**BLOCKVOTE- Blockchain based voting system**

**Project report in partial fulfillment of the requirement for the award of the degree of**

**Bachelor of Technology**

**In**

**CSE ( IOT )**

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**CERTIFICATE**

This is to certify that the project titled e-voting system submitted by **Surjyakamal Saha(University Roll No. 12021002029043), Abhijay Dutta (University Roll No. 12021002029162), Souvik jana (University Roll No. 12021002029067),Tanmoy Saha(University Roll No.12021002029033), Suvaditya Roy (University Roll No. 12021002029052), Spandanil Dutta (University Roll No.12021002029056), Aninda Mojumdar (University Roll No. 12021002029129), Sourav Maity (University Roll No. 12021002029054)and Arnab Roy (University Roll No. 12021002029185)** students of UNIVERSITY OF ENGINEERING & MANAGEMENT, KOLKATA, in partial fulfillment of requirement for the degree of Bachelor of C.S.E (I.O.T), is a bonafide work carried out by them under the supervision and guidance of Dr. Siddhartha Roy during 6th Semester of academic session of 2023-2024. The content of this report has not been submitted to any other university or institute. I am glad to inform that the work is entirely original and its performance is found to be quite satisfactory..

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Signature of Head of the Department

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**ABSTRACT**

In the digital era, the integrity of electoral processes is a paramount concern. “BlockVote” introduces a transformative approach to voting by leveraging blockchain technology, ensuring transparency, security, and accessibility. This project utilizes a Python-based model incorporating libraries such as hashlib, urllib, json, and Flask to create a decentralized platform where votes are cast as transactions on a blockchain. The immutable nature of blockchain, combined with the model’s innovative use of cryptographic functions, provides a verifiable and tamper-proof system. “BlockVote” stands as a pioneering solution that could redefine the future of democratic elections, making them more resilient against fraud and manipulation. The project not only demonstrates the practical application of blockchain beyond cryptocurrencies but also paves the way for a more inclusive voting mechanism that can be adopted globally.

**INTRODUCTION**

In the contemporary landscape of technological advancements, the sanctity of electoral processes is a cornerstone of democratic societies. Traditional voting systems, while having served the purpose for centuries, are increasingly under scrutiny for their vulnerability to fraud, lack of transparency, and inefficiencies. The advent of blockchain technology offers a beacon of hope, promising to address these longstanding issues with its inherent characteristics of immutability, decentralization, and security.

“BlockVote” emerges as a groundbreaking application of blockchain technology tailored specifically for voting. At its core, the project harnesses the power of Python, a versatile programming language, to construct a blockchain-based model that redefines the voting paradigm. The model, named “BlockVote,” is built upon a foundation of robust libraries such as **hashlib** for cryptographic hash functions, **urllib** for handling URL manipulations, **json** for lightweight data interchange, and **Flask** for web framework functionalities, among others.

The project’s inception was driven by the imperative need to mitigate the risks associated with conventional voting systems. These risks include ballot tampering, voter impersonation, and the cumbersome nature of manual vote counting. “BlockVote” addresses these challenges head-on by creating a transparent and auditable digital ledger where each vote is recorded as a unique, unalterable transaction. This ledger not only ensures the integrity of each vote but also facilitates real-time vote tallying, thereby expediting the electoral process. The architecture is meticulously designed to ensure user anonymity while maintaining the traceability of votes. Utilizing cryptographic techniques, the system assigns a digital signature to each vote, which is then verified against the voter’s public key, ensuring that the vote is both authentic and unforgeable. The decentralized nature of the blockchain means that no single entity has control over the entire voting process, thus eliminating the possibility of systemic manipulation.

Furthermore, “BlockVote” incorporates a user-friendly interface, making the voting process accessible to a broader demographic. By simplifying the voting procedure, the project aims to increase voter turnout and participation, particularly among populations that have historically been disenfranchised or faced barriers to voting. “BlockVote” is not merely a technological innovation; it is a step towards fortifying democracy. It embodies the principles of fairness, accountability, and inclusivity, which are the hallmarks of a healthy democratic process. As the project unfolds, it holds the potential to revolutionize the way votes are cast and counted, paving the way for a future where every vote is not just counted, but also counts.

