess, coupled with rigorous stress testing under varying loads, becomes indispensable in guaranteeing the system's reliability and operational efficacy even during peak voting periods.

3.2 RISK ANALYSIS

The comprehensive evaluation of a blockchain-driven e-voting project necessitates a meticulous examination of the multifaceted technical, operational, and regulatory risks inherent in its implementation. Firstly, technical risks loom large, requiring vigilant mitigation strategies to address vulnerabilities inherent in blockchain technology. This entails a nuanced understanding and proactive mitigation of potential issues such as consensus algorithm vulnerabilities and the looming specter of network attacks, including distributed denial-of-service (DDoS) assaults and other network-level threats.

Data integrity and immutability stand as pillars of the e-voting system's integrity. Ensuring the steadfast maintenance of the blockchain's immutability and fortifying it against unauthorized modifications to the voting data emerges as a paramount concern, demanding robust safeguards and protocols to uphold the sanctity of the electoral process.

Privacy and data protection concerns necessitate a meticulous approach to address potential apprehensions surrounding voter privacy. Implementing robust encryption measures and ensuring stringent compliance with data protection laws are imperative steps to assuage privacy concerns and bolster confidence in the system's integrity.

Navigating the regulatory landscape presents an intricate web of challenges, necessitating a proactive stance towards identifying and mitigating regulatory risks. This entails a comprehensive assessment of potential legal hurdles that may arise from the adoption of blockchain technology in the electoral process, with strategic

measures devised to navigate these challenges adeptly.

Adoption risks loom large on the horizon, demanding a keen understanding of potential resistance or reluctance from stakeholders or voters to embrace the new system. Strategic engagement and proactive communication strategies are indispensable in fostering widespread acceptance and endorsement of the blockchain-driven e-voting paradigm.

Operational risks mandate a prudent approach towards contingency planning, with meticulous preparations laid to address system failures or technical glitches that may arise during voting events. A robust framework for mitigating such contingencies ensures the seamless conduct of electoral processes, safeguarding against disruptions and ensuring voter confidence in the system's reliability.

Budget overruns pose a perennial threat, demanding vigilant monitoring and control of project expenses to forestall budgetary excesses. A judicious allocation of financial resources and stringent adherence to budgetary constraints are indispensable in ensuring the fiscal sustainability of the e-voting project.

Legal challenges pose a formidable obstacle to the integrity and results of the e-voting system, necessitating meticulous preparations to navigate potential legal disputes. Vigilant monitoring and proactive legal strategies are imperative to safeguard the system's integrity and legitimacy.

Public perception emerges as a pivotal determinant of the system's success, underscoring the imperative of managing and nurturing public trust and acceptance. Transparent communication and proactive engagement initiatives are indispensable in shaping a positive public perception of the e-voting system, fostering widespread trust and confidence in its integrity.

Continuous maintenance emerges as a cornerstone of the e-voting system's sustainability, demanding a strategic approach towards ongoing maintenance and updates. A robust strategy for continuous maintenance ensures the system's

resilience and adaptability to evolving challenges, safeguarding its long-term viability and efficacy.

In summary, conducting a comprehensive feasibility study and risk analysis stands as a crucial precursor to the success of a blockchain-driven e-voting project. It serves as a compass, guiding stakeholders through the labyrinth of challenges and complexities inherent in the implementation of a secure, transparent, and decentralized electoral system. By identifying potential pitfalls and charting a roadmap for their mitigation, stakeholders can navigate the tumultuous waters of e-voting implementation with confidence and resilience, ensuring the realization of a vision for democratic governance that is secure, transparent, and inclusive.

3.3 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

3.3.1 Internet

The Blockchain-Driven E-Voting Paradigm is a revolutionary solution aimed at creating a transparent, immutable, and decentralized electoral system. This document outlines the software requirements for the development of this system.

3.3.2 Hardware Specifications:

- Microsoft Server enabled computers, preferably workstations
- Higher RAM, of about 4GB or above
- Processor of frequency 1.5GHz or above
- A laptop/PC with updated version of Windows or MAC OS, to install and run
- the NPM packages

3.3.3 System Overview

The Blockchain-Driven E-Voting Paradigm will consist of a blockchain-based platform that allows voters to securely and transparently cast their votes. The system will have a user-friendly interface, secure authentication, and real-time verification mechanisms.

3.3.4 Functional Requirements

Voter Registration: The system shall allow eligible voters to register, with voter registration information securely stored on the blockchain.

Authentication and Security: Robust authentication mechanisms shall be implemented to ensure only eligible voters participate, utilizing blockchain to ensure the security and immutability of voter data.

Vote Casting: Voters shall be able to cast their votes electronically, with each vote recorded on the blockchain for transparency and integrity.

Verification: Real-time verification of votes by authorized entities shall be facilitated by the system, with verification data accessible via a secure API.

Results Reporting: The system shall provide real-time, transparent, and immutable election results, available for public scrutiny to ensure transparency and accountability.

3.3.5 Non-Functional Requirements

Performance: The system shall effectively handle a large number of concurrent users during elections, with minimal response times for user interactions to ensure a seamless voting experience.

Security: Implementation of encryption and hashing shall fortify the system's security, with regular security audits and penetration tests conducted to identify and mitigate potential vulnerabilities, ensuring the integrity and confidentiality of voter data.

This Software Requirements Specification document serves, outlining the key requirements for the Blockchain-Driven E-Voting Paradigm. It lays the foundation for a transparent, immutable, and decentralized electoral system, ensuring integrity and trust in the electoral process.

CHAPTER – 4

DESCRIPTION OF PROPOSED SYSTEM

The proposed blockchain-driven e-voting paradigm represents a groundbreaking approach to revolutionize electoral systems. By harnessing blockchain technology, it offers unprecedented levels of transparency, immutability, and decentralization, fundamentally enhancing the integrity and security of the electoral process. With each vote recorded as a tamper-resistant transaction on the blockchain, the system ensures a verifiable and unalterable record of all votes cast. This not only bolsters trust in the system but also allows for efficient audits and greater civic engagement.

However, implementing such a system must be approached with careful consideration, addressing concerns surrounding voter privacy, cybersecurity, equitable access, as well as regulatory and legal frameworks. Furthermore, educating the public about the technology's intricacies is crucial for widespread acceptance and adoption.

Moreover, collaboration between government entities, technologists, cybersecurity experts, and civil society organizations is essential to develop robust e-voting platforms that inspire confidence and withstand potential threats. Additionally, continual monitoring and updates to the system are necessary to adapt to evolving security challenges and technological advancements.

Ultimately, this pioneering e-voting system has the potential to reshape how we conduct elections, fostering a more reliable, secure, and inclusive electoral landscape for generations to come. Its successful implementation could serve as a model for democratic processes worldwide, paving the way for greater participation and trust in democratic institutions.

4.1 SELECTED METHODOLOGY OR PROCESS MODEL

Selecting an appropriate methodology or process model is crucial when developing a blockchain-driven e-voting paradigm. In this context, an iterative and flexible approach like "Agile" would be a suitable choice.

Objectives:

- **Enhance Electoral Integrity:** The primary objective is to develop a secure and tamper-proof e-voting system using blockchain technology. This system should prevent common electoral issues like vote rigging, hacking, and manipulation, thereby enhancing the integrity of the electoral process.
- **Increase Transparency:** Create a transparent voting system where every vote and transaction is recorded on an immutable blockchain ledger. This transparency ensures that election results can be independently verified, fostering trust among voters and stakeholders.
- **Protect Voter Privacy:** Develop mechanisms that protect the privacy of voters while still allowing for verifiability. It's important to ensure that individuals can cast their votes anonymously and without fear of their choices being exposed.
- **User-Friendly Implementation:** Design a user-friendly interface and voting process to encourage broader participation in the electoral process. The system should be accessible to a wide range of voters, including those with limited technical expertise, to promote inclusivity in the voting process.

The Agile methodology, known for its adaptability and collaboration, aligns well with the innovative and evolving nature of blockchain technology and e-voting systems. Here's how Agile can be applied:

- **Continuous Iteration:** Agile promotes iterative development, allowing for continuous improvements. This aligns with the dynamic nature of blockchain technology, which may require updates and enhancements over time.
- **Collaboration and Stakeholder Involvement:** Agile emphasizes collaboration between development teams, stakeholders, and end-users. In the case of e-voting, involving various stakeholders, including government authorities, cybersecurity experts, and voters, is essential to ensure the system's success and security.

- **Transparency:** Agile principles emphasize transparency and regular feedback. In the context of a transparent e-voting system, this aligns perfectly with the goals of the project.
- **Risk Management:** Agile methodology encourages risk assessment and mitigation, which is essential in the context of e-voting, where security and privacy are paramount.
- **Scalability:** Blockchain technology may require scalability adjustments, and Agile allows for these changes to be incorporated as needed.
- **User-Centric Design:** Agile focuses on delivering value to end-users. In an e-voting system, this means ensuring that the system is user-friendly, secure, and accessible.
- **Verification and Validation:** Agile incorporates ongoing testing and validation, which is crucial in ensuring the integrity and security of e-voting processes.

It's important to note that while Agile can provide a flexible and adaptive framework for development, it should be implemented with a strong focus on cybersecurity and adherence to regulatory and legal requirements. Additionally, collaboration with blockchain experts and election authorities is essential to create a secure and trustworthy e-voting system.

