

Development of Secure Electronic Voting Machine (EVM) using Fingerprint Biometric Authentication

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Abstract—Electronic voting systems are used to make elections faster and easier, but many systems still face problems such as fake voting, duplicate voting, and unauthorized access. This paper presents biometric electronic voting system uses ESP32 and fingerprint authentication technology. The system verifies the voter's fingerprint before going to voting and alerts many voting attempts. An ESP32 microcontroller, fingerprint sensor and face recognition, voting buttons, and EEPROM storage are used for this safe offline vote management. The system is a simple, reliable and suitable for schools, colleges and organizations.

Index Terms—Biometric Authentication, Electronic Voting Machine, ESP32, Fingerprint Recognition, Secure Voting System.

I. INTRODUCTION

Elections are important part of a democratic country because the people select their own representatives. Voting system should be safe, accurate, and reliable. More time is need for Traditional voting methods and it can leads to problems like fake voting, duplicate voting, and errors while counting.

Electronic Voting Machines (EVMs) helps to make voting faster but some system still face security issues like access by unauthorized people and not proper voter verification. Biometric authentications are used for safe voter identification.

This paper presents a secure offline biometric electronic voting system using ESP32 and fingerprint authentication and face recognition technology. The system verifies the voter's fingerprint before they go for voting and alert duplicate voting using EEPROM memory. The system is simple, low-cost, reliable, and suitable for schools, colleges, organizations, and small-scale elections.

II. LITERATURE REVIEW

A. "Biometric Based Secured Remote Electronic Voting System" – S. S. Agarwal et al.

[1] This paper explains that a fingerprint-based electronic voting machine is developed to improve election security and fairness. Before voting the finger print of the voter is checked. The authors said that traditional voting systems face problems like fake voting and duplicate voting. To solve these issues, the authors proposed system that uses biometric verification to make sure that a voter can vote only single time. In this linking the system with Aadhaar data leads to better voter identification and protected election management.

B. "A Secured Automated Bimodal Biometric Electronic Voting System" – K. Okokpujie et al.

[2] A safe electronic voting system that uses two biometric methods for vote authentication. This system improved the voter verification, accuracy and reduces misuse of others identity during elections. A traditional voting systems cannot provide full security and it can allow access for persons who are not authorized. They suggested a system to increases dependence and fairness by using multiple biometric methods. They state that biometric-based systems can improve both security and flow in modern elections.

C. "Biometric System Based Electronic Voting Machine" – S. T. Haripriya et al

[3] This is about how a fingerprint-based electronic voting machine designed using embedded system technology. The system checks the voter's fingerprint before letting them to vote, which helps us to prevent duplicate voting and fake voting. The authors

explained that fingerprint authentication is secure, simple, and easy for us to use. The system also reduces the manual work and counting errors during the elections. This paper highlights that biometric voting systems improve fairness, reliability, and efficiency in the voting process among the peoples.

D. "Smart E-Voting System Using Fingerprint Authentication and Blockchain Technology" – M. R. Islam et al.

[4] This paper introduces smart electronic voting system that combines both the fingerprint authentication and blockchain technology. The fingerprint sensors are used to verify voter identity and the blockchain technology safely stores voting records and prevents data from being manipulated. The authors says that blockchain improves fairness and protects data of elections from any unwanted changes. The system checks that only registered members can vote and improves trust in voting systems. The study states that combining biometric technology with the blockchain can create a reliable election system.

E. "A Novel Biometric Voting System Using Fingerprint Recognition" – N. Gupta and S. Yadav.

[5] This paper presents a face recognition-based electronic voting system using Raspberry Pi and a camera module. The system verifies voters using facial recognition before allowing them to cast their votes. A one-time voting token is used to prevent duplicating vote. The authors explained that the proposed system reduces identity fraud problems found in traditional elections. Experimental testing showed high recognition accuracy and fast voting performance. The study highlighted that biometric technology can improve election security and fair.

F. "Secure E-Voting System Utilizing Fingerprint Authentication, AES-GCM Encryption and Hybrid Blind Watermarking" – Asia Abdullah et al..

[6] This paper focuses on improving electronic voting security using fingerprint authentication, encryption, and watermarking techniques. Fingerprint recognition is used for secure voter verification before voting. The system uses AES-GCM encryption to protect voting data and maintain privacy. The authors also used watermarking methods to prevent data misuse and cyberattacks. Experimental results shows that the system provides strong security and reliable

performance. The paper concluded that combining biometric authentication with encryption improves election safety and reliability.

G. "Design and Development of Fingerprint Based Voting Machine Using Embedded Systems" – R. T. Acharya et al.

[7] It explains the designing a fingerprint-based voting machine using embedded system technology. A microcontroller connected to a fingerprint sensor for secure voter authentication. Before voting, the voter's fingerprint is verified to ensure that only people authorized can participate. The system reduces duplicate voting and improves election fairness. The authors highlighted that embedded systems make voting operations faster, simpler, and more efficient.