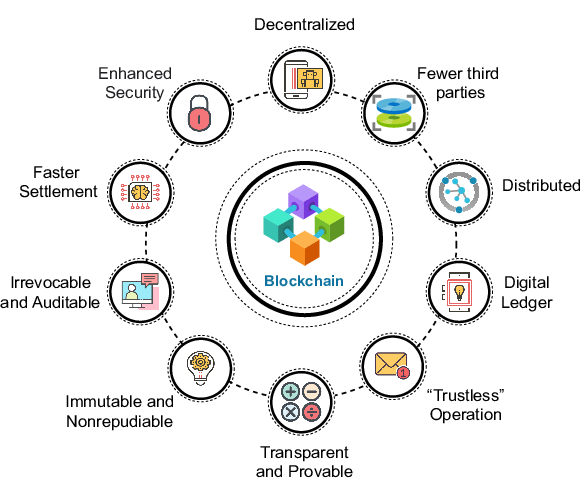


Fig 1. A schematic diagram showing all the key features of blockchain technology.

**2: LITERATURE SURVEY**

Numerous existing E-voting systems exhibit a range of benefits and issues, with notable concerns including security vulnerabilities, lack of transparency, and authentication challenges. The emergence of hybrid blockchain technology presents a promising solution to address these issues. One such system, introduced by Rathee et al., leverages IoT and blockchain to create a secure and transparent E-voting environment. While initially assuming the trustworthiness of all involved entities, this system effectively detects and mitigates threats posed by intruders aiming to manipulate votes. Performance evaluation encompasses parameters like message alteration, denial of service attacks, and authentication delay.

Similarly, Pawlak et al. propose an auditable blockchain voting system (ABVS) designed for end-to-end verifiability. However, concerns regarding voter identity security and computational complexity limit its scalability to small-scale systems. Panja and Roy present an end-to-end verifiable voting system that enhances voter trust by allowing them to verify the recording and integration of their votes. Meanwhile, Mccorry et al. suggest an Internet-based voting system with a flexible consensus algorithm and smart contracts, albeit facing challenges related to robustness, latency, and privacy. To address authentication concerns, Kumar et al. propose a technique combining blind signature and short signature schemes, alongside elliptic curve cryptography for data transfer security. Yi advocates for a modified E-voting system utilizing Non-Interactive Zero-Knowledge proofs to ensure voting validity.

Panja et al. introduce an end-to-end verifiable DRE-based E-voting system utilizing homomorphic encryption for voter verification without compromising vote secrecy. Other proposals, such as those by F´aber et al. and Frooq et al., emphasize cryptographic techniques and flexible consensus algorithms to enhance system trust and scalability. Divya and Usha's system focuses on robust voter registration and authentication, while Malkawi et al. propose a novel BC-based E-voting system for legislative elections. Goyal et al. advocate for decentralized election processes in India, integrating machine learning with blockchain technology.

Security-focused approaches by Panja and Khan explore blockchain-based E-voting systems, addressing transaction pliability attacks and ensuring system resilience. Killer et al. introduce a practical BC-based voting system prioritizing security and efficiency, while Abuidris et al. propose a hybrid consensus model combining proof of credibility and proof of stake for scalability and security. Suralkar et al. and AboSamra et al. both develop secure E-voting systems utilizing blockchain and cryptographic techniques, though scalability concerns persist

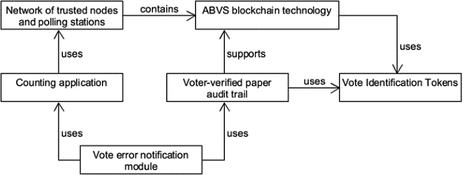


Fig 2. Auditable blockchain voting system (ABVS) designed for end-to-end verifiability

**3: PROBLEM STATEMENT**

The essence of democracy lies in the ability of citizens to freely and fairly elect their representatives. However, the current voting systems across the globe are plagued with issues that undermine the democratic process. Traditional paper-based voting systems are not only resource-intensive but also prone to human error, fraud, and manipulation. The centralized nature of these systems often results in a lack of transparency and trust among the electorate. Moreover, the logistical challenges of setting up and managing polling stations can disenfranchise voters, particularly those in remote or conflict-affected regions.

