IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125386

TRUST VOTE: A SECURE VOTING SYSTEM

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Abstract: Ensuring a fair and secure voting process is vital in today's digital democracy. Conventional systems unauthorized voting, duplicate entries, and identity fraud. The proposed system, titled Trust Vote, addresses these challenges by implementing a three-stage identity verification process using RFID tags, face recognition, and fingerprint scans. Each voter is authenticated using all three methods before access is granted to.

The system architecture is NodeMCU ESP8266 microcontroller, which facilitates real-time communication with a central SQL database where voter records and biometric details are securely stored. In cases of failed verification or repeated attempts, a buzzer provides immediate alerts, ensuring compliance with the principle of "One Voter, One Vote." At the end of the process, the system automatically counts and displays valid votes. By combining hardware-level security with software automation, this project delivers a scalable and tamper-resistant voting platform designed to strengthen the credibility of electoral systems.

Index Terms: Secure Voting System, Biometric Authentication, RFID-based Verification, Facial Recognition, Fingerprint Scanner, Multi-Level Security, Electronic Ballot, NodeMCU ESP8266, IoT-based Voting, Voter Eligibility Check, Vote Duplication Prevention, Tamper-Proof Election, Real-Time Vote Monitoring, Embedded System in Elections, Automated Polling Process

I. INTRODUCTION

Voting is pillars of democratic a chance to express their will and influence their country's future. Any democracy would require to be safe, transparent, and credible. But even the most conventional voting techniques and some of the electronic ones suffer from issues such as impersonation, double voting by a single individual, booth capturing, and late counting of results. These vulnerabilities not only undermine but also decrease public trust in the democratic process.

With advancements in pressure to automate voting systems so that it becomes more efficient and secure. Biometric and RFID-based systems have shown promise as possible solutions to replace traditionalvoting systems. Technologies such as fingerprint reading, facial recognition, and RFID tag verification provide secure methods of identifying voters, which makes fraudulent operations more challenging. Here, the given project named "Trust Vote: A Secure Voting System" presents a multi-factor authentication-based voting machine. The system is planned to authenticate voters in three successive layers of RFID tag identification, facial recognition, and fingerprint authentication. The voter is only allowed to vote after passing all three phases. This multi-layered security method helps avoid impersonation, invalid double voting, and ensures that only genuine voters can engage process.

Secondly, the system features computerized counting of votes and real-time response mechanisms, for example, alerts in the form of a buzzer in case of unauthorized entry. The overriding goal is to of elections whilekeeping voting accessible to voters. By integrating hardware and software technologies, this project envisions an era where elections are not only secure and fair but accessible and verifiable as well.

II. LITERATURE SURVEY

[1] Fingerprint Biometric Voting Machine Using Internet of Things: This paper proposed a fingerprint-based voting system integrated with Internet of Things (IoT) technology. The authors emphasized digital vote recording and cloud storage, allowing for fast and accurate result processing. Their system identifies fraudulent attempts through biometric mismatch alerts, making it suitable for secure and transparent elections. Compared to traditional systems, it improves reliability while reducing manual effort.

[2] Design And Realization Of RFID Smart Voting System With Frontal Face Recognition Technique : The researchers introduced a that verifies voters using a combination of RFID scanning and facial recognition. Each voter must pass through both stages to be authenticated. This dual-check mechanism enhances security by minimizing the chances of impersonation. The system focuses on real-time validation and aims to eliminate the inefficiencies of manual identification at polling booths.

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[3] Smart voting using Fingerprint, Face and OTP Technology with Blockchain: This study presented a secure online voting framework that combines fingerprint recognition, facial verification, and OTP (One-Time Password) authentication. The core innovation lies in the use of blockchain to encrypt voting data, thereby maintaining privacy, transparency, and preventing vote tampering. The system is designed to support remote voting, especially for individuals unable to access traditional polling locations.

