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Electronic Voting System With Two-Step Authentication

Two-Step Authentication for Reliable Voting Systems

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Abstract: The advancement of digital technologies has transformed traditional voting methods, emphasizing the need for secure and user-friendly electronic voting systems. This paper introduces an Electronic Voting (E-voting) system designed with two-step authentication to ensure the security and integrity of the voting process. The system features a separate interface for administrators and voters, each tailored to their roles. The administrator panel provides functionalities for managing voters, candidates, positions, and election settings, as well as generating real-time voting statistics. The voter interface ensures secure voting with a time-limited session and OTP-based verification for submission. The system is developed using PHP for backend logic, JavaScript for interactive frontend, and MySQL for secure data storage. By addressing common vulnerabilities in electronic voting systems, this project delivers a scalable, secure, and efficient solution suitable for modern elections.

Index Terms - E-voting, two-step authentication, OTP verification, secure voting system, admin-voter interface.

I. INTRODUCTION

The voting process is a vital part of democracy, allowing citizens to express their choices and have a say in the governance of their society. Traditionally, paper-based voting systems have been trusted for their transparency and simplicity. However, these systems face significant challenges, including inefficiencies in logistics, high operational costs, and the potential for human error in vote counting. These issues are becoming more apparent in today's fast-paced, technologically advanced world, where there is a growing need for modern solutions to address these shortcomings while ensuring fairness and security in the electoral process.

Electronic Voting (E-voting) systems have emerged as a promising solution to these challenges. By digitizing key components of the voting process, such as voter registration, ballot creation, and result tabulation, E-voting systems offer greater speed, convenience, and efficiency compared to traditional paper-based systems. These systems help eliminate logistical issues associated with manual voting and can produce results in a fraction of the time. However, despite the potential advantages, concerns about the security of

digital systems, especially regarding unauthorized access, data manipulation, and vote tampering, have made many hesitant to fully embrace this technology. Addressing these security concerns is critical for the broader adoption of E-voting.

To mitigate these concerns, the proposed E-voting system integrates two-step authentication with OTP (One-Time Password) verification. This system ensures that only authenticated voters are able to cast their votes, significantly reducing the risk of unauthorized access and fraud. By incorporating this additional layer of security, the system helps guarantee the integrity of the voting process, providing peace of mind to both administrators and voters. This secure framework not only protects the system from potential breaches but also fosters trust in the election results.

Usability is another critical factor influencing the success of E-voting systems. Overly complicated systems can discourage participation, especially among users with limited technical expertise. The proposed system emphasizes simplicity and accessibility, ensuring that both administrators and voters can easily navigate the system. The admin panel allows election officials to manage various aspects of the election, from registering voters to configuring candidate information and monitoring real-time voting data. Meanwhile, the voter interface is designed to guide participants through the voting process in a clear, easy-to-follow manner, ensuring secure and accurate voting.

The adaptability of the proposed system ensures it can be used in a variety of electoral settings. This flexibility allows the system to be tailored to meet the specific needs of different organizations or elections, ensuring it remains relevant across a wide range of applications. By combining advanced security features with a user-friendly design and adaptable functionality, the proposed E-voting system offers a comprehensive solution that meets the demands of modern voting processes.

II. LITERATURE REVIEW

The transition from traditional voting methods to digital solutions has garnered significant attention in recent years. While paper-based voting systems have been trusted for their reliability and transparency, they are increasingly challenged by logistical inefficiencies, human error, and delays in result processing. Electronic Voting (E-voting) systems have emerged as a promising alternative to address these limitations, offering improved efficiency, streamlined workflows, and secure voting mechanisms.

Despite these advantages, the adoption of E-voting systems has been hindered by security concerns. Critical vulnerabilities include risks such as unauthorized access, data breaches, and inadequate authentication of voters. Traditional password-based authentication, though widely implemented, often falls short in providing the robust security needed for sensitive operations like voting. As a response, advanced methods such as two-step authentication have gained prominence. Among these, OTP-based mechanisms are particularly effective in enhancing security by requiring voters to verify their identity through a one-time password sent to their registered contact information. This process ensures that only legitimate voters can participate, safeguarding the integrity of the voting system.

