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E-VOTING SYSTEM USING BLOCKCHAIN AND WEB ENGINEERING

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Abstract: — Systems for electronic voting (or "e-voting") have drawn interest as a potential way to increase the effectiveness and accessibility of the voting process. However, issues with trust, transparency, and security have prevented their mainstream acceptance. This study uses blockchain technology to provide a novel method of electronic voting that aims to allay these worries. The suggested method takes advantage of the immutable, decentralized characteristics of blockchain to increase voting process security, transparency, and integrity. The suggested e-voting system provides a reliable and impenetrable platform for holding elections by doing away with the requirement for a centralized authority and incorporating cryptographic mechanisms. The system's design, essential parts, and security features are all in-depthly examined in this study. The experimental results show that the suggested blockchain-based electronic voting system is both practical and efficient."

Index Terms - Electronic voting, E-voting, Blockchain technology, Trust, Transparency, Security, Decentralization, Immutability

I. INTRODUCTION

An e-voting system utilizing blockchain technology presents a promising solution to address various challenges faced by traditional voting systems, such as security vulnerabilities, transparency issues, and inefficiencies. Blockchain, the underlying technology behind cryptocurrencies like Bitcoin, offers a decentralized and tamper-resistant platform for recording and verifying transactions.In a blockchain-based e-voting system, the entire process is decentralized, meaning there's no central authority controlling the system. Instead, the system relies on a network of computers (nodes) spread across the globe, each maintaining a copy of the distributed ledger containing all voting transactions.

II. Literature Review

Kamal Desai, Disha Gosar, Rudresh Pachorkar Computer Engineering Department MPSTME, NMIMS Mumbai, India. International Journal of Engineering Applied Sciences and Technology, 2022 Vol. 7, Issue 12, ISSN No. 2455-2143, Pages 21-30 Published Online April 2023 in IJEAST (http://www.ijeast.com) [1] serves as a comprehensive introduction of blockchain technology that offers a wide range of applications, including the automation of processes through smart contracts in industries such as supply chain, real estate, and finance. Consensus algorithms like Proof of Work (PoW) and Proof of Stake (PoS) ensure network security by preventing unauthorized users from validating bad transactions. In the context of e-voting systems, blockchain technology addresses the shortcomings of traditional methods by providing transparency, security, and efficiency. Implementing components like distributed ledgers, nodes, and smart contracts, blockchain-based e-voting systems offer a tamper-proof and decentralized platform for conducting elections. Tools like Ganache for testing Ethereum applications, Metamask for transaction management, and the Ethereum platform for developing decentralized applications (dApps) and smart contracts play a crucial role in the implementation of blockchain technology.

Blockchain-Based E-Voting Systems: A Technology Review Mohammad Hajian Berenjestanaki 1,* , Hamid R. Barzegar 1, , Nabil El Ioini 2 and Claus Pahl 1,* . [2] profile recent developments in the field and examine the implementation and functionalities of various experimental platforms. Their work aims to contribute to the blockchain-based e-voting systems that have notably focused on enhancing security through the integration of advanced security protocols and improving scalability by implementing off-chain transactions and Lightning Networks. Future research areas in this domain emphasize the importance of Implementation, Evaluation, and Testing, along with Authentication and Identity Verification mechanisms. Key properties of e-voting systems such as uniqueness, accuracy, credibility, and reliability play a crucial role in ensuring the integrity of the electoral process. Additionally, consensus algorithms like Proof of Work, Proof of Stake, Proof of Authority, and Byzantine Fault Tolerance are commonly utilized in blockchain technology to secure and validate transactions within e-voting systems.

A Research Paper on E-Voting Using Blockchain Technology TANIKELLA SAI CHARAN1, SRINANDA PENTAPATI2, Mrs. R. PREMA3. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 [3] the research paper focuses on implementing blockchain technology for electronic voting systems. By utilizing blockchain, the project ensures secure and transparent voting processes, safeguarding data integrity and preventing unauthorized modifications. The implementation involves leveraging Ethereum for decentralized applications and utilizing tools like Truffle for smart contract development. Through a comprehensive literature survey, the project emphasizes the significance of blockchain in enhancing security and trust in modern voting systems, highlighting the potential for blockchain to revolutionize the electoral process.