4.2 ARCHITECTURE/OVERALL DESIGN OF PROPOSED SYSTEM

The architecture for a blockchain-driven e-voting paradigm, designed to be transparent, immutable, and decentralized, comprises several key components that work together to ensure the integrity and security of the electoral process. Below is a proposed system architecture for this innovative e-voting system:

User Interface:

Voters access the system through a user-friendly interface, which can be a web application or a dedicated voting app. This interface allows voters to authenticate

themselves securely and cast their votes.

Identity Verification:

To ensure the eligibility of voters, a secure identity verification system is integrated. This may involve biometrics, digital IDs, or other secure authentication methods.

Blockchain Network:

The core of the system is a permissioned blockchain network that operates on a decentralized consensus mechanism. This network is where all vote transactions are recorded, ensuring transparency and immutability. Popular blockchain platforms such as Ethereum, Hyperledger Fabric, or custom-built solutions may be employed.

Smart Contracts:

Smart contracts are deployed on the blockchain to facilitate the voting process. They handle the logic of the election, such as verifying voter eligibility, securely recording votes, and ensuring privacy.

Voter Registration and Authentication:

Before an election, voter registration data is securely stored on the blockchain, ensuring the immutability of the voter list. Voter authentication is performed securely through cryptographic methods.

Casting Votes:

Voters select their candidates or preferences through the user interface. The smart contract securely records these votes on the blockchain.

Decentralized Nodes:

The blockchain network consists of decentralized nodes operated by various entities, such as government authorities, independent auditors, and election observers. This decentralization ensures that no single entity has complete control over the network.

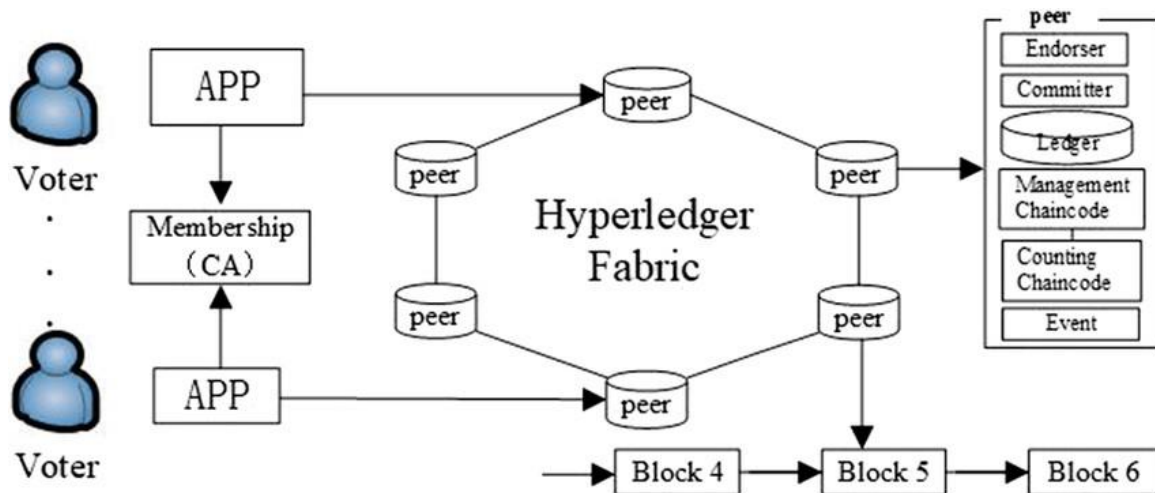


Fig 4.1.1: System Architecture for Blockchain E-Voting System

This proposed system architecture leverages blockchain technology to create a secure, transparent, and immutable e-voting system that enhances trust in electoral processes while maintaining the principles of decentralization and privacy. However, it is essential to collaborate with experts in blockchain technology, cybersecurity, and legal compliance to develop and deploy such a system successfully.

Verification and Auditing:

Independent auditors and observers can access the blockchain to verify the accuracy and integrity of the election results. Auditing is made more efficient due to the transparent and tamper-proof nature of the blockchain.

Secure Data Storage:

Sensitive voter data, such as personal information and voting records, is stored securely on the blockchain with strong encryption and privacy protection mechanisms.

Immutable Records:

Once recorded on the blockchain, votes are immutable and cannot be altered. This ensures the integrity of election results.

Accessibility and Usability:

The system must be designed for accessibility, making it available to all eligible voters, including those with disabilities, and ensuring a user-friendly experience.

Cybersecurity and Compliance:

Robust cybersecurity measures are implemented to protect against cyber threats and to comply with data protection and election laws. Regular security audits and penetration testing are crucial.

Voter Anonymity:

The system must maintain voter anonymity, ensuring that individual votes cannot be linked to specific voters, thereby protecting voter privacy.

Public Interface:

A public interface provides real-time access to election results, allowing citizens, the media, and other stakeholders to monitor the progress of the election.

Transparency and Trust:

The transparency of blockchain technology fosters trust in the electoral process by allowing voters to track their votes and ensuring that no unauthorized changes can be made to the voting data.

Decentralization:

Decentralization reduces the risk of single points of failure and enhances the resilience of the electoral system against hacking or manipulation attempts.

Smart Contract Automation:

Smart contracts can automate various aspects of the election process, such as voter registration, ballot counting, and result tabulation, reducing the potential for human error and increasing efficiency.

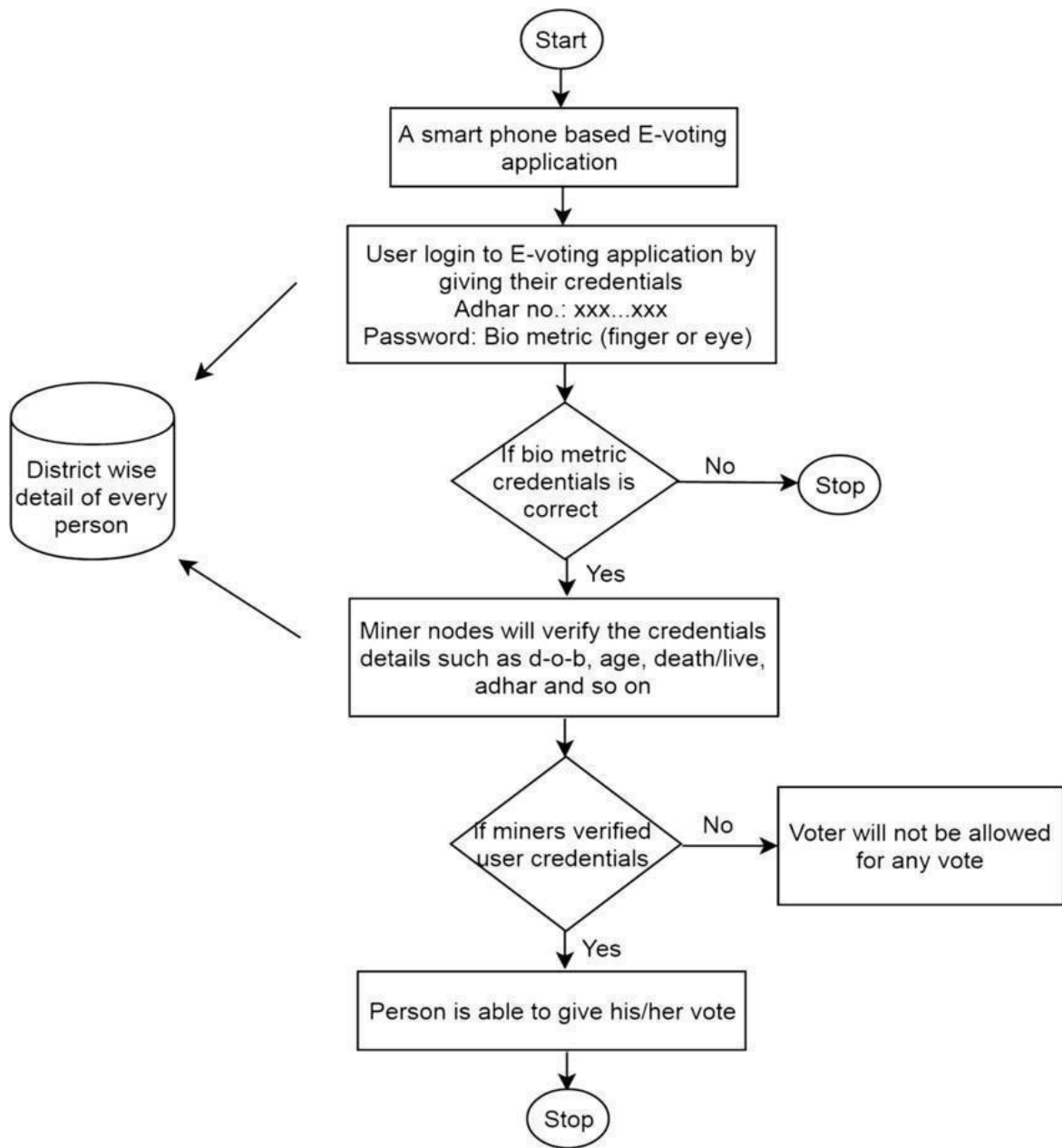


Fig 4.1.2: Flow Chart

4.3 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

The software for implementing the proposed Blockchain-Driven E-Voting Paradigm is a multifaceted system designed to ensure the transparent, immutable, and decentralized operation of electoral processes. It comprises several key components:

Blockchain Infrastructure: The core of the system is a blockchain network, based on a suitable blockchain protocol (e.g., Ethereum, Hyperledger). It records votes as transactions and ensures the security and immutability of data.