Another key factor influencing the adoption of E-voting systems is usability. Overly complex designs and unintuitive interfaces can discourage participation, particularly among individuals with limited technical knowledge. Studies emphasize the importance of creating systems that are user-friendly and accessible to diverse demographics. A well-designed interface not only facilitates smooth interaction but also builds trust in the system, encouraging wider acceptance and use. Enhancing usability ensures that voters can easily navigate the system while administrators can manage the election process efficiently.

Adaptability is equally important in making E-voting systems practical and effective. While these systems are often associated with governmental elections, their use in organizational contexts, such as selecting leaders or conducting internal decision-making, is increasingly common. For an E-voting system to succeed, it must be flexible enough to accommodate various requirements, ranging from small-scale elections in institutions to more complex scenarios with larger voter bases. Customizable features and scalable designs play a pivotal role in ensuring the system remains relevant across different applications.

The proposed E-voting system integrates these principles by addressing gaps in security, usability, and adaptability. It incorporates a secure authentication mechanism that verifies voter identity before allowing them to cast their vote, preventing unauthorized access. The system is designed to guide voters through the voting process seamlessly, with clear instructions and an intuitive interface that minimizes confusion or errors. Additionally, it is configured to support diverse voting scenarios, making it suitable for both organizational and broader electoral contexts.

By focusing on these critical aspects, the proposed system bridges the shortcomings of traditional and early E-voting models. It offers a secure, user-centric, and flexible platform that meets the demands of modern voting requirements while fostering trust and confidence among stakeholders. This comprehensive approach demonstrates the potential of digital solutions to modernize electoral processes and ensure fairness and efficiency.

III. System Design

The E-voting system is meticulously designed to prioritize security, ease of use, and operational efficiency. By addressing the unique needs of administrators and voters, the system ensures a smooth electoral process while maintaining the integrity and confidentiality of votes. The system architecture comprises two key modules: the Admin Panel and the Voter Interface, each playing a critical role in the system's overall functionality.

3.1 Overview

The E-voting system provides a seamless and secure voting experience, divided into the following modules:

i. **Admin Panel**:

The **Admin Panel** is the operational backbone of the E-voting system, empowering administrators to manage all aspects of the election process. Its comprehensive set of tools includes features for registering voters, configuring election settings, and monitoring real-time voting activity.

- **Election Management**: Administrators can define positions, assign candidates, and customize election configurations such as time limits and voting rules. This ensures the system can adapt to various organizational needs.
- **User-Friendly Interface**: The panel's intuitive design simplifies complex tasks, allowing administrators to focus on managing elections without technical hindrances. Actions such as editing voter records or modifying candidate details can be performed effortlessly.
- **Real-Time Monitoring**: Through a dynamic dashboard, administrators gain access to real-time statistics, such as the number of voters registered, votes cast, and candidate standings. This transparency ensures that election progress is monitored effectively and discrepancies are addressed promptly.
- **Security Measures**: The admin panel is protected with role-based access control and requires secure credentials, ensuring that only authorized personnel can make changes to the system.

ii. **Voter Interface**:

The Voter Interface is designed with simplicity and security in mind, ensuring that voters can cast their ballots confidently and without confusion.

- **Step-by-Step Guidance:** The interface guides voters through the entire process, from reviewing candidate profiles to submitting their final choices. This structured approach minimizes errors and enhances user experience.
- **Candidate Information:** Voters can view detailed profiles of candidates, including their names, photographs, and platform descriptions, ensuring they have the information needed to make informed decisions.
- **OTP-Based Authentication:** A critical security feature of the system is its two-step authentication process. After voters select their candidates and click "Send OTP," they receive a one-time password via a phone call. Entering this OTP enables the "Submit" button, ensuring that only verified individuals can complete the voting process.
- **Time-Limited Voting:** A countdown timer ensures that voters complete their selections within the prescribed time, maintaining the efficiency and flow of the election.