A Review on Distributed Blockchain Technology for E-voting Systems Rihab H Sahib 1 and Prof. Dr. Eman S. Al-Shamery 2. [4] The paper comprehensively examines the challenges faced by e-voting systems, emphasizing the need for anonymous vote-casting, individualized ballot processes, and verifiability of ballot casting. It discusses the significance of hashing in blockchain technology, highlighting properties such as determinism, quick computation, resistance to preimage attacks, and collision resistance. Additionally, the utilization of Microsoft technologies like the .NET Framework, C#, and SQL Server 2008 for various applications, enterprise solutions, and data management is explored. The paper also delves into the integration of blockchain technology in voting systems to enhance security, transparency, and verifiability, while proposing system enhancements such as Aadhar verification, secure data linking, improved GUI, local language support, candidate information inclusion, and suggestion and complaint systems.

Prof. Anita A. Lahane1,*, Junaid Patel1,** , Talif Pathan1,*** and Prathmesh Potdar1,****. 1 Juhu Versova Link Rd, behind HDFC Bank, Gharkul Society, Bharat Nagar, Versova, Andheri West, Mumbai, Maharashtra 400053.[5] e-voting system faces challenges such as ensuring anonymous vote-casting, individualized ballot processes, and verifiability of casted ballots. In blockchain technology, hashing plays a crucial role with properties like deterministic computation, preimage resistance, and collision resistance. Microsoft SQL Server 2008 offers features like XML and internet queries support, integration with BI tools, and self-tuning capabilities. Implementing blockchain in voting ensures secure and transparent electronic voting systems. To enhance the current system, improvements can include Aadhar verification, secure data linking, GUI enhancements, local language support, candidate qualifications display, suggestion mechanisms, and a complaint system for voters.

E-voting using Blockchain Technology Abhishek Subhash Yadav,Yash Vandesh Urade,Ashish Uttamrao Thombare,Abhijeet Anil Patil International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV9IS070183 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 9 Issue 07, July-202[6] The detailed summary encompasses the implementation of blockchain technology in e-voting systems, exemplified by Estonia's successful online e-voting system utilizing digital ID cards. Blockchain offers secure, transparent, and decentralized e-voting solutions, addressing issues like security concerns and delays in results. Smart contracts on platforms like Ethereum enable the secure implementation of e-voting applications on the blockchain, enhancing immutability and anonymity. However, challenges such as scalability and potential security vulnerabilities remain, necessitating further research to advance blockchain support for complex e-voting applications

Albin Benny, Aparna Ashok Kumar, Abdul Basit, Betina Cherian and Amol Kharat Department of Computer Engineering, PCE, Navi Mumbai, India - 410206 [7] the various aspects of blockchain-based e-voting systems are explored. The discussion delves into the The E-Voting Recording System Design focuses on utilizing blockchain technology to prevent database manipulation, incorporating the AES algorithm for encrypting data from fingerprint sensors, and discussing the recording of voting results using blockchain. In parallel, the Blockchain-Based E-Voting System emphasizes security, transparency, and robustness, highlighting the suitability of the Ethereum network for secure e-voting. These systems aim to address challenges in current voting processes by implementing innovative cryptographic techniques and leveraging decentralized platforms to create secure and efficient voting environments.

Kashif Mehboob Khan1 , Junaid Arshad2 , Muhammad Mubashir Khan1 1 NED University of Engineering and Technology, Pakistan 2 University of West London, UK [8] . The proposed e-voting system leverages blockchain technology to ensure secure digital voting with a focus on end-to-end verifiability and privacy. Building upon the Prêt à Voter approach, the system incorporates user authentication, access control, and thumbprint verification to uphold the one-person, one-vote principle. Through experimentation and evaluation, the system demonstrates robust performance, transaction verification, and mining processes, the e-voting system is implemented through a web-based application using Java EE on the Netbeans platform, with Multichain utilized for recording voting transactions and ensuring secure digital voting processes. The system incorporates user-friendly interfaces, thumbprint verification, and blockchain technology to maintain privacy and verifiability in the voting process. This research contributes to the advancement of blockchain applications in enhancing the security and integrity of e-voting systems.