Smart Contracts: Smart contracts are used to automate the execution of voting rules, ensuring that each vote is cast, verified, and recorded accurately. These contracts are immutable and self-executing.

User Interface: A user-friendly front-end application allows voters to securely log in, cast their votes, and verify their choices. It provides a smooth and intuitive user experience.

Identity Verification: Robust identity verification mechanisms are integrated to ensure that only eligible voters can participate. This might include biometric authentication, digital signatures, or other secure identification methods.

Security Features: The software includes robust security measures, such as encryption, multi-factor authentication, and threat detection, to safeguard against cyberattacks and unauthorized access.

TESTING PLAN

Unit Testing: Each component of the software, including smart contracts and the user interface, will undergo unit testing to ensure individual functionality and correctness.

Integration Testing: The integration of different software components will be tested to ensure they work seamlessly together. This includes testing the interaction between the blockchain network and the user interface.

Security Testing: Rigorous security testing will be conducted to identify vulnerabilities and ensure the protection of voter data and the blockchain network from potential attacks.

Performance Testing: Performance testing will evaluate the system's ability to handle a large number of concurrent users, ensuring it remains responsive and scalable during peak voting periods.

Usability Testing: Usability testing will be conducted to assess the user interface's intuitiveness and accessibility. Feedback from test users will guide improvements.

Functional Testing: Comprehensive functional testing will confirm that the system operates according to the specified requirements and that votes are accurately recorded and counted.

Load Testing: Load testing will determine how the system behaves under varying levels of load and simulate high-stress scenarios to ensure its reliability during elections.

Compliance Testing: Compliance testing will verify that the system complies with relevant electoral regulations and standards, ensuring its legality and integrity.

End-to-End Testing: End-to-end testing will simulate the entire voting process, from registration to vote casting and tallying, to validate the system's integrity throughout the entire electoral cycle.

Scalability and Redundancy Testing: Testing will be conducted to evaluate the system's ability to scale as needed and maintain operations in the event of component failures.

The software for the Blockchain-Driven E-Voting Paradigm will undergo an exhaustive testing plan to ensure its reliability, security, and compliance with electoral standards. Iterative testing, refinement, and user feedback will be integral to achieving a transparent, immutable, and decentralized electoral system that instills confidence in voters and electoral authorities.

4.4 PROJECT MANAGEMENT PLAN

Project Overview:

- **Goal:** Develop a comprehensive vendor distribution system using .NET to optimize and streamline distribution operations.
- **Objectives:** Enhance order management, inventory control, and route planning for vendors.

Scope:

- Detailed requirement analysis, system design, development, testing, and deployment.
- Integration with vendor and customer portals.
- Mobile app development for on-the-go access.

Risk Management:

- Identification and assessment of project risks.
- Mitigation and contingency plans in place.

Communication:

- Regular status meetings with the project team.

Quality Assurance:

- Testing and quality assurance procedures to ensure system reliability.

Documentation:

- Comprehensive documentation of project specifications, design, and implementation.

4.5 TRANSITION/SOFTWARE TO OPERATIONS PLAN

Transitioning from software development to operational deployment of a blockchain-driven e-voting paradigm necessitates a meticulously planned and executed strategy to ensure a seamless and secure transformation. The process begins with the formulation of a comprehensive deployment strategy, delineating key milestones, timelines, and assigning responsibilities to various teams or individuals. Adopting a phased approach is advisable, commencing with small-scale pilot projects to meticulously test the system's functionality and security before full-scale implementation. This iterative methodology allows for early detection and resolution of any issues, mitigating risks associated with large-scale deployment.

Infrastructure setup is a pivotal aspect of the transition process, requiring meticulous attention to detail. Preparation involves selecting suitable hardware and cloud services, ensuring optimal performance and high availability of the blockchain network and e-voting software. Additionally, robust network security measures must be implemented to safeguard against potential threats, encompassing encryption protocols, stringent access controls, and regular security audits to fortify the system's defenses against evolving cyber threats.

User training is paramount to ensure the smooth adoption and utilization of the e-voting system by election officials, administrators, and voters alike. Extensive training programs should be conducted, emphasizing not only the operational aspects of the system but also best practices in security and adherence to usage guidelines to mitigate the risk of misuse or exploitation. Accessibility considerations are equally crucial to ensure inclusivity, with provisions made to accommodate voters of varying technological proficiency and support for those facing barriers to independent usage, thereby ensuring equitable participation in the electoral process.

Testing and quality assurance procedures are integral to validate the reliability and integrity of the e-voting software. Rigorous testing, including simulated elections, facilitates the identification and rectification of any bugs or vulnerabilities, bolstering confidence in the system's functionality and security. Regulatory compliance is paramount, necessitating close collaboration with election authorities to ensure adherence to relevant laws and regulations, obtaining necessary approvals and endorsements to facilitate a smooth deployment process. Public awareness campaigns play a pivotal role in fostering trust and confidence in the new e-voting system, educating citizens about its transparency, security features, and the importance of active participation in the electoral process.

CHAPTER – 5

IMPLEMENTATION DETAILS

5.1 DESIGN CONSIDERATIONS:

Transitioning to operational deployment of a blockchain-driven e-voting paradigm demands meticulous planning across several crucial fronts. Ensuring voter privacy and anonymity is paramount, necessitating measures to shield votes from identification. Robust security protocols must be established to safeguard against tampering and maintain the integrity of the voting process. Scalability is key, requiring a system capable of handling large transaction volumes efficiently without compromising performance. Accessibility considerations are vital to ensure equitable participation, particularly for voters with disabilities or limited technology access. Transparency is fundamental, allowing voters to verify the accuracy of their votes and fostering trust in the electoral process through publicly accessible records and auditing mechanisms. Thus, a comprehensive approach addressing these facets is essential for a smooth and secure transition to blockchain-driven e-voting.

5.2 BLOCKCHAIN SELECTION:

Selecting a suitable blockchain platform for e-voting hinges on various factors, including scalability, security, decentralization, and ease of development. Popular options like Ethereum, Hyperledger Fabric, and EOS offer distinct advantages tailored to specific needs. Ethereum boasts robust scalability and security features, making it well-suited for large-scale e-voting systems. Hyperledger Fabric, renowned for its permissioned network model, prioritizes security and governance, ideal for deployments requiring stringent access controls. EOS, with its high throughput and low latency, excels in handling a high volume of transactions efficiently, making it a viable option for rapid and secure e-voting. Thus, the choice of blockchain platform must align with the unique requirements and priorities of the e-voting project, ensuring optimal performance, security, and usability.

5.3 SMART CONTRACT DEVELOPMENT:

To implement a blockchain-driven e-voting system effectively, it's essential to develop smart contracts overseeing tasks like voter registration, ballot creation, and tallying. These contracts enforce crucial rules to ensure voter eligibility, prevent double voting, and maintain anonymity. Thoroughly auditing the smart contracts is vital to identify and rectify any security vulnerabilities, enhancing the system's reliability and trustworthiness. Overall, these steps are pivotal for deploying a secure and transparent e-voting platform.

5.4 VOTER REGISTRATION:

To establish a secure voter registration process, eligible voters must be able to register their identities securely. This involves assigning each voter a unique identifier, such as a cryptographic key, to ensure their participation in the voting process. Through this method, voters can securely register their identities, providing a foundation for a reliable and transparent electoral system.

5.5 BALLOT CREATION:

The process of creating digital ballots for each election or referendum is a crucial step in ensuring the integrity and effectiveness of the e-voting system. By including relevant information such as candidates or options along with any necessary instructions or explanations, voters can make informed decisions. Digital ballots offer the advantage of flexibility and accessibility, allowing voters to participate from various locations using different devices. However, careful attention must be paid to the design and presentation of the ballots to ensure clarity and ease of use for all voters, regardless of their technological proficiency or accessibility needs.

5.6 VOTING PROCESS:

Facilitating the voting process in an e-voting system involves providing voters with secure access to the electronic platform, typically through web or mobile

applications. Authentication mechanisms, such as unique identifiers or cryptographic keys, are essential to prevent unauthorized access and maintain the integrity of the voting process. By incorporating robust security measures, voters can cast their votes securely and anonymously, ensuring confidentiality and preventing any attempts at tampering or manipulation. Additionally, user-friendly interfaces and clear instructions are vital to guiding voters through the voting process smoothly and efficiently, minimizing potential barriers or confusion.

5.7 VOTE TALLYING:

Utilizing blockchain technology for real-time recording and tallying of votes is a significant advancement in ensuring the accuracy and transparency of election results. By leveraging the inherent features of blockchain, such as immutability and decentralization, the tallying process becomes more secure and resistant to manipulation. Only valid votes are counted, and the entire process is transparent and auditable, providing stakeholders with confidence in the integrity of the electoral outcome. Real-time tallying allows for quick dissemination of results, enhancing the efficiency and credibility of the electoral process.

