E-Voting Mobile Application System

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Abstract: Any democracy must have an open voting process that satisfies the demands of the populace in order to assign power to the most qualified candidate. A fair and transparent election system is essential to the freedom that the majority of people in today's world enjoy. In every nation, voting is an important and serious occasion. However, the traditional elections are controlled and managed by a centralised authority, which makes them vulnerable to numerous security privacy, fraud, integrity, and fairness issues. On the other hand, electronic voting offers less errors and quicker counting. It can also remove votes that are questioned or declared invalid. Currently, the election system used by Universiti Teknologi Mara Cawangan Kelantan (UiTMCK) is suffering from a poor voter turnout since the system in place is not convenient for most students. Normally, the students would have to stand in a long queue to register when joining a voting event. As the registration of the students is recorded manually, it is difficult for the event organizer to manage the event efficiently. It is also unable to prevent any irresponsible authorities who may exploit and manipulate the votes in favor of their preferred candidates which temper the expected free and fair elections. Therefore, E-Voting Mobile Application System (E-Voting MAS) is proposed to overcome these problems. E-Voting MAS was developed using Agile model. This study proves the E-Voting MAS is feasible at UiTMCK, utilizing an approach that seamlessly integrates convenience and security.

Keywords: Agile, e-voting, Electronic voting, SDLC

1 Introduction

Voting is a tool used by the voter to freely express their opinion in elections. Paper voting is a type of voting system that uses paper ballots, where votes are cast and counted by hand. Many of the paper ballot voting systems in use today fail to cope with several threats. Based on this, attempts are made to solve the problems of voting with the help of information and communication technologies [1-4]. In light of the rapid development of the Internet, conventional voting practises are commonly being substituted with electronic voting. The computerised voting procedure primarily relies on third-party organisations for the counting of votes. However, the non-dependency of these third parties and their complete control over voting information might potentially result in information unreliability and significant privacy breaches [5]. To understand electronic voting, there are four key processes in an election process [6]. The first one is ballot composition where voters select choices. Second, ballot casting where voters submit their ballots. Third is ballot recording where a system records the submitted ballots. The last one is tabulation where votes are tabulated. Even with voting systems that are not entirely electronics, computers are used for ballot casting, recording, and tabulation. In the strictest

sense, electronic voting is a method in which the initial stage, where ballots are created or chosen, is performed with the assistance of a computer [6].

Elections allow people to select their representatives. The integrity of the electoral process is, of course, crucial to the integrity of democracy itself. In general, there are six fundamental actions that must be completed in each manual voting election in which voters must register, be authenticated, acquire, and mark their vote form, and present the vote form to a ballot box [7]. The votes must then be collected and counted by election officials. If the election is called into question, the ballots may have to be recounted. The system is protected by stringent security measures. These security elements will be applied from the time a voter logs into the voting system until they cast their vote for their preferred candidate and depart the system. This method also sets restrictions that prevent voters from voting for the same election candidates more than once. The system to be deployed must handle the difficulties of the security requirements of a vote cast via the internet. In order to provide a safe way of voting online, user authentication and validation, access permissions, information encryption, and voting security must all be thoroughly investigated.

The project will concentrate on changing the present paper-based election method used by UiTMCK into an online system. The present voting procedure utilised by the student union has a low voter participation since it is inconvenient for most students. In the previous elections held in UiTMCK, voter attendance has been low. Initially, students were supposed to line up and vote in the ballots assigned to their respective faculty. The existing method does not check or account for voters because no voting registration is done beforehand. This has created several loopholes, such as allowing a student who is not in the session to queue, provided he or she possesses a student identity card. The existing method also does not provide information on the number of predicted voters because it is based on student population, and not all students are interested in these elections. This is the biggest problem for voters and election commission personnel. Therefore, the proposed system which is an E-Voting MAS