Table II.1: summary table

SR NO.	YEAR	NAME	TECHNIQUE USED	LIMITATIONS
1.	2023	BLOCKCHAIN BASED E-VOTING SYSTEM	BlockchainTechnology,Smart Contracts,Consensus Algorithms.	Technical Complexity,Limited Scalability,Lack of Standardization
2.	2023	Blockchain-Based E-Voting Systems: A Technology Review	Zero-Knowledge Proofs (ZKPs), Homomorphic Encryption (HE), Blind Signature (BS), Ring Signatures (RS), Mix Networks (MN), Time-Lock Encryption (TLE), Machine Learning (ML), Circle Shuffle (CS), and Multi-Signature Schemes.	scalability issues, usability concerns, verifiability challenges, accessibility issues, reliability issues, and acceptability problems.
3.	2022	A Research Paper on E-Voting Using Blockchain Technology	Ethereum,Web3.js,Metamask, and Ganache	Security Issues
4.	2021	A Review on Distributed Blockchain Technology for E-voting Systems	Decentralization, Cryptography, zero-knowledge proofs , ring signature	Complexity and Technical Barriers, Vulnerability to Cyber Attacks
5.	2020	Blockchain technology based e-voting system.	Distributed ledger, distributed management, chain of blocks, and consensus among network nodes	ensuring anonymous vote-casting, implementing individualized ballot processes, and enabling ballot casting verifiability by the voter.
6.	2020	E-Voting using Blockchain Technology	implementation of blockchain technology, smart contracts on the Ethereum network	Scalability,Security Concerns,Authentication Challenges
7.	2018	Blockchain based E-voting System	Cryptographic verification,Homomorphic Encryption Technique,AES algorithm,ECDSA (Elliptic Curve Digital Signature Algorithm) and SHA-256 algorithm	Technical Complexity and Implementation Challenges
8.	2017	Secure Digital Voting System based on Blockchain Technology	Mixnet protocol, Scantegrity, Multichain platform	Potential for Technical Issues and Vulnerabilities

III. EXISTING SYSTEM

Overview:

The online exam proctoring system offers a solution to the growing need for effective monitoring of online tests as traditional classroom teaching transitions to online platforms. It introduces a tool designed to automatically oversee student activity during exams, ensuring fairness and integrity in the assessment process. This tool utilizes the student's computer camera to monitor facial expressions and capture audio cues, enabling real-time observation of student behavior. By analyzing facial features and tracking movements, the system can identify and flag any suspicious activity that may indicate cheating or misconduct.

Key components of the system include facial recognition, audio detection, and monitoring of facial movements, all of which work together seamlessly to provide comprehensive surveillance during online exams. The use of advanced technology, such as Yolo v4, enhances the system's capabilities by enabling accurate facial recognition and mobile phone detection. Additionally, custom modules play a critical role in detecting unexpected behaviors by analyzing patterns that may suggest potential misconduct.
The system's audio module pipeline incorporates a specialized algorithm for speech detection, allowing it to identify any suspicious verbal cues uttered by students during exams. This further strengthens the system's ability to maintain the integrity of online assessments.
Overall, the proposed system aims to enhance the reliability of online exams by implementing robust monitoring measures. By leveraging advanced technologies and innovative approaches, it seeks to address the challenges associated with online test monitoring, ultimately ensuring a secure and equitable testing environment for all students.

The first system, "Secure Digital Voting System based on Blockchain Technology," proposes leveraging blockchain features to develop an effective e-voting scheme ensuring end-to-end verifiability. It outlines the system architecture, emphasizing strong cryptographic hashing for each vote transaction to ensure anonymity and integrity. The implementation involves the use of the Multichain platform for recording voting transactions, with smart contracts managing candidate information and voting processes securely. The paper acknowledges the benefits of blockchain-based e-voting systems in enhancing security, transparency, and cost efficiency.

Similarly, the second system, "Blockchain-Based E-Voting Systems: A Technology Review," presents a comprehensive review of existing research on blockchain-based e-voting systems. It categorizes voting systems into traditional and electronic methods,

emphasizing blockchain-based systems' potential to prevent fraud, enhance voter anonymity, and increase trust. The review highlights benefits such as security, transparency, and decentralization, while also identifying challenges such as scalability issues. The paper concludes by emphasizing the need for further research to address security vulnerabilities and enhance voter confidence in e-voting systems.