5.8 RESULTS VERIFICATION:

Enabling voters and other stakeholders to independently verify election results is essential for promoting transparency and trust in the e-voting system. By providing tools or interfaces for users to audit the blockchain and confirm the fairness and accuracy of the voting process, the system enhances accountability and credibility. Transparent and accessible verification mechanisms empower stakeholders to scrutinize the results, mitigating concerns about potential discrepancies or irregularities. This fosters a culture of transparency and accountability, reinforcing public confidence in the electoral process and its outcomes.

5.9 POST-ELECTION PROCEDURES:

After the conclusion of voting, handling disputes or challenges to the election results is crucial for maintaining trust in the electoral process. Transparent and fair procedures must be in place to address any concerns raised by stakeholders. This may involve independent review boards or arbitration processes to ensure impartiality and adherence to established protocols. Additionally, archiving the election data and results securely is essential for future reference or auditing purposes. By maintaining comprehensive records, the integrity of the electoral process can be upheld, and any discrepancies or irregularities can be investigated thoroughly.

5.10 SECURITY MEASURES:

Implementing robust security measures is paramount to protect the integrity and confidentiality of the e-voting system. Encryption plays a critical role in securing communications and data storage, preventing unauthorized access or tampering. Regular security audits and updates are necessary to address any vulnerabilities promptly and maintain the system's resilience against evolving threats. By prioritizing security, the e-voting system can instill confidence in stakeholders and mitigate risks associated with cyberattacks, fraud, or other malicious activities.

5.11 REGULATORY COMPLIANCE:

Ensuring compliance with relevant legal and regulatory requirements is essential to the successful deployment and operation of the e-voting system. This includes adherence to data protection laws, electoral regulations, and other applicable statutes. Collaborating with legal experts can help address any legal challenges or concerns and ensure that the system meets all necessary requirements. By proactively addressing regulatory compliance, the e-voting system can operate within a framework that safeguards the rights and interests of all stakeholders while upholding the principles of democracy and transparency.

5.12 TESTING AND DEPLOYMENT:

Thorough testing of the e-voting system in a controlled environment is essential to identify and mitigate any issues or shortcomings before live deployment. Pilot tests or simulations can help evaluate the system's performance and functionality under real-world conditions, allowing for adjustments or refinements as needed. By prioritizing testing and deployment best practices, the e-voting system can minimize risks and ensure a smooth transition to live elections, enhancing confidence in its reliability and effectiveness.

5.13 EDUCATION AND TRAINING:

Providing comprehensive education and training for election officials, voters, and other stakeholders is critical to ensuring the successful adoption and use of the e-voting system. Training programs should focus on familiarizing users with the system's features, security protocols, and best practices for effective and secure voting. By empowering stakeholders with the knowledge and skills they need, the e-voting system can maximize participation and promote trust in the electoral process.

5.14 CONTINUOUS IMPROVEMENT:

Gathering feedback from users and stakeholders after each election is essential for identifying areas for improvement and implementing updates or enhancements accordingly. By staying informed about new developments in blockchain technology and e-voting practices, the system can evolve to meet changing needs and address emerging challenges. Continuous improvement fosters innovation and ensures that the e-voting system remains robust, reliable, and secure, maintaining public confidence in its integrity and effectiveness.

CHAPTER – 6

RESULTS AND DISCUSSIONS

Blockchain technology offers significant advancements in the realm of electoral processes, particularly in terms of security and integrity. Its decentralized nature ensures that votes recorded on the blockchain cannot be altered or tampered with, instilling trust in the electoral process and minimizing the risk of fraud or manipulation. Moreover, the transparent and immutable nature of the blockchain enhances transparency and audibility in the voting process, as all transactions, including votes cast, are recorded and verifiable by any interested party. This transparency helps to ensure the accuracy and credibility of election results, fostering confidence among stakeholders.

Accessibility and inclusivity are also bolstered by blockchain-based e-voting systems, which have the potential to improve voter access and participation. By enabling electronic voting from anywhere with an internet connection, these systems can overcome barriers faced by individuals with disabilities or those residing in remote areas. Additionally, the cost and efficiency benefits of blockchain e-voting, such as reducing reliance on physical ballots and manual counting processes, contribute to streamlining the electoral process and enhancing efficiency.

The implementation of secure and transparent e-voting systems built on blockchain technology has the potential to increase voter confidence in the electoral process, thereby encouraging higher voter turnout rates and fostering a more representative democracy. However, several challenges and concerns must be addressed to ensure the success and integrity of such systems. These include technological barriers like scalability and usability, as well as legal and regulatory challenges such as compliance with electoral laws and regulations. Moreover, concerns about the privacy and security of voter data, as well as the potential for cyberattacks or hacking attempts, must be carefully addressed.

Pilot projects and real-world implementations play a crucial role in exploring the feasibility, benefits, and challenges of blockchain-driven e-voting systems. These

initiatives provide valuable insights that inform future developments in the field, guiding ongoing research, testing, and collaboration among governments, technology providers, and other stakeholders. Through continued efforts in research, testing, and collaboration, the full potential of blockchain technology in electronic voting can be realized, paving the way for more secure, transparent, and inclusive electoral processes.

RESULT:

The implementation of blockchain-driven e-voting systems holds promise in enhancing the security, transparency, accessibility, and efficiency of electoral processes. By leveraging blockchain technology, electoral systems can offer increased integrity and confidence in election results, leading to higher voter participation rates and a more representative democracy. However, challenges such as technological barriers, legal and regulatory compliance, and concerns about privacy and security must be addressed to ensure the success and integrity of such systems. Ongoing research, testing, and collaboration are essential in realizing the full potential of blockchain technology in electronic voting.

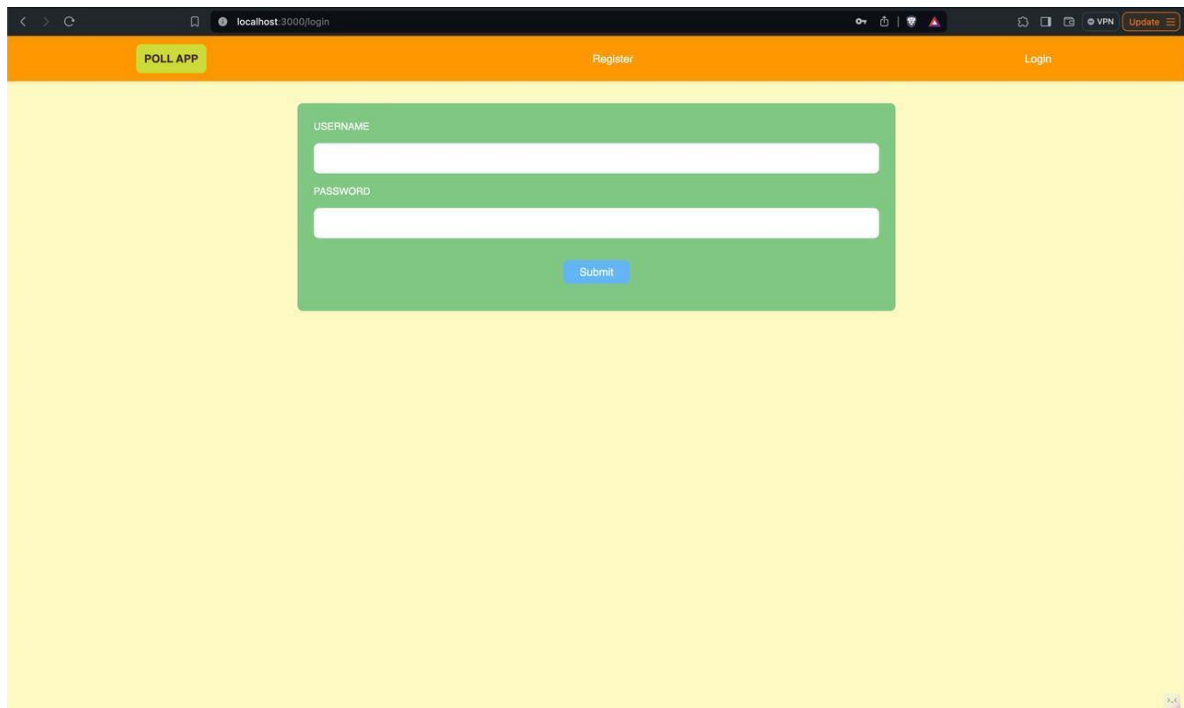
The image is a screenshot of a web browser displaying a login page for a 'POLL APP'. The browser's address bar shows 'localhost:3000/login'. The page has an orange header bar with three links: 'POLL APP' (highlighted in yellow), 'Register', and 'Login'. The main body of the page has a yellow background. In the center, there is a green rectangular form. Inside this form, there are two white input fields: the top one is labeled 'USERNAME' and the bottom one is labeled 'PASSWORD'. Below these fields is a blue button labeled 'Submit'.