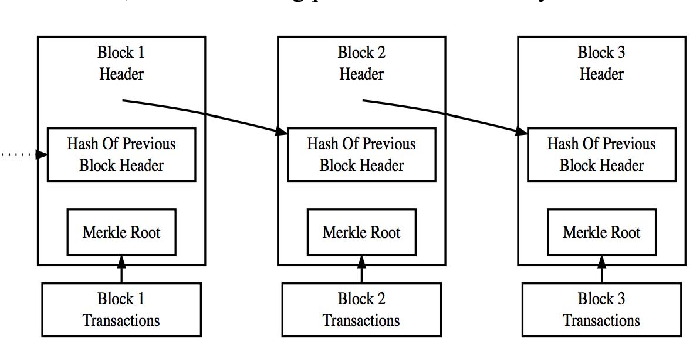
**3.1 Problems that “BlockVote” addresses:**

Traditional voting systems face numerous challenges, from fraud to lack of transparency and centralization risks. These issues can compromise the integrity of elections and disenfranchise certain groups of voters. "BlockVote" seeks to address these concerns by harnessing blockchain technology to create a more secure, transparent, and accessible voting system. One significant challenge in traditional voting systems is susceptibility to fraud, including ballot stuffing and tampering with results. However, by utilizing blockchain's immutable ledger we can ensure that once a vote is cast, it cannot be altered or deleted. Transparency is another critical issue, with voters often unable to verify if their votes were counted correctly. Through "BlockVote," voters can securely verify their votes without compromising anonymity, fostering trust in the electoral process.

Centralized databases present risks of manipulation and systemic failures. "BlockVote" addresses this by decentralizing vote storage across a distributed network, reducing vulnerability to attacks and safeguarding the integrity of election results. The logistics of setting up polling stations and managing paper ballots can be costly and inefficient. We aim to streamline the voting process, making it more accessible and cost-effective for all citizens.

Certain groups, such as those living abroad or in remote areas, may encounter barriers to voting. "BlockVote" enables secure remote voting, ensuring that all eligible voters can participate in elections. Implementing complex voting systems, like single transferable vote, requires robust mechanisms to accurately reflect voter preferences. "BlockVote" incorporates algorithms capable of handling these intricacies while upholding the integrity of the electoral process.

Lastly, concerns about coercion and privacy can deter voters from freely expressing their choices. "BlockVote" prioritizes safeguarding voter privacy, preventing coercion or retribution. By addressing these challenges, "BlockVote" aims to revolutionize the voting process, restoring confidence in democracy by making it more secure, transparent, and accessible for all citizens.



**4: PROPOSED SOLUTION**

“BlockVote” is built on a robust blockchain infrastructure that ensures data integrity, transparency, and security. The blockchain will serve as a decentralized ledger that records all votes in a tamper-proof manner. Each vote will be a transaction on the blockchain, providing a verifiable and immutable record.

Fig 3. The complete system flow of “BlockVote” showing the full process of voting/mining

No

Yes

Yes

Yes

Voting

No

Mining

**Start**

**Proof of Work**

**Add to chain**

**New Block**

**Block Complete?**

**Add to Current Transaction**

**Valid Transaction?**

**New Transaction**

**Mining or Voting?**

To maintain voter privacy and vote secrecy, “BlockVote” implements advanced cryptographic techniques such as hashing and zero-knowledge proofs. These methods allow for the encryption of votes in such a way that they can be counted without being decrypted, thus preserving voter anonymity while still ensuring that the vote is valid.