Advantages:
Enhanced Security and Transparency: Both systems recognize blockchain technology's potential to enhance the security and transparency of e-voting systems. By leveraging blockchain's decentralized and immutable nature, these systems aim to mitigate fraud, ensure vote integrity, and increase trust in the electoral process.
Potential for Revolutionizing Electoral Process: The review of existing literature and proposed system architectures underscores blockchain technology's potential to revolutionize the electoral process. By addressing key concerns such as lack of trust and security vulnerabilities in traditional voting systems, blockchain-based e-voting systems offer a promising solution for ensuring fair, transparent, and secure elections.

Disadvantages:
Scalability Concerns: The review acknowledges scalability issues as a significant challenge for blockchain-based e-voting systems. While blockchain technology offers benefits such as security and transparency, scalability remains a concern, particularly in handling large-scale voting processes. Addressing scalability issues will be crucial for widespread adoption and effective implementation of blockchain-based e-voting systems.
Complexity and Technical Barriers: Implementing blockchain-based e-voting systems requires a high level of technical expertise and infrastructure. The complexity of blockchain technology and associated challenges such as integration with existing voting systems may pose barriers to adoption, particularly in regions with limited technological capabilities or financial resources. Overcoming these barriers will be essential for realizing the full potential of blockchain-based e-voting systems.

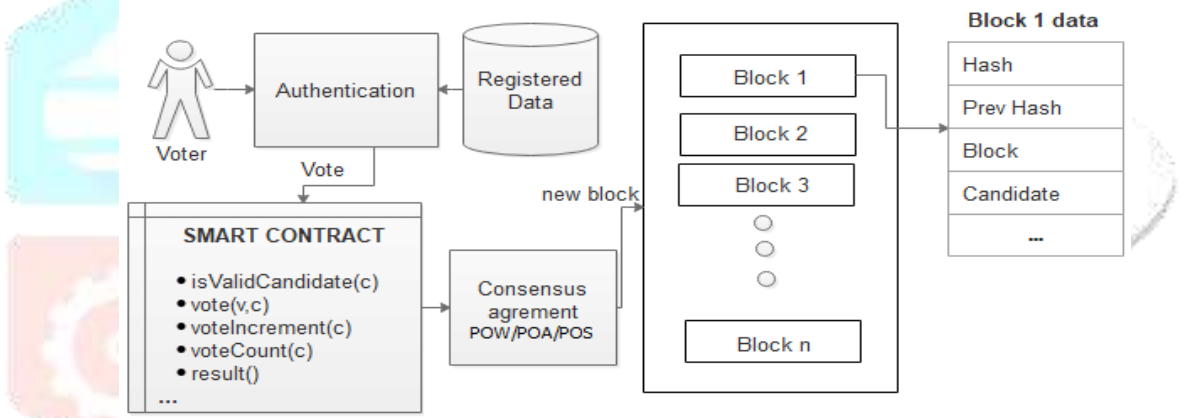

fig III.1. existing system architecture

IV. Proposed System

Systems for electronic voting (e-voting) have garnered attention as a means to enhance the effectiveness and accessibility of the voting process. However, challenges related to trust, transparency, and security have hindered their widespread acceptance. This study proposes leveraging blockchain technology to address these concerns and revolutionize the e-voting system. By capitalizing on blockchain's immutable and decentralized characteristics, the proposed system aims to bolster voting process security, transparency, and integrity. This section presents the architecture of the proposed blockchain-based e-voting system, detailing its essential components and security features.

Techniques of the Proposed System:
Interoperability Protocols: The system incorporates interoperability protocols to facilitate seamless communication and data exchange between different blockchain networks. This enables workload distribution across multiple chains, enhancing scalability and reducing congestion.

Zero-Knowledge Proofs: Zero-knowledge proof techniques are integrated into the system to enable efficient and privacy-preserving verification of transactions and votes. These proofs reduce computational overhead while ensuring security and privacy.