Fig 6.1.1: User Login Page

The user login page serves as the gateway to the blockchain-driven e-voting system, representing the initial point of interaction for voters. Designed with a focus on security and accessibility, the login page provides a secure authentication mechanism for users to access the voting platform. Incorporating robust encryption protocols and multi-factor authentication methods, such as biometric verification or one-time passwords, ensures the confidentiality and integrity of user credentials. Additionally, the user login page features user-friendly interfaces and clear instructions, guiding voters through the authentication process seamlessly. By prioritizing usability and security, the login page facilitates a smooth and trustworthy user experience, instilling confidence in the integrity and reliability of the e-voting system.

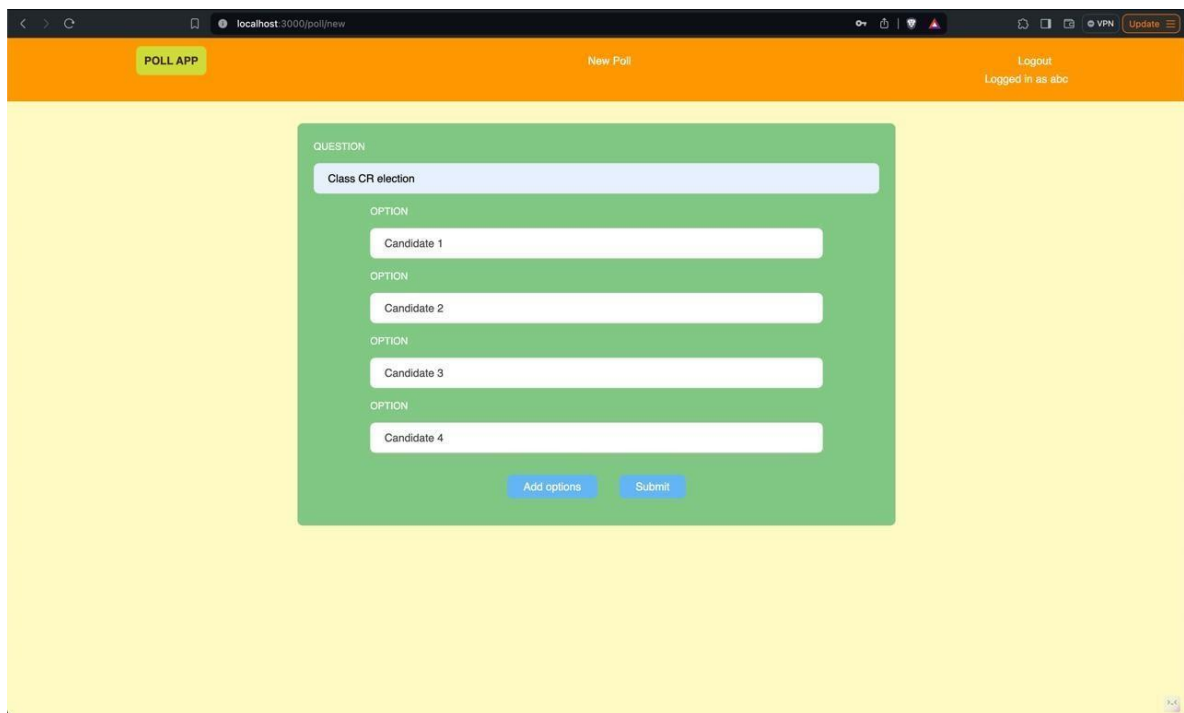


Fig 6.1.2: Create Poll Page

The poll creation process is a pivotal stage in establishing the foundation for a transparent and inclusive voting experience within the blockchain-driven e-voting system. This page serves as the interface through which voters can access and engage with the ballot, shaping the trajectory of the electoral process. Careful consideration is given to the design and layout of the poll page to ensure clarity and accessibility for all users, regardless of their technological proficiency or accessibility

needs. Information regarding candidates, ballot measures, or referendum options is presented in a clear and concise manner, empowering voters to make informed decisions. Moreover, the poll page incorporates mechanisms to safeguard voter privacy and anonymity, such as randomized ballot order and secure encryption protocols. By prioritizing user-centric design principles and leveraging blockchain technology, the poll page creation process facilitates a seamless and trustworthy voting experience, bolstering confidence in the integrity and fairness of the electoral process.

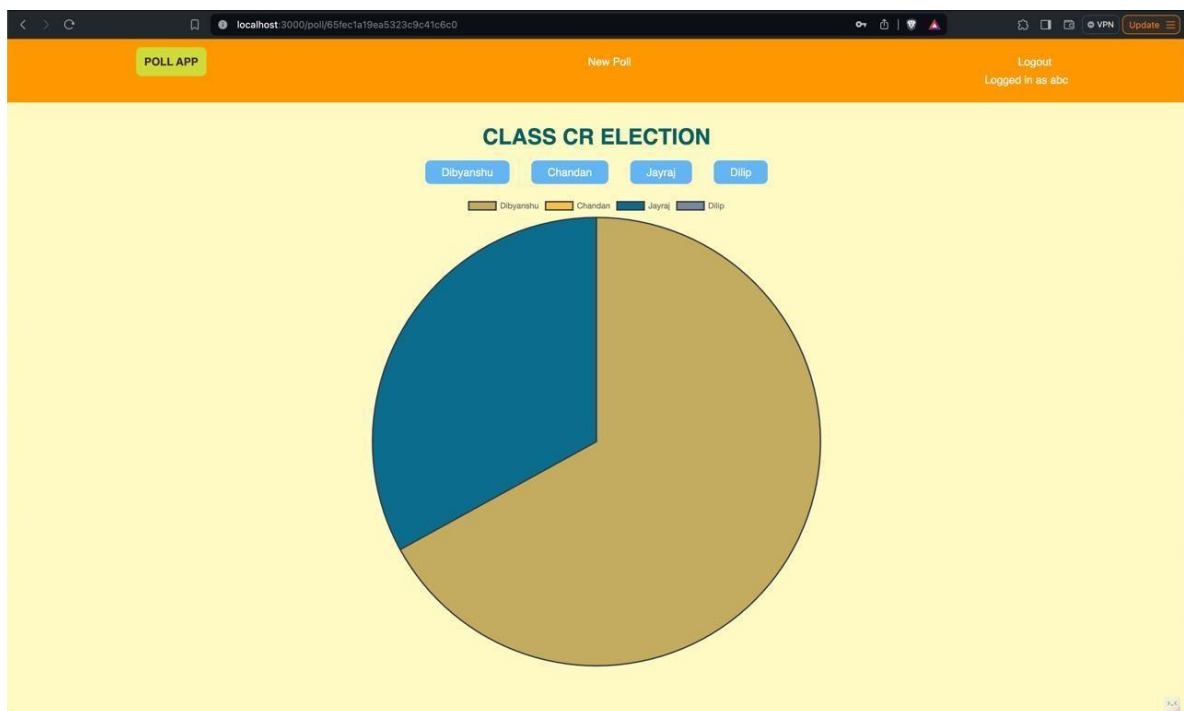


Fig 6.1.3: Poll Results

The presentation of poll results within the blockchain-driven e-voting system marks a pivotal moment in the electoral process, offering transparency and accountability to voters and stakeholders alike. Leveraging the immutable and decentralized nature of blockchain technology, the system ensures that poll results are recorded and tallied in real-time, providing instantaneous access to accurate and verifiable outcomes. Through user-friendly interfaces and interactive visualizations, voters can easily interpret and analyze the data.

CHAPTER – 7

CONCLUSION

The adoption of a blockchain-driven e-voting paradigm holds immense promise for revolutionizing the electoral process. By leveraging the inherent strengths of blockchain technology, such as decentralization, transparency, and immutability, e-voting systems built on blockchain can address longstanding challenges in traditional voting methods while introducing a new era of trust, efficiency, and accessibility in democratic processes.

The implementation of blockchain-driven e-voting offers several key advantages. Firstly, the decentralized nature of blockchain ensures that votes are securely recorded and cannot be tampered with, thereby enhancing the integrity of the electoral process. Furthermore, every transaction on the blockchain is transparent and immutable, allowing for real-time verification of voting results by all stakeholders and fostering trust in the electoral outcome. Additionally, blockchain e-voting systems can expand access to voting for individuals who face barriers to participation, such as those with disabilities or living in remote areas, by enabling them to cast their votes conveniently from anywhere with an internet connection. Moreover, by streamlining the voting process and eliminating the need for paper-based ballots and manual counting, blockchain e-voting systems can reduce costs and improve the efficiency of elections. Lastly, a secure and transparent e-voting system built on blockchain technology can increase voter confidence in the electoral process, leading to higher voter turnout rates and a more representative democracy.

However, challenges and concerns remain, including technological scalability, usability, legal and regulatory compliance, and ensuring the privacy and security of voter data. Addressing these challenges will require collaboration between governments, technology providers, and other stakeholders, as well as ongoing research, testing, and refinement of blockchain e-voting systems.

Despite these challenges, the potential benefits of blockchain-driven e-voting are undeniable. As countries and organizations continue to explore and implement

blockchain technology in the electoral process through pilot projects and real-world deployments, the vision of a more secure, transparent, and inclusive democracy powered by blockchain is within reach. With careful planning, innovation, and commitment to democratic principles, blockchain-driven e-voting has the potential to reshape the future of elections and governance worldwide.