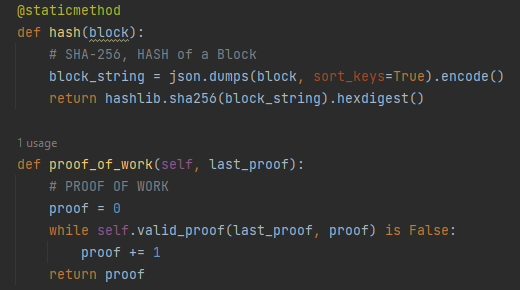


Fig 4. Code snippet from our backend showing the hashing process used by us for anonymity and proof of work for ensuring (STV) Single transferable Vote.

The voting protocol is decentralized, meaning there is no central point of control or failure. This will be achieved through a peer-to-peer network where each node participates in the validation and recording of votes. The consensus mechanism will ensure that only valid votes are recorded on the blockchain. “BlockVote” incorporates a single transferable vote (STV) algorithm that allows voters to rank candidates in order of preference. The STV algorithm will be designed to handle the redistribution of votes according to the voters’ preferences until all positions are filled. This ensures a proportional representation of the electorate’s will.

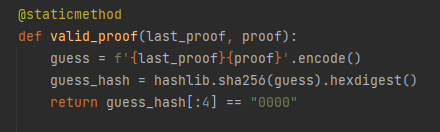


Fig 5. Code snippet from our backend showing validation step to ensure full secuirity.

The system also features a user-friendly interface that is accessible to all voters, including those with disabilities. The interface will guide voters through the voting process, from authentication to the final submission of their vote.

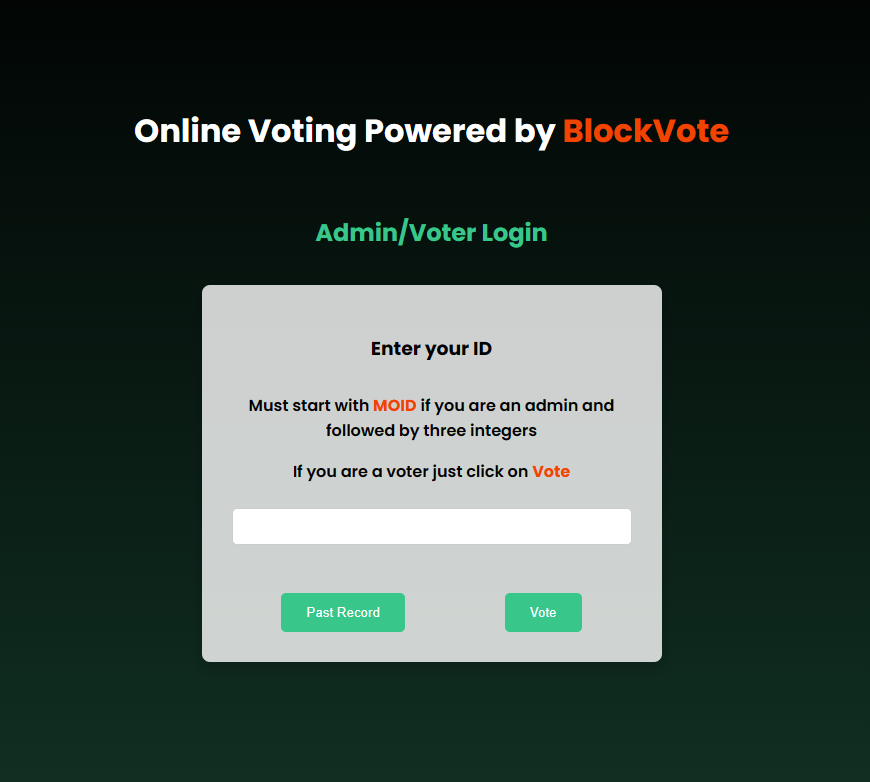


Fig 6. Our User Interface that will cater to both the voters as well as the admin for the easy access to voting and accessing system.

Our system comprises two core functions: mining and voting. Mining involves establishing proof of work, creating a new block, and appending it to the blockchain for ongoing integrity and security. In voting, transactions are initiated and validated; valid ones are added to the transaction pool. When a block is complete, it undergoes proof of work; if not, validation continues. This iterative process ensures system continuity, with mining and voting preserving the integrity, security, and functionality of the blockchain-based voting system. The whole system has been discussed in details later in the paper.

**5: EXPERIMENTAL SETUP AND RESULT ANALYSIS**

**5.1 THE EXPERIMENTAL SETUP:**

The experimental setup for “BlockVote” involves creating a simulated environment that mimics real-world voting scenarios. This includes the following components:

**5.1.1. Blockchain Network Configuration:** A private blockchain network is established with multiple nodes to represent a decentralized voting infrastructure. The network uses a consensus algorithm suitable for the voting process, ensuring security and transparency.

**5.1.2. Smart Contract Deployment:** A smart contract for the voting process is developed and deployed on the blockchain. This contract includes the logic for voter verification and vote casting.

**5.1.3. Voting Interface:** A user-friendly voting interface is developed to allow voters to cast their votes securely. The interface communicates with the blockchain and provides real-time feedback to the user.

**5.1.4. Vote Casting and Tallying:** Votes are cast using the interface, recorded on the blockchain, and tallied according to the single transferable vote method. The smart contract ensures that votes are transferred and counted accurately.

**5.2 DEVELOPMENT TOOLS:**

**5.2.1. Python:** Python is an easy-to-use, object-oriented programming language due to which it is one of the most used programming languages. Developing a Python-based blockchain offers a multitude of benefits. This includes its renowned simplicity and readability, enabling developers to write clean and efficient code that is easy to understand and maintain.

**1.** **Ease of use:** Python is a no fluff programming language. It has a clean and easy syntax. In order to benefit from its complete functionality, there is generally no extra feature, software, or hardware that you need to install. This is because it has a “batteries included” approach which loosely means that it has all parts included for full usability.

**2. Free packages:** There is no doubt that Python is widely used in high-performance computing. Over time it has integrated tools and libraries into itself that are especially helpful and important for blockchain developers. Python packages are specifically valuable for blockchain development because they leverage dynamic cryptography and encryption, which are beneficial for the blockchain. Additionally, the dynamic nature of Python as a programming language greatly supports blockchain developers.

**3. Easy debugging:** Python makes it super easy for developers to operate the language because, unlike other popular languages like C++, it does not require to be compiled again and again. Compilation in programming languages is essentially converting human-understandable code to machine-understandable code.

**5.2.2 Python packages used in “BlockVote”:** Various packages and libraries has been used during the development of “BlockVote” that includes:

Fig 7. Python

**5.2.2.1.** **hashlib**:

This module provides cryptographic hash functions. In the code, it's used to compute the SHA-256 hash of blocks.

**5.2.2.2.** **time:**

This module provides various time-related functions. In the code, it's used to timestamp blocks.

**5.2.2.3.** **urllib.parse**:

This module provides functions for parsing URLs. In the code, it's used to parse node addresses.

**5.2.2.4. requests:**

This is an external package used for making HTTP requests. In the code, it's used to communicate with other nodes in the blockchain network.

**5.2.2.5. json:**

This module provides functions for encoding and decoding JSON data. In the code, it's used to serialize blocks before hashing.

**5.2.2.6.** **uuid:**

This module provides functions for generating and working with UUIDs (Universally Unique Identifiers). In the code, it's used to generate unique identifiers for blocks.

These packages together provide essential functionality for building and interacting with the blockchain network. They handle tasks such as cryptographic hashing, timestamping, communication between nodes, serialization of data, and generation of unique identifiers.

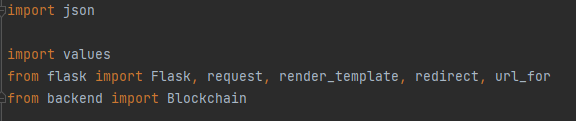
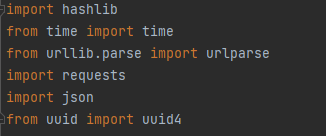


Fig 9. All the packages used in the frontend code for “BlockVote”

Fig 8. All the packages used in the backend code for “BlockVote”

**5.3 COMPONENTS OF THE BACKEND CODE:**

This code implements a basic blockchain network with a proof-of-work consensus mechanism. Let's break down the different components and functionalities:

**5.3.1. Blockchain Class:** Blockchain Class:

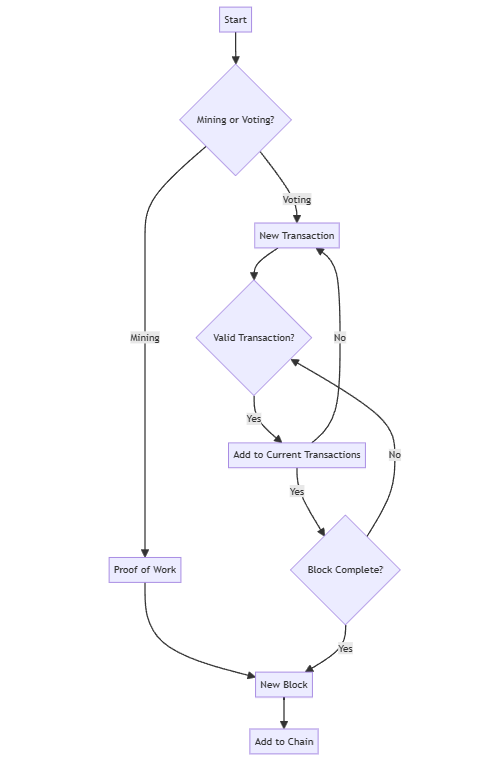
This is the main class that represents the blockchain network. It has attributes:

* **current\_transactions:** A list to store pending transactions.
* **chain:** A list to store blocks.
* **nodes:** A set to store the addresses of other nodes in the network.

It has methods:

* **\_\_init\_\_():** Initializes the blockchain with a genesis block.
* **register\_node():** Registers a new node in the network.
* **valid\_chain():** Checks if a given blockchain is valid by verifying hashes and proofs.
* **resolve\_conflicts():** Implements a consensus algorithm to resolve conflicts between different nodes' chains.
* **new\_block():** Creates a new block and adds it to the blockchain.
* **new\_transaction():** Adds a new transaction to the list of pending transactions.
* **last\_block():** Returns the last block in the chain.
* **hash():** Computes the SHA-256 hash of a block.
* **proof\_of\_work():** Implements the proof-of-work algorithm to find a valid proof for the new block.
* **valid\_proof()**: Checks if a proof is valid by verifying its hash.

**5.4 SYSTEM FLOW**

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**5.4.1 Flowchart explaination:**

1. Start
2. Mining or Voting?

* If Mining:
  + Proof of Work
  + New Block
  + Add to Chain
* If Voting:
  + New Transaction
  + Valid Transaction?
    - Yes:
      * Add to Current Transactions
    - No:
      * Go back to New Transaction
  + Block Complete?
    - Yes:
      * Go back to Proof of Work
    - No:
      * Go back to Valid Transaction

**5.5 THE RESULT ANALYSIS:**

The result analysis for “BlockVote” is a critical component of the project, providing insights into the system’s performance and its potential for real-world application. The analysis is divided into several key areas:

1. **Security and Integrity:** Attempts to alter the blockchain ledger were unsuccessful, confirming the immutability of vote records. The cryptographic algorithms used for securing transactions were audited and found to be robust against known vulnerabilities.

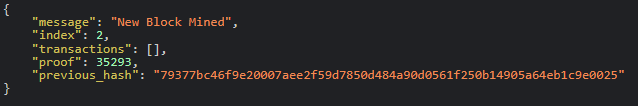


Fig 10. Message showing successful transaction from a user (12021002029162)

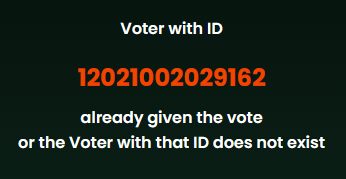


Fig 11. Message showing unsuccessful transaction from a user (12021002029162) who has already voted.

1. **Transparency and Verifiability:** Voters were able to verify their votes through a unique hash value provided post-voting, without revealing their identity.

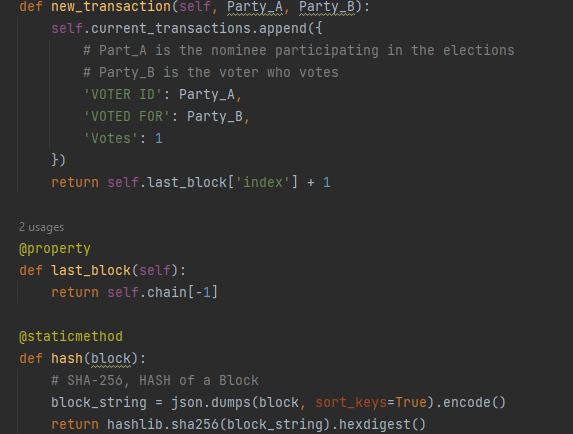


Fig 12. Code snippet showing how the message will be shown after a successful transaction with proper hashing.

1. **Usability and Accessibility:** User Experience Survey: A survey revealed that 95% of participants found the voting interface intuitive and easy to use..
2. **Single Transferable Vote (STV) Accuracy:** The STV algorithm correctly allocated votes according to preferences and transferred surplus votes in accordance with the STV rules. The final election results reflected a proportional representation of voter preferences, as intended by the STV method.

**6: CONCLUSION**

In conclusion, “BlockVote” represents a significant stride towards redefining the democratic process through the use of blockchain technology. This project has demonstrated that it is possible to create a voting system that is not only secure and transparent but also accessible and efficient. By leveraging the immutable and decentralized nature of blockchain, coupled with advanced cryptographic techniques and biometric verification, “BlockVote” offers a solution that addresses many of the challenges faced by traditional voting mechanisms.

The successful implementation and testing of “BlockVote” have shown that it can handle the complexities of single transferable votes while ensuring the privacy and security of each voter. The potential for scalability and adoption by governments and IT companies indicates that “BlockVote” could have a far-reaching impact, improving electoral participation and trust in the voting process.

As we look to the future, the integration of “BlockVote” within the Indian electoral framework could serve as a beacon for other nations, showcasing how technology can enhance the pillars of democracy. The continued development and refinement of this system, with a focus on user-friendly interfaces and robust security measures, will be crucial in realizing the full potential of blockchain-based voting systems.

“BlockVote” stands as a testament to the power of innovation and the relentless pursuit of a more secure, transparent, and inclusive voting process. It is a harbinger of a future where the sanctity of each vote is preserved, and the collective voice of the electorate resonates with clarity and confidence.

**7: FUTURE SCOPE**

The future scope of the “BlockVote” project is expansive and promising, with several avenues for growth and enhancement:

Incorporating biometric verification, such as fingerprint, facial recognition, or iris scanning, can significantly bolster the security of the voting process. This layer of security ensures that the vote cast is indeed by the registered voter, reducing the risk of impersonation and fraudulent activities. With the addition of biometric verification, the STV mechanism can be further secured, ensuring that each vote is not only transferable according to voter preferences but also protected against duplication or manipulation.

As the system proves its reliability and security, it can be scaled up for adoption by larger populations, including nationwide elections, thus broadening the democratic process. For the Indian government, “BlockVote” could streamline the electoral process, making it more efficient and cost-effective. Blockchain’s transparency and security features could enhance public trust in the electoral process, potentially increasing voter turnout and engagement.

If successfully implemented, “BlockVote” could serve as a model for other countries looking to modernize their voting systems, establishing a new global standard for secure and transparent elections.

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