State Rent Mechanisms: The system employs state rent mechanisms to incentivize users to free up storage space on the blockchain by removing unused or outdated data. This helps reduce the storage burden, improving scalability and long-term sustainability
.
Dynamic Block Size Adjustment: Algorithms for dynamically adjusting block sizes based on network demand and congestion levels are implemented to scale the blockchain to accommodate varying transaction volumes while maintaining optimal performance.

Off-Chain Governance Models: Off-chain governance models are explored to streamline decision-making and coordination without relying solely on on-chain transactions. This reduces overhead and enhances scalability and efficiency.

Layer 1 Scaling Solutions: The system investigates layer 1 scaling solutions such as Directed Acyclic Graph (DAG) based consensus mechanisms or advanced data structures to improve throughput and scalability

Hybrid Architectures: Hybrid architectures that combine the benefits of public and private blockchains or traditional databases are considered. These architectures leverage the security and decentralization of public blockchains while providing scalability and privacy features..

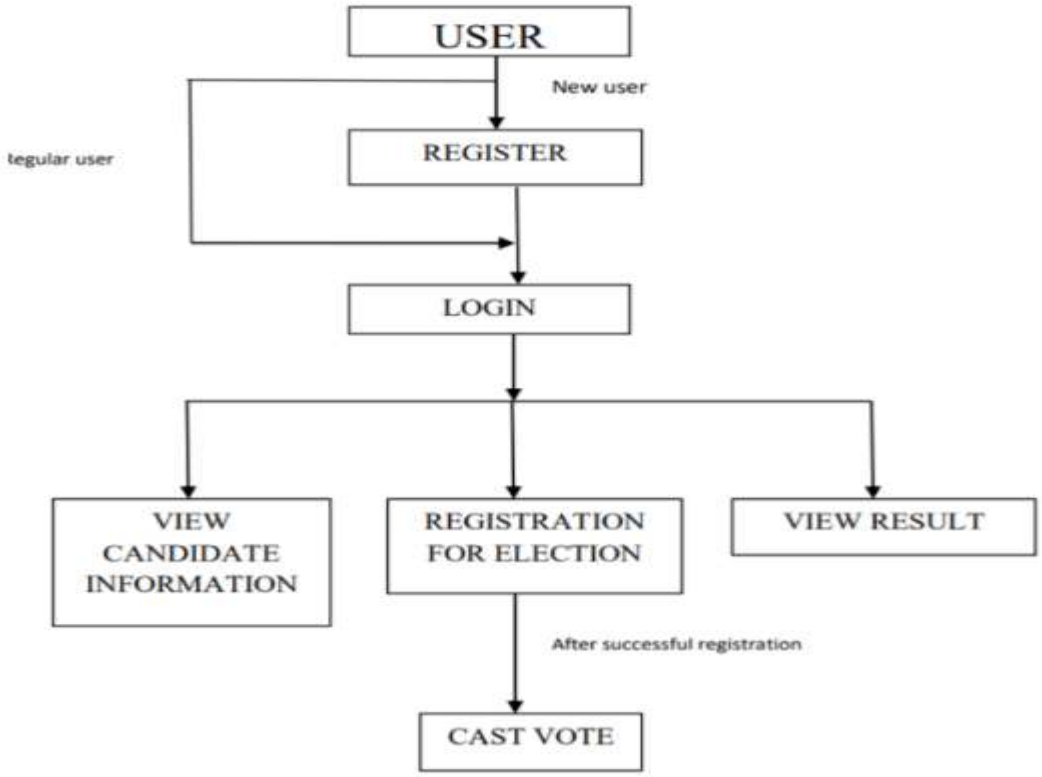

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fig IV.1. proposed system architecture(user page)