[4] Smart Voting Using Fingerprint and Facial Recognition: This paper proposed a biometric-based voting system that uses Aadhar-linked fingerprint and facial recognition. The use of the LBPH algorithm for facial recognition helps ensure accurate identification. It aims to eliminate vote duplication and facilitate voting for citizens in remote areas or with disabilities. However, the authors acknowledge concerns regarding privacy and the digital divide in rural regions.

[5] Smart Online Voting System: The authors suggested an online voting model that leverages fingerprint and facial biometrics for voter verification. It is intended to offer remote access to voting for rural citizens and people with mobility issues. While the system provides real-time, tamper-proof results and convenience, it also introduces risks related to biometric data storage and potential misuse.

[6] Smart and Secure Voting Machine Using Biometrics: This research proposed a secure EVM fingerprint and RFID verification. Each voter is authenticated using an RFID tag and their fingerprint before being allowed. The system automates vote counting and reduces human error. However, it relies on stable power and connectivity, which may limit its scalability in rural deployments.

[7] Aadhar-Based Electronic Voting Machine Using Arduino: This project incorporates Aadhar verification into e-voting using Raspberry Pi and Arduino. Voters authenticate themselves through their and verify their identity through fingerprints. quick and precise but is limited by factors such as reliance on Aadhar infrastructure and data privacy-related issues in underdeveloped areas.

[8] A Bi-Factor Biometric Authentication System For Secure Electronic Voting: The authors created a two-layer facial recognition authentication mechanism. authenticated voters are able to access the voting platform, minimizing impersonation and illicit voting. The system is expected to increase faith in e-voting but requires advanced equipment and high data protection levels.

[9] Mobile Based Facial Recognition Using OTP Verification for Voting System: A mobile application for voting was introduced in this study, where voter identity is confirmed using facial recognition averification. Voters receive an OTP on their registered mobile number after facial verification. The system supports remote voting but depends heavily on internet access and raises privacy concerns.

[10] Smart Voting Machine using Fingerprint Sensor and Face Recognition: This paper proposed a secure voting machine that employs both fingerprint and face recognition to authenticate voters. The system includes a user-friendly interface for casting votes and provides real-time vote counts to election officials. While it boosts security and speed, it demands robust infrastructure and secure handling of biometric data.

[11] Secure I-voting System Using QR Code And Biometric Authentication: The system uses QR code scanning along with fingerprint verification for online voting. A unique ‘q’ parameter ensures vote secrecy and detects tampering attempts. It prevents unauthorized access and provides resistance against malware threats, though its deployment requires solid infrastructure and secure network communication.

[12] RFID and Fingerprint Recognition based Electronic Voting System for Real Time Application: This research details a system combining RFID tag identification with fingerprint scanning. The dual authentication ensures the voter’s identity is confirmed before voting. A buzzer alert system detects any mismatches or attempts at double voting. The system emphasizes real- time validation and is suitable for deployment in controlled environments.

[13] Electronic Voting Machine Using RFID And Fingerprint: This system combines technology into machine. It verifies voter identity and scans for double voting. The outcome is shown on an LCD, and any misbehavior initiates an alert. developed with and supports voting secrecy.

[14] Secured Electronic Voting Protocol Using Biometric Authentication: The authors suggested a cost-effective web-based employs biometric verification such as iris recognition. The voting and verification are done in one transaction, enhancing speed and security. The system, although best suited for rapid elections, has to consider privacy and internet accessibility concerns.

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[15] Enhancing Voting Security and Efficiency: System Integrated With Biometric Identifiers : This research recommends a more developed EVM system with fingerprint and facial recognition to verify voters. It aims to reduce double voting and enhance accuracy. The writer also encourages eco-friendly practices by minimizing paper usage. In spite of its advantages, the system should treat biometric data sensitively to uphold voters' confidence.

III. SUMMARY

The Trust Vote project proposes a multi-level authentication reliability and security of elections. The system identifies a voter's identity through three independent mechanisms: RFID-based identification, facial recognition, and fingerprint verification. these methods in combination the voting interface, greatly minimizing the possibility of voter impersonation or fraudulent voting.