Furthermore, the success of blockchain-driven e-voting systems hinges on the collaboration and cooperation of various stakeholders. Governments, election authorities, technology providers, and citizens must work together to ensure the successful implementation and adoption of these innovative solutions. Transparent communication, stakeholder engagement, and feedback mechanisms are essential to address concerns, garner support, and build trust in the new electoral processes. Moreover, ongoing education and awareness campaigns are necessary to familiarize voters with blockchain technology and its implications for the electoral process. By fostering a culture of collaboration and transparency, stakeholders can collectively navigate the challenges and opportunities presented by blockchain-driven e-voting systems.

In addition to collaboration, ongoing research and development are crucial to advancing the capabilities and functionalities of blockchain e-voting systems. Innovation in areas such as scalability, usability, privacy-preserving techniques, and integration with existing electoral infrastructure is necessary to address the evolving needs and requirements of modern democracies. Through continuous iteration, testing, and refinement, blockchain e-voting systems can evolve into robust, reliable, and adaptable solutions that meet the diverse needs of voters and election authorities worldwide.

7.1 FUTURE WORK:

Future work in blockchain-driven e-voting requires a multifaceted approach encompassing various aspects of technology, policy, and usability. Scalability solutions are necessary to handle large transaction volumes during elections without compromising security. Robust voter authentication methods must be developed to verify voter identity securely while maintaining anonymity. Privacy enhancements, such as advanced cryptographic techniques, are crucial to protect voter privacy and

prevent the linkage of votes to individuals. Usability improvements and accessibility features are essential to ensure that e-voting systems are intuitive and inclusive for all demographics, including those with limited technological literacy or disabilities. Auditing transparency mechanisms are needed to verify the integrity of election results and detect any tampering attempts. Regulatory compliance efforts are essential to ensure that e-voting systems adhere to legal and regulatory requirements, including data protection laws and election regulations. Resistance to various types of attacks, including denial-of-service attacks and manipulation attempts, must be addressed through robust security measures. Hybrid models that combine blockchain technology with other voting methods can enhance the security and trustworthiness of e-voting systems. Education and outreach initiatives are crucial to build trust and confidence in e-voting systems among stakeholders and the general public. Pilot programs and real-world testing are necessary to evaluate the effectiveness of e-voting systems under real-world conditions and identify areas for improvement. Interoperability standards must be established to facilitate communication and compatibility between different e-voting systems. Community engagement efforts are vital to foster collaboration, knowledge-sharing, and open-source development in the e-voting community. International collaboration is essential for developing global standards and best practices for blockchain-driven e-voting, promoting trust, interoperability, and transparency in elections worldwide. By addressing these aspects, researchers and practitioners can contribute to the advancement of secure, transparent, and accessible e-voting systems for the future.

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APPENDIX

A. SOURCE CODE

```
<!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="theme-color" content="#000000">
    <!--
      manifest.json provides metadata used when your web app is added to the
      homescreen on Android. See
https://developers.google.com/web/fundamentals/engage-and-retain/web-app-
manifest/
    -->
    <link rel="manifest" href="%PUBLIC_URL%/manifest.json">
    <link rel="shortcut icon" href="%PUBLIC_URL%/favicon.ico">
    <!--
      Notice the use of %PUBLIC_URL% in the tags above.
      It will be replaced with the URL of the `public` folder during the build.
      Only files inside the `public` folder can be referenced from the HTML.

      Unlike "/favicon.ico" or "favicon.ico", "%PUBLIC_URL%/favicon.ico" will
      work correctly both with client-side routing and a non-root public URL.
      Learn how to configure a non-root public URL by running `npm run build`.
    -->
    <title>React App</title>
  </head>
  <body>
    <noscript>
      You need to enable JavaScript to run this app.
```

```

</noscript>
<div id="root"></div>
<!--
  This HTML file is a template.
  If you open it directly in the browser, you will see an empty page.

  You can add webfonts, meta tags, or analytics to this file.
  The build step will place the bundled scripts into the <body> tag.

  To begin the development, run `npm start` or `yarn start`.
  To create a production bundle, use `npm run build` or `yarn build`.
-->
</body>
</html>
  function getCandidate(uint candidateID) public view returns (uint,string
memory, string memory,uint) {
    return
(candidateID,candidates[candidateID].name,candidates[candidateID].party,cand
didates[candidateID].voteCount);
  }

  {
"short_name": "React App",
"name": "Create React App Sample",
"icons": [
  {
    "src": "favicon.ico",
    "sizes": "64x64 32x32 24x24 16x16",
    "type": "image/x-icon"
  }
],
"start_url": "./index.html",
"display": "standalone",

```

```

    "theme_color": "#000000",
    "background_color": "#ffffff"
  }
  {
    "name": "client",
    "version": "0.1.0",
    "private": true,
    "dependencies": {
      "axios": "^0.18.0",
      "chart.js": "^2.7.2",
      "jwt-decode": "^2.2.0",
      "react": "^16.3.2",
      "react-chartjs-2": "^2.7.2",
      "react-dom": "^16.3.2",
      "react-redux": "^5.0.7",
      "react-router-dom": "^4.2.2",
      "react-scripts": "1.1.4",
      "redux": "^4.0.0",
      "redux-thunk": "^2.2.0"
    },
    "scripts": {
      "start": "react-scripts start",
      "build": "react-scripts build",
      "test": "react-scripts test --env=jsdom",
      "eject": "react-scripts eject"
    },
    "proxy": "http://localhost:4000"
  }
import React from 'react';
import { render } from 'react-dom';

import './index.css';
import App from './containers/App';

```

```

import registerServiceWorker from './registerServiceWorker';

render(<App />, document.getElementById('root'));
registerServiceWorker();
@import './styles/base.css';
@import './styles/reset.css';
@import './styles/utilities.css';
@import './styles/error.css';
@import './styles/navbar.css';
@import './styles/buttons.css';
@import './styles/polls.css';
@import './styles/form.css' // In production, we register a service worker to
serve assets from local cache.

// This lets the app load faster on subsequent visits in production, and gives
// it offline capabilities. However, it also means that developers (and users)
// will only see deployed updates on the "N+1" visit to a page, since previously
// cached resources are updated in the background.

// To learn more about the benefits of this model, read https://goo.gl/KwvDNy.
// This link also includes instructions on opting out of this behavior.

const isLocalhost = Boolean(
  window.location.hostname === 'localhost' ||
    // [::1] is the IPv6 localhost address.
    window.location.hostname === '[::1]' ||
    // 127.0.0.1/8 is considered localhost for IPv4.
    window.location.hostname.match(
      /^127(?:\.(?:25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?) ){3}$/
    )
);

export default function register() {

```

```

if (process.env.NODE_ENV === 'production' && 'serviceWorker' in navigator)
{
  // The URL constructor is available in all browsers that support SW.
  const publicUrl = new URL(process.env.PUBLIC_URL, window.location);
  if (publicUrl.origin !== window.location.origin) {
    // Our service worker won't work if PUBLIC_URL is on a different origin
    // from what our page is served on. This might happen if a CDN is used to
    // serve assets; see https://github.com/facebookincubator/create-react-
app/issues/2374
    return;
  }

```

```

window.addEventListener('load', () => {
  const swUrl = `${process.env.PUBLIC_URL}/service-worker.js`;

  if (isLocalhost) {
    // This is running on localhost. Lets check if a service worker still exists or
not.

```

```

    checkValidServiceWorker(swUrl);

```

```

    // Add some additional logging to localhost, pointing developers to the
    // service worker/PWA documentation.

```

```

    navigator.serviceWorker.ready.then(() => {
      console.log(
        'This web app is being served cache-first by a service ' +
        'worker. To learn more, visit https://goo.gl/SC7cgQ'
      );
    });

```

```

  } else {
    // Is not local host. Just register service worker
    registerValidSW(swUrl);
  }
}

```

```

});

```

```
}  
}
```

```
function registerValidSW(swUrl) {  
  navigator.serviceWorker  
    .register(swUrl)  
    .then(registration => {  
      registration.onupdatefound = () => {  
        const installingWorker = registration.installing;  
        installingWorker.onstatechange = () => {  
          if (installingWorker.state === 'installed') {  
            if (navigator.serviceWorker.controller) {  
              // At this point, the old content will have been purged and  
              // the fresh content will have been added to the cache.  
              // It's the perfect time to display a "New content is  
              // available; please refresh." message in your web app.  
              console.log('New content is available; please refresh.');            } else {  
              // At this point, everything has been precached.  
              // It's the perfect time to display a  
              // "Content is cached for offline use." message.  
              console.log('Content is cached for offline use.');            }  
          }  
        }  
      }  
    }  
  );  
};  
  
})  
  .catch(error => {  
    console.error('Error during service worker registration:', error);  
  });  
}
```

```
function checkValidServiceWorker(swUrl) {
```

```

// Check if the service worker can be found. If it can't reload the page.
fetch(swUrl)
  .then(response => {
    // Ensure service worker exists, and that we really are getting a JS file.
    if (
      response.status === 404 ||
      response.headers.get('content-type').indexOf('javascript') === -1
    ) {
      // No service worker found. Probably a different app. Reload the page.
      navigator.serviceWorker.ready.then(registration => {
        registration.unregister().then(() => {
          window.location.reload();
        });
      });
    } else {
      // Service worker found. Proceed as normal.
      registerValidSW(swUrl);
    }
  })
  .catch(() => {
    console.log(
      'No internet connection found. App is running in offline mode.'
    );
  });
}

export function unregister() {
  if ('serviceWorker' in navigator) {
    navigator.serviceWorker.ready.then(registration => {
      registration.unregister();
    });
  }
}