H. "Fingerprint Authentication System for Secure Electronic Voting" – A. Sharma and D. Saini

[8] It presents a secure voting using fingerprint authentication technology. Before allowing the voters the system checks the finger prints. The authors explained that traditional voting methods may lead to fake voting and manual verification errors. To overcome these problems, the proposed system provides secure voter authentication and improves election accuracy. The study concluded that fingerprint authentication is reliable, cost-effective, and suitable for electronic voting systems.

I. "IoT Based Secure Voting System Using Biometric Authentication" – M. A. Khan et al.

[9] This paper discusses an IoT-based electronic voting system with biometric authentication. The system uses biometric verification to identify voters and prevent unauthorized access. IoT technology enables real-time monitoring and communication through internet connectivity. The proposed system improves automation, transparency, and efficiency in election management. The authors explained that integrating IoT with biometric technology can create secure and user-friendly electronic voting systems.

J. "Secure and Privacy-Preserving Voting System Using Biometric and Blockchain" – L. Zhao and J. Zhang

[10] In this paper a secure electronic voting system using biometric authentication and blockchain technology. Before voting the identity of the voter is

checked before letting them vote. Blockchain safely stores voting to prevent misuse or unwanted changes. The system improves fairness, privacy, and reliability on the election. The decentralized blockchain storage reduces the dangers of hacking and data changing for unauthorized person. In this method by combining blockchain with biometric systems creates a secure voting system.

K. “Biometric-Based Internet Voting System Using Multi-Level Authentication” – S. Alizadeh et al.

[11] Here an online voting system uses biometric authentication and multi-level security methods. Authors proposed a system During internet voting it protects against identity being stolen, cyberattacks and preventing unauthorized access. Election security and voter trust is increased by adding multi-level authentication improves. Registered voters can only participate in online elections. Finally advanced authentication methods improve the safety and reliability of internet voting systems.

L. “Evaluation of Fingerprint Recognition Algorithms for E-Voting Authentication” – J. P. Rodrigues et al.

[12] In electronic voting systems different fingerprint recognition algorithms are used. Based on speed, accuracy, and reliability the authors compared the algorithms. The Advanced fingerprint recognition methods provide secure and efficient verification of voters. The paper says that selecting a suitable biometric algorithm is must important for the improvement of election security and performance of voting. Dependency of electronic voting systems based on the accuracy of fingerprint recognition.

M. “Biometric-Enhanced Online Voting with Liveness Detection” – M. Fischer et al.

[13] This paper presents an online voting system enhanced with biometric authentication and liveness detection technology. The system checks whether the biometric sample belongs to a real person to prevent spoofing attacks and fake access. The authors explained that liveness detection improves the security and trustworthiness of biometric systems. The model make sure that only registered users can vote online. The study concluded that combining biometric verification with liveness detection creates a safer and more reliable voting system.

N. “Fingerprint Based Attendance and Voting System” – S. Ali et al.

[14] This paper explains a fingerprint-based attendance and voting system developed for schools, colleges, and organizations. The system uses fingerprint authentication before marking attendance or allowing users to vote. The authors explained that traditional attendance systems may allow duplicate entries and manual errors. The proposed model improves accuracy, reduces manual work, and prevents fake attendance or duplicate voting. The study concluded that fingerprint-based systems are secure, reliable, and easy to use.

O. “Multibiometric Systems: A Review” – N. Khaleghi et al.

[15] This paper reviews different multibiometric systems used for secure authentication. The authors explained that multibiometric systems use more than just one biometric method like fingerprint, face recognition, iris scanning or voice recognition. Combining multiple biometric techniques improves security, reliability, and accuracy compared to single biometric systems. The paper also talked about the challenges such as system complexity and storage requirements. The study ended that multibiometric systems provide stronger authentication for secure applications like electronic voting systems.

VII. CONCLUSION

Overall, papers says that fingerprint-based electronic voting systems make the voting process more secure, reliable, and easy to use. Most of the researchers used fingerprint authentication to check the identity of voters and prevent problems like fake voting, duplicate voting, and unauthorized access. Different technologies such as embedded systems, IoT, blockchain, encryption, and biometric sensors were also used to improve security and voting efficiency. These systems help to reduce the manual work, save time and also make elections more accurate and transparent.

The paper says that problems still exist, such as sensor errors, fake fingerprints, hacking, and data security issues. Researchers working to increase security like detection, stronger encryption and combining different biometric methods. These improvements can make elections safer, faster, and

more trustworthy for use in schools, colleges and organizations.

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