3.2 Technologies Used

The system is built using a combination of modern technologies to ensure reliability, scalability, and security. These technologies are categorized as follows:

i. **Frontend Technologies**:

- **JavaScript:** Powers dynamic elements such as form validations, countdown timers, and real-time updates for user interactions.
- **CSS:** Enhances the system's visual appeal by creating a clean, responsive, and consistent design across all devices.
- **HTML:** Provides the structural foundation of the user interface, ensuring compatibility and ease of navigation.

ii. **Backend Technologies**:

- **PHP**: Handles server-side logic, including data processing, secure interactions with the database, and user authentication. Its flexibility and efficiency make it an ideal choice for the system's backend operations.

iii. **Database Management**:

- **MySQL**: Organizes and securely stores election-related data, including voter records, candidate details, and votes.
- Implements structured relationships between tables to ensure data consistency and integrity.

iv. **Authentication Mechanism**:

- **2Factor API**: Implements OTP-based two-step authentication to verify voter identities. This mechanism prevents unauthorized access and ensures that only legitimate users participate in the voting process.

v. **Development Environment**:

- The system is developed and tested using **XAMPP**, a widely used platform for hosting PHP applications and managing MySQL databases locally during development.

3.3 System Features

The system provides a comprehensive set of features designed to enhance functionality and user experience. These features are organized by module:

3.3.1 Admin Panel Functionalities

The admin panel is the command center of the E-voting system, providing the following capabilities:

i. Dashboard:

- Displays real-time statistics, including the total number of voters, candidates, positions, and votes cast.
- Allows administrators to monitor voter turnout and election progress effectively.
- Provides visual insights into key metrics for better decision-making during the election.

ii. Voter Management:

- Allows administrators to register new voters by capturing essential details like first name, last name, unique ID, and phone number.
- Includes functionality to edit or delete voter records, ensuring that the voter database remains accurate and up-to-date.
- Generates a unique ID for each voter upon registration, which is later used for authentication.

iii. Candidate and Position Management:

- Facilitates the addition, modification, and removal of candidates and positions.
- Captures candidate details such as their name, position, and platform description, alongside their photograph for easy identification.
- Displays the list of positions available for contest, along with associated details like descriptions and configured voting limits.

iv. Election Settings:

- Enables administrators to customize the ballot title to reflect the specific election being conducted.
- Provides options to configure and manage voting rules, ensuring that elections adhere to organizational requirements.

v. **Profile and Logout Management**:

- Provides functionality for administrators to update their credentials, such as username and password, to enhance security.
- Includes a secure logout option to terminate admin sessions and prevent unauthorized access.

3.3.2 Voter Interface Functionalities

The voter interface prioritizes ease of use and security, offering the following features:

i. **Secure Login**:

- Voters authenticate themselves using a unique ID and password assigned during the registration process.
- Employs session management to maintain user security during the voting process.

ii. **Voting Mechanism**:

- Upon successful login, voters can view a list of candidates and the positions they are competing for, along with platform descriptions and photographs.
- Voters select their preferred candidates and proceed to cast their vote securely.
- Before submission, an OTP is sent to the voter's registered phone number. The OTP must be entered correctly to enable the final submission, ensuring that only authenticated votes are counted.

iii. **Time-Limited Session**:

- The voting session is restricted to a specified duration (e.g., 2 minutes) to ensure process efficiency and discourage delays.
- A countdown timer is displayed, keeping voters informed of the remaining time to cast their vote.
- If the voter fails to submit their vote within the allotted time, the session is terminated to maintain system integrity.

This comprehensive system design leverages modern technologies and intuitive features to deliver a secure, efficient, and user-friendly voting platform. The combination of robust backend logic, interactive frontend design, and advanced authentication ensures the reliability and trustworthiness of the voting process.