```

```

:root {
  --danger: #f06292; /* A vibrant pink for warnings */
  --blue: #64b5f6; /* A bright light blue */
  --light: #fff9c4; /* A sunny light yellow */
}

body {
  background-color: var(--light);
}

.button {
  background-color: var(--blue);
  border: none;
  border-radius: 0.5rem;
  color: white; /* White text for better contrast on vibrant backgrounds */
  font-size: 1rem;
  margin: 1rem;
  padding: 0.5rem 1.5rem;
  transition: transform 0.3s ease-out, box-shadow 0.3s ease-out;
}

.button:hover {
  background-color: #ff8a65; /* A fun, softer orange on hover */
  transform: translateY(-2px);
  box-shadow: 0px 10px 15px rgba(0, 0, 0, 0.1); /* Subtle shadow for a "lifting"
effect */
}

.buttons_center {
  display: flex;
  justify-content: center;
}

.error {

```

```
background-color: var(--danger);
text-align: center;
color: white;
width: 70%;
margin: 2rem auto;
padding: 1rem;
border-radius: 0.5rem;
}
```

```
.form {
width: 60%;
margin: 2rem auto;
background-color: #81c784; /* A calming, muted green */
padding: 1.5rem;
border-radius: 0.5rem;
}
```

```
.form-input {
width: 100%;
padding: 0.75rem 1.25rem;
margin: 1rem 0;
border: 1px solid #eeeeee; /* Light border for a soft contrast */
border-radius: 0.5rem;
box-sizing: border-box;
outline: none;
font-size: 1rem;
color: #424242; /* Dark grey for text */
background-color: white; /* Keeping input fields neutral for clarity */
}
```

```
.form-label {
color: white;
text-transform: uppercase;
```

```

    font-size: 0.9rem;
.navbar {
    background-color: #ff9800; /* A strong, energetic orange */
    padding: 1.5rem 0;
}

.navbar-brand {
    background-color: #cddc39; /* Lime green for contrast and fun */
    color: #3e2723; /* Deep brown for readability */
    text-decoration: none;
    padding: 0.75rem;
    border-radius: 0.5rem;
    text-transform: uppercase;
    font-weight: bold;
}

.navbar-container {
    display: flex;
    justify-content: space-between;
    padding: 0 1rem;
}

.navbar-item {
    color: white;
    text-decoration: none;
    cursor: pointer;
    margin: 0 0.5rem;
}

.navbar-user {
    margin-top: 0.5rem;
    text-align: right;
    color: white; /* Maintained for contrast */

```

```

}
.polls li {
  background-color: var(--light);
  color: #33691e; /* Deep green for a natural look */
  padding: 0.75rem;
  text-align: center;
  border-radius: 0.25rem;
  transition: background-color 0.3s;
}

.polls li:nth-child(odd) {
  background-color: #b2ff59; /* Light green for variation */
}

.polls li:hover {
  background-color: var(--blue); /* Bringing in a unifying color on hover */
  color: white; /* Ensure readability */
}

.poll-title {
  color: #006064; /* A deep teal for a splash of sophistication */
  font-size: 2rem;
  margin-top: 2rem;
  text-align: center;
  text-transform: uppercase;
}

* {
  margin: 0;
  padding: 0;
  font-family: sans-serif;
  list-style: none;
}
except mysql.connector.Error as err:
    print(err)

```

```

        raise HTTPException(
            status_code=status.HTTP_500_INTERNAL_SERVER_ERROR,
            detail="Database error"
        )
    .container {
        margin: auto;
        width: 80%;
    }
import { createStore, applyMiddleware, compose } from 'redux';
import thunk from 'redux-thunk';

import rootReducer from './reducers';

const DEFAULT_STATE = {
    auth: { isAuthenticated: false },
    error: { message: null },
    polls: [],
    currentPoll: {
        _id: '5b086e20f7d2381502ce0e46',
        options: [],
        question: 'test_poll',
    },
};

export const store = createStore(
    rootReducer,
    DEFAULT_STATE,
    compose(
        applyMiddleware(thunk),
    ),
);

export const ADD_ERROR = 'ADD_ERROR';
export const REMOVE_ERROR = 'REMOVE_ERROR';

```

```
export const SET_CURRENT_USER = 'SET_CURRENT_USER';
```

```
export const SET_POLLS = 'SET_POLLS';
```

```
export const SET_CURRENT_POLL = 'SET_CURRENT_POLL';
```

```
import { SET_CURRENT_USER } from '../actionTypes';
```

```
const DEFAULT_STATE = {
```

```
  isAuthenticated: false,
```

```
  user: {},
```

```
};
```

```
export default (state = DEFAULT_STATE, action) => {
```

```
  switch (action.type) {
```

```
    case SET_CURRENT_USER:
```

```
      return {
```

```
        isAuthenticated: !!Object.keys(action.user).length,
```

```
        user: action.user,
```

```
      };
```

```
    default:
```

```
      return state;
```

```
  }
```

```
};
```

```
import { ADD_ERROR, REMOVE_ERROR } from '../actionTypes';
```

```
export default (state = { message: null }, action) => {
```

```
  switch (action.type) {
```

```
    case ADD_ERROR:
```

```
      return { ...state, message: action.error };
```

```
    case REMOVE_ERROR:
```

```
      return { ...state, message: null };
```

```
    default:
```

```
      return state;
```

```

    }
  };
import { combineReducers } from 'redux';

import error from './error';
import auth from './auth';
import { polls, currentPoll } from './polls';

export default combineReducers({
  auth,
  error,
  polls,
  currentPoll,
}); import { SET_POLLS, SET_CURRENT_POLL } from './actionTypes';

export const polls = (state = [], action) => {
  switch (action.type) {
    case SET_POLLS:
      return action.polls;
    default:
      return state;
  }
};

export const currentPoll = (state = {}, action) => {
  switch (action.type) {
    case SET_CURRENT_POLL:
      return action.poll;
    default:
      return state;
  }
};

export const ADD_ERROR = 'ADD_ERROR';

```

```

export const REMOVE_ERROR = 'REMOVE_ERROR';

export const SET_CURRENT_USER = 'SET_CURRENT_USER';

export const SET_POLLS = 'SET_POLLS';
export const SET_CURRENT_POLL = 'SET_CURRENT_POLL';

import { addError, removeError } from './error';
import { SET_CURRENT_USER } from '../actionTypes';
import API from '../services/api';

export const setCurrentUser = user => ({
  type: SET_CURRENT_USER,
  user,
});

export const setToken = token => {
  API.setToken(token);
};

export const logout = () => {
  return dispatch => {
    localStorage.clear();
    API.setToken(null);
    dispatch(setCurrentUser({}));
    dispatch(removeError());
  };
};

export const authUser = (path, data) => {
  return async dispatch => {
    try {
      const { token, ...user } = await API.call('post', `auth/${path}`, data);

```

```

    localStorage.setItem('jwtToken', token);
    API.setToken(token);
    dispatch(setCurrentUser(user));
    dispatch(removeError());
  } catch (err) {
    const { error } = err.response.data;
    dispatch(addError(error));
  }
};

};

import { addError, removeError } from './error';
import { SET_CURRENT_USER } from './actionTypes';
import API from '../services/api';

export const setCurrentUser = user => ({
  type: SET_CURRENT_USER,
  user,
});

export const setToken = token => {
  API.setToken(token);
};

export const logout = () => {
  return dispatch => {
    localStorage.clear();
    API.setToken(null);
    dispatch(setCurrentUser({}));
    dispatch(removeError());
  };
};

export const authUser = (path, data) => {

```

```

return async dispatch => {
  try {
    const { token, ...user } = await API.call('post', `auth/${path}`, data);
    localStorage.setItem('jwtToken', token);
    API.setToken(token);
    dispatch(setCurrentUser(user));
    dispatch(removeError());
  } catch (err) {
    const { error } = err.response.data;
    dispatch(addError(error));
  }
};
};

import { ADD_ERROR, REMOVE_ERROR } from '../actionTypes';

export const addError = error => ({
  type: ADD_ERROR,
  error,
});

export const removeError = () => ({
  type: REMOVE_ERROR,
});

export * from './auth';
export * from './error';
export * from './polls';
import API from '../services/api';
import { SET_POLLS, SET_CURRENT_POLL } from '../actionTypes';
import { addError, removeError } from './error';

export const setPolls = polls => ({
  type: SET_POLLS,
  polls,

```

```
});
```

```
export const setCurrentPoll = poll => ({  
  type: SET_CURRENT_POLL,  
  poll,  
});
```

```
export const getPolls = () => {  
  return async dispatch => {  
    try {  
      const polls = await API.call('get', `polls`);  
      dispatch(setPolls(polls));  
      dispatch(removeError());  
    } catch (err) {  
      const { error } = err.response.data;  
      dispatch(addError(error));  
    }  
  };  
};
```

```
export const getUserPolls = () => {  
  return async dispatch => {  
    try {  
      const polls = await API.call('get', 'polls/user');  
      dispatch(setPolls(polls));  
      dispatch(removeError());  
    } catch (err) {  
      const { error } = err.response.data;  
      dispatch(addError(error));  
    }  
  };  
};
```

```

export const createPoll = data => {
  return async dispatch => {
    try {
      const poll = await API.call('post', 'polls', data);
      dispatch(setCurrentPoll(poll));
      dispatch(removeError());
    } catch (err) {
      const { error } = err.response.data;
      dispatch(addError(error));
    }
  };
};