The system starts off by scanning the voter's RFID card to read their unique ID. Upon matching, the voter's face is scanned and matched with facial data stored using algorithm. Lastly, biometric scanning verify fingerprints. A voter can only go through once they succeed in all three verifications. In case one of the authentication phases fails or where a duplicate attempt at voting is sensed, the system sends a buzzer signal to signal an illegal action.

NodeMCU ESP8266, RFID modules, biometric sensors, and a camera module are used in this project, all synchronized through embedded software and a secure database. The system is also able to keep track of a real-time vote count and prevent double voting attempts, and therefore highly fit for use in polling stations.

Through layered security and automation, Trust Vote makes more transparent, minimizes the chances of human error, and ensures a fair democratic process. It provides an example of how contemporary technology can be utilized to reinforce the very heart of democratic participation.

IV. PROBLEM IDENTIFICATION

(1)Identity theft – Voters could vote under duplicate identities or double-vote.
(2)Unauthorized use – Un-authenticated users are able to penetrate the voting platform.
(3) Human mistakes – Human errors in verification and tallying make it possible to make errors or manipulate the information.
(4) Lack of transparency – Voters cannot often confirm that they voted correctly.
(5) Slow and inefficient – Delayed announcements on results and voting confidence are triggered by manual or half-digital processes.

In most conventional voting systems, authenticity and security are still principal issues. Identity fraud, double voting by the same voter, unauthorized access, and human errors in verification and counting affect the integrity of elections. In addition, the absence of an open and tamper-free verification mechanism loses confidence from the voters and slows down announcement of correct results.

Current methods of voting are generally ineffective in ascertaining that only valid and that no voter votes more than once. secure, computerized urgently required that can authenticate voters by employing multiple levels of identification. The suggested project, "Trust Vote: A Secure Voting System," will solve these issues by utilizing RFID-based identification, facial recognition, and fingerprint verification. This multi-factor authentication procedure enables secure, one-time voting and guards against unauthorized access, hence contributing to the overall reliability, transparency, and efficiency of the election process.

V. FUTURE SCOPE

The proposed system can be significantly enhanced in the future to support broader and more flexible voting environments. One major extension is the integration of cloud-based databases, allowing voter data and election records to be securely stored and accessed from any authorized location. This can be especially beneficial in large-scale elections, where centralized data handling improves efficiency and reliability.

Also, the system can be enabled to accommodate mobile or remote voting. Through building a secure mobile app withthe same multi-layer authentication—RFID, facial recognition, and fingerprint confirmation—qualified voters could vote without ever having physically. This would come in handy mostly for people with disabilities, the elderly, or voters residing far. For further security enhancement, blockchain technology may secure vote records in an immutable and tamper-resistant ledger. any unauthorized modification cannot be made and maximum transparency during the count of votes.

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The system can also be coupled with government ID databases (like Aadhar or national ID systems), where real-time identity verification and minimizing the requirement for local data storage. Future development could incorporate voice recognition or iris scanning as further biometric layers, enhancing security and accuracy. With increasing digital literacy and infrastructure, systems such as Trust Vote have the potential to be a building block for nationwide secure and trustworthy electronic voting.

VI. CONCLUSION

The Trust Vote mechanism effectively proves a safe and effective method for bringing the voting process into the modern age via multi layered voter authentication. By integrating RFID verification, facial recognition, and fingerprint scanning, the mechanism prevents only certified individuals from voting and allows every individual to only vote once. This dramatically prevents the possibility of fraud, impersonation, and other election irregularities prevalent in current systems.

The project not only increases voting security but also streamlines the process for administrators and voters alike. Real-time alerts and automatic vote counting further and reliability. The combination of biometric and embedded technologies proves to be an effective means of securing democratic in a scalable and flexible manner.In total, this system provides voting systems. It advances the vision of an open, tamper-free, and reliable electoral system that can be confidently deployed at the local, regional, or national level.

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