IV. IMPLEMENTATION

4.1 Database Design

The database structure is designed to support the smooth functioning of the E-voting system by organizing and storing essential election data. It includes the following key tables:

i. **Voters Table**:

The **Voter's Table** is central to maintaining the registration data of every individual participating in the election. This table stores critical information about voters such as:

- **Name**: Full name of the voter, essential for identification and ensuring each person has a unique record.
- **Voter ID (Unique ID):** A unique identifier is generated for every voter to ensure that they can be easily authenticated during the voting process. This ID prevents any duplication of records.
- **Phone Number**: This serves as a communication channel for sending OTPs (One-Time Passwords) for voter authentication.

This table ensures that each voter has a unique entry in the system and is registered with accurate, identifiable information.

ii. Candidates Table:

The **Candidates Table** holds essential details about the candidates competing in the election. The data here is crucial for voters to make informed decisions and includes:

- **Name**: The full name of the candidate running for a particular position.
- **Platform Description**: A brief description outlining the candidate's goals, ideas, and objectives for the position they are contesting. This information helps voters understand the candidate's stance and vision.
- **Photograph**: A clear photo of the candidate to aid voters in visually recognizing them.

The table enables the system to present the candidate information in a structured format for voters to access easily. This data is updated and managed by administrators.

iii. Votes Table:

The **Votes Table** is where the actual voting data is stored. This table links the voter to the candidate they selected and is essential for tracking votes and maintaining the integrity of the election. It includes the following details:

- **Position**: The specific position being voted on, such as "President," "Secretary," or any other role in the election. This helps categorize votes according to the positions being contested.
- **Candidate**: The name of the candidate the voter selected for each position. This links the vote to the candidate running for that specific position.
- **Voter Name**: The name of the voter who cast the vote. This ensures that each vote is associated with a specific individual and helps maintain the legitimacy of the election process.

This table is crucial for organizing election data and ensuring that each vote is properly attributed to both the correct candidate and the voter. It plays an important role in tracking election participation and validating the voting process.

iv. Positions Table:

The **Positions Table** organizes information about the available positions and the candidates competing for each position. It includes the following key details:

- **Description**: The specific title of the position being contested, such as "President," "Secretary," etc.
- **Maximum Votes**: The total number of votes each candidate has received for a particular position. This is dynamically updated as votes are cast, showing the current vote count for each candidate.

This table is essential for organizing and displaying the results of the election, ensuring that the number of votes each candidate has received is easily accessible and transparently shown for each position. It helps in tracking election progress and ensures the process is clear for both administrators and voters.

4.2 Workflow

4.2.1 Administrator Actions:

The administrator panel simplifies the management of elections through the following actions:

i. Voter Registration and Unique ID Assignment:

- Administrators add new voters by entering their details, such as name, phone number, and other relevant information.
- The system generates a unique ID for each voter, which serves as their primary identifier during the voting process.
- The admin can also edit or delete voter records to maintain the accuracy of the voter database.

ii. Configuring Election Settings:

- Administrators define the contestable positions and the candidates competing for them.
- They can provide detailed descriptions for each position and candidate, ensuring clarity for voters.
- The election settings include customizing the ballot title and configuring specific rules, such as voting time limits or restrictions.

iii. Monitoring Real-Time Statistics:

- A dashboard provides administrators with up-to-date metrics, such as the number of registered voters, active candidates, and votes cast.
- This real-time view helps track election progress and ensures smooth operations.

4.2.2 Voter Journey:

The **Voter Journey** is designed to ensure a secure, efficient, and user-friendly voting experience. Below is the process that a voter follows when using the system:

i. Login and Authentication:

- Voters log in using their **Voter ID** and password. These credentials are validated against the system to ensure only registered and authorized voters can participate.
- Upon successful login, voters are granted access to the election interface, where they can review the available positions and candidates.

ii. Reviewing Candidate Information:

- Once logged in, voters are presented with a list of positions and the candidates running for each role.
- Each candidate's profile includes their name, photograph, and a brief description of their platform, allowing voters to make informed decisions about their vote.

iii. Casting Votes:

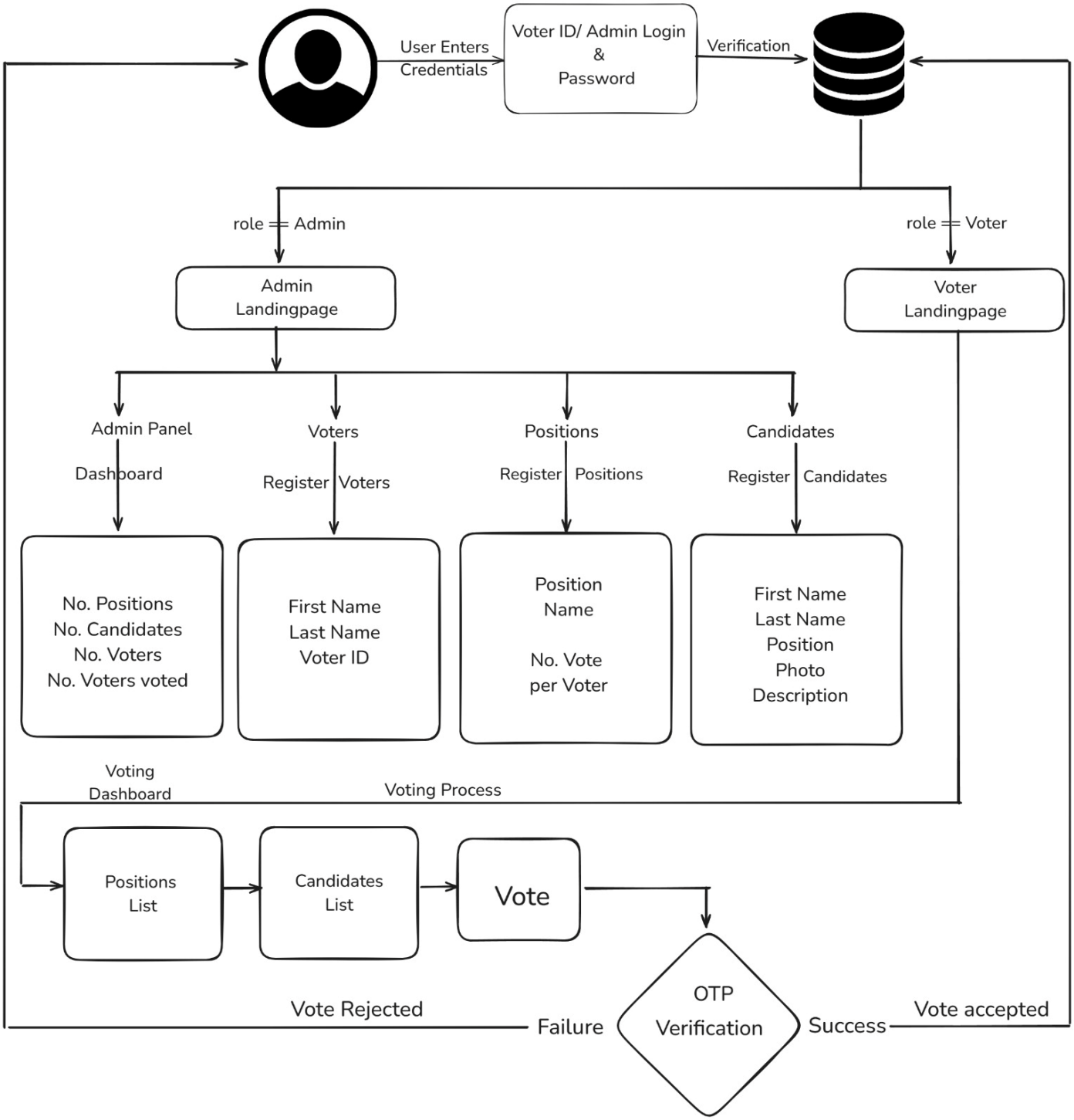
- Voters select their preferred candidates for each position. The interface is designed to make selecting candidates simple and intuitive.
- After making their selections, the voter proceeds to the next step to finalize and submit their vote.

iv. OTP Verification and Vote Submission:

- There are two buttons presented to the voter at this stage: **Send OTP** and **Submit**.
- **Send OTP**: When the voter clicks this button, an OTP is sent to the registered mobile number via a phone call.
- **Entering OTP**: The voter must enter the OTP received on their phone to proceed.
- Once the correct OTP is entered, the **Submit** button is enabled, allowing the voter to submit their final choice.
- The **Submit** button remains disabled until the OTP is correctly entered. This ensures that the vote is verified securely. Once the OTP is entered and validated, the vote is recorded, and a confirmation message is displayed to inform the voter that their vote has been successfully submitted.

This workflow ensures the election process is both secure and user-friendly, with the OTP verification step adding an extra layer of authentication before the voter can submit their vote.

V. OUTPUT


User Enters Credentials
Voter ID/ Admin Login & Password
Verification
role == Admin
role == Voter
Admin Landingpage
Voter Landingpage
Admin Panel
Dashboard
Voters
Register Voters
Positions
Register Positions
Candidates
Register Candidates
No. Positions
No. Candidates
No. Voters
No. Voters voted
First Name
Last Name
Voter ID
Position Name
No. Vote per Voter
First Name
Last Name
Position
Photo
Description
Voting Dashboard
Voting Process
Positions List
Candidates List
Vote
OTP Verification
Failure
Success
Vote Rejected
Vote accepted

VI. CONCLUSION

The proposed E-voting system was tested in a controlled environment to evaluate its functionality and effectiveness in managing an election process. The testing confirmed that the system successfully fulfills its objectives of providing a secure and streamlined voting experience.

The system's user interface was intuitive and accessible, allowing both administrators and voters to navigate the platform with ease. Administrators efficiently carried out tasks such as voter registration, election configuration, and real-time monitoring, while voters could seamlessly log in, review candidate profiles, and cast their votes. This simplicity ensures the system can be adopted without requiring extensive training or technical expertise.

The security of the voting process was a key focus during testing. The OTP-based two-step authentication ensured that only authorized voters could access the system and cast their votes, safeguarding the integrity of the process. The use of secure authentication methods eliminated risks associated with unauthorized access, demonstrating the robustness of the system's design.

Overall, the testing validated the system's ability to provide a secure, efficient, and user-friendly platform for conducting elections. Its reliability and straightforward approach make it a suitable solution for various organizational voting needs, emphasizing transparency and trust in the electoral process.

REFERENCES

[1] D. Bhanderi, M. Kavathiya, T. Bhut, H. Kaur and M. Mehta, "Impact of Two-Factor Authentication on User Convenience and Security," 2023 10th International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, India, 2023, pp. 617-622.

[2] M. B. Segoro and P. A. Wibowo Putro, "Implementation of Two Factor Authentication (2FA) and Hybrid Encryption to Reduce the Impact of Account Theft on Android-Based Instant Messaging (IM) Applications," 2020 International Workshop on Big Data and Information Security (IWBIS), Depok, Indonesia, 2020, pp. 115-120, doi: 10.1109/IWBIS50925.2020.9255501.

[3] S. Ganesh Prabhu, A. Nizarahammed., S. Prabu., S. Raghul., R. R. Thirrunavukkarasu and P. Jayarajan, "Smart Online Voting System," 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021, pp. 632-634, doi: 10.1109/ICACCS51430.2021.9441818.

[4] A. H. Hakami and W. Elmedany, "Secure authentication framework based on one-time password for internet of things," 6th Smart Cities Symposium (SCS 2022), Hybrid Conference, Bahrain, 2022, pp. 451-457, doi: 10.1049/icp.2023.0645.

[5] Angga Fantiya Hermawan, Dwi Rachmawati, and Dwi Haryadi, "Two factor authentication in E-voting system using time-based one-time password," 2nd International Conference on Advanced Information Scientific Development (ICAISD) 2021

[6] S. Komatineni and G. Lingala, "Secured E-voting System Using Two-factor Biometric Authentication," 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2020, pp. 245-248, doi: 10.1109/ICCMC48092.2020.ICCMC-00046.