```

```

export const getCurrentPoll = path => {
  return async dispatch => {
    try {
      const poll = await API.call('get', `polls/${path}`);
      dispatch(setCurrentPoll(poll));
      dispatch(removeError());
    } catch (err) {
      const { error } = err.response.data;
      dispatch(addError(error));
    }
  };
};

```

B. SCREENSHOTS

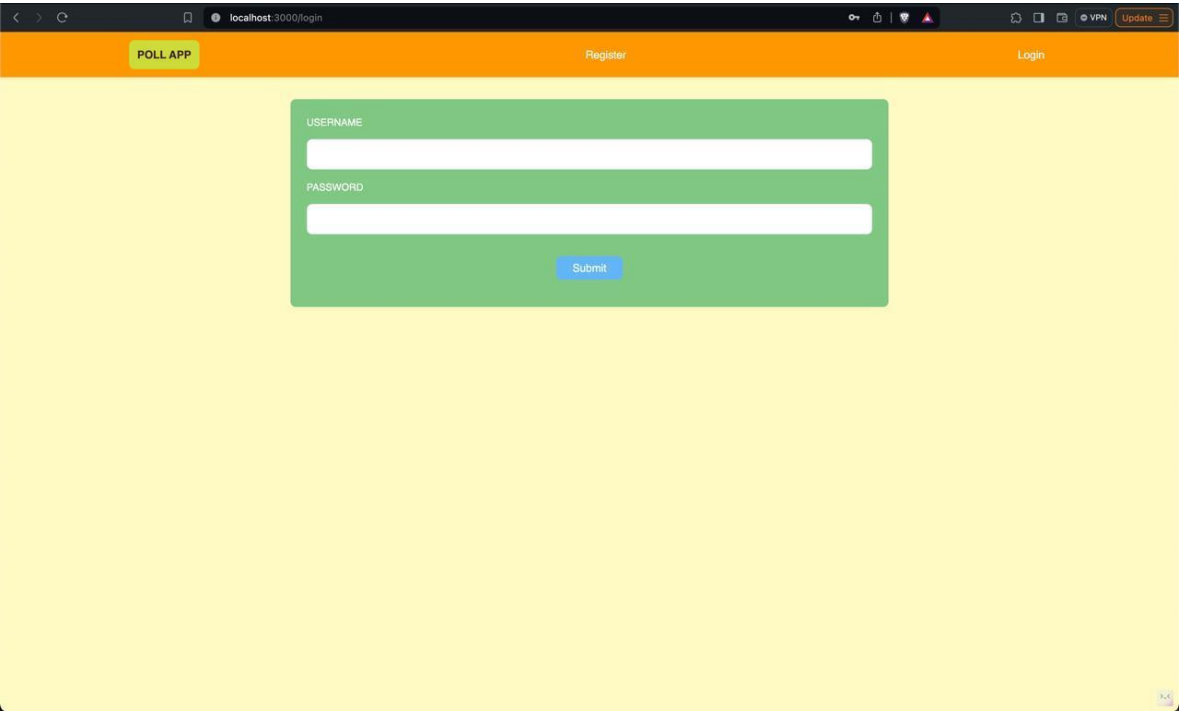


Fig B1: User Login Page

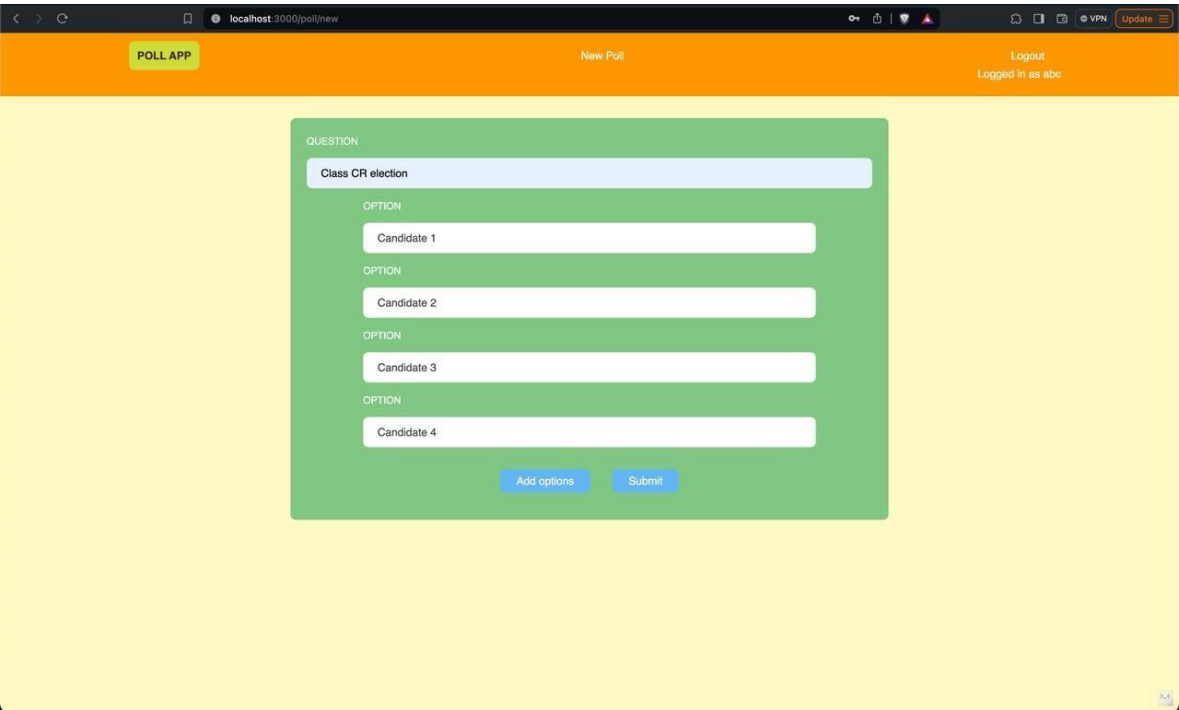


Fig B2: Create Poll Page

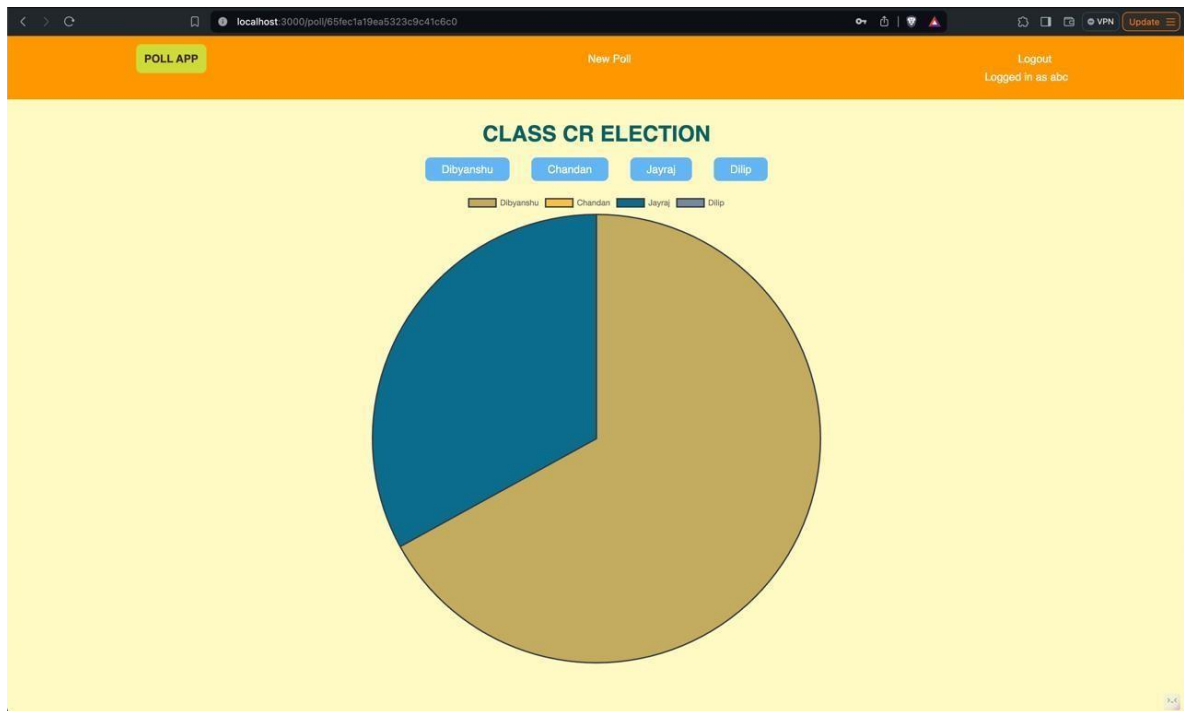


Fig B3: Poll Results