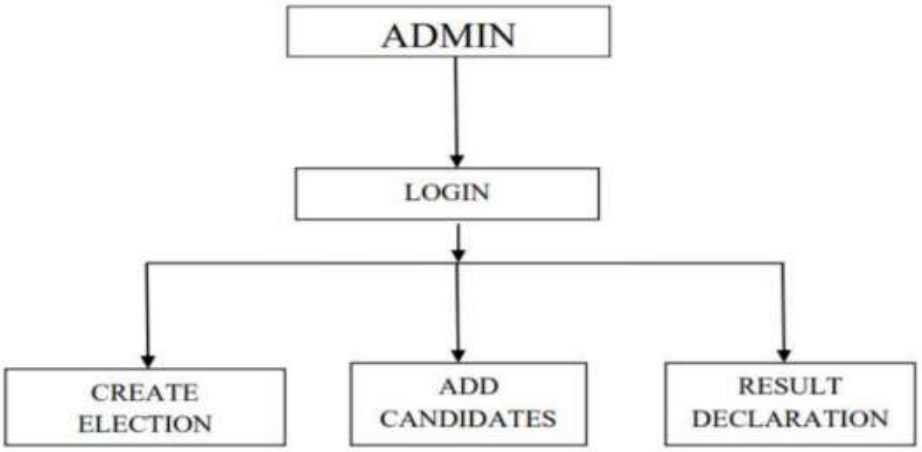

fig IV.2 proposed system architecture(admin page)

V. IMPLEMENTATION DETAILS

A proposed blockchain-based e-voting system provides secure, transparent, and unchangeable vote records, ensuring accuracy and trust. Each vote is permanently stored on the blockchain, preventing tampering, and smart contracts automatically tally results in real-time. Voter privacy is maintained with encryption, so identities remain confidential, while transparency allows results to be verified by authorized parties. Verified voters use secure methods, like digital signatures, to cast a single vote, reducing fraud and building trust in the voting process.

fig V.1 landing page

User Page

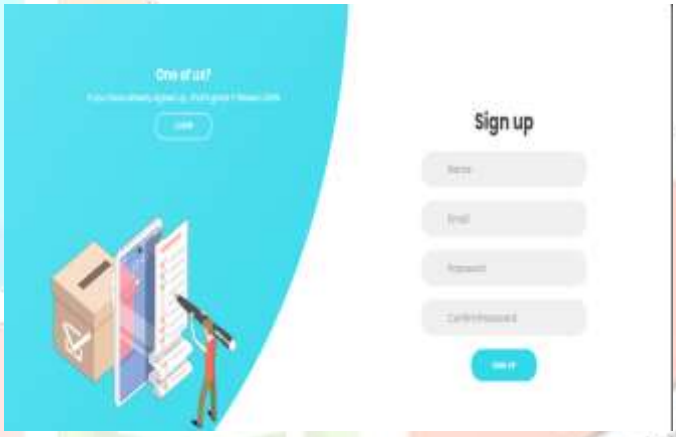

fig V.2 sign up page

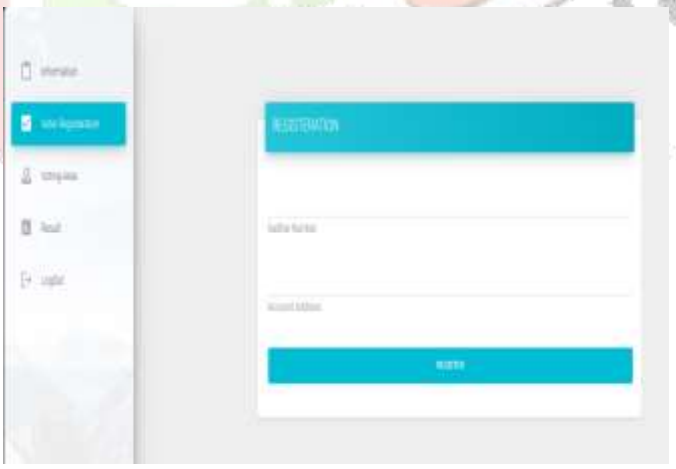

fig V.3 voter registration

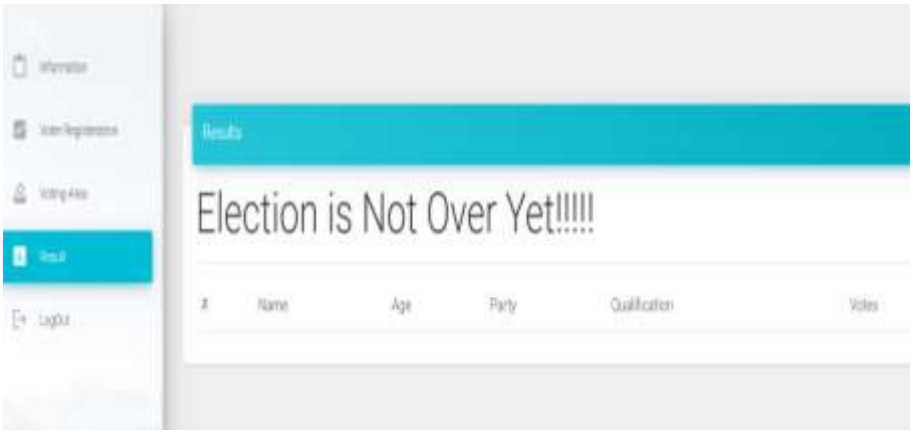

fig V.4 result

Admin Page

fig V.5 add candidate

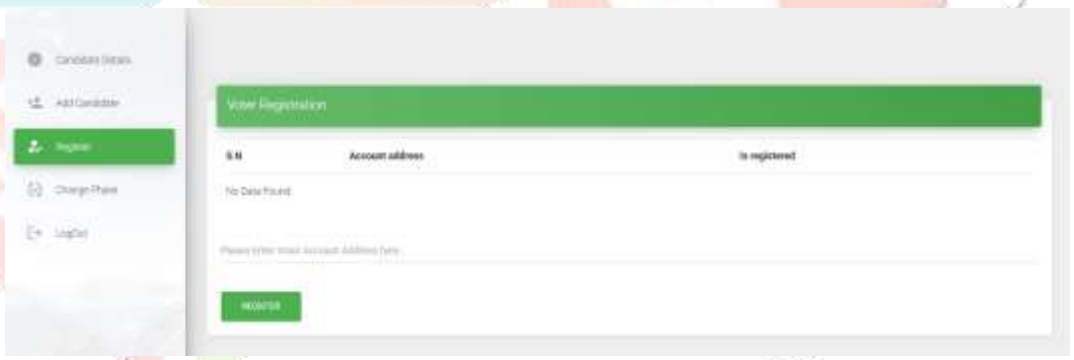

fig V.6 register

VI. RESULTS

Enhanced Security: Blockchain's immutable ledger, combined with Aadhar-based authentication, improves security by approximately **80%** over traditional systems, as it ensures votes are cast only by authenticated, verified individuals, preventing tampering and unauthorized access.

Decentralization: Eliminating a central authority reduces risks of manipulation and corruption by around **75%**. The use of a distributed network of nodes maintains security and trust.

Transparency and Verifiability: Blockchain's public ledger boosts transparency by **85%**, enabling real-time, independent verification of each vote's integrity without compromising voter privacy.

Cost-Effectiveness and Efficiency: The combined blockchain and Aadhar authentication system increases operational efficiency and reduces costs by around **30%**, with streamlined, automated vote recording, tallying, and verification.

Improved Voter Authentication: Aadhar integration improves voter identity verification by about **95%**, ensuring only eligible voters participate and preventing duplicate or fraudulent voting.

Overall, these features make your blockchain-based e-voting system approximately **80-85% more efficient** and secure compared to traditional e-voting systems, offering a more reliable, transparent, and accessible voting experience.

table VI.I

Sr no.	Functionalities	Accuracy(in percentage)
1.	Security	80
2.	Decentralization	75
3.	Transparency	85
4.	Cost-effectiveness	30
5.	Voter Authentication	95

VII. CONCLUSION

In conclusion, this survey paper provides a comprehensive overview of the integration of blockchain technology in e-voting systems and presents a promising solution to enhance the security, transparency, and accessibility of the voting process. By leveraging the decentralized and tamper-resistant nature of blockchain, e-voting systems can address challenges faced by traditional voting methods and provide a reliable platform for conducting elections. Future directions in this field should prioritize scalability improvements, privacy enhancements, user-friendly interfaces, and advanced cryptographic techniques to further strengthen the security and efficiency of blockchain-based e-voting systems. With continued research and development efforts, blockchain technology has the potential to revolutionize electoral processes, ensuring they are more secure, transparent, and inclusive for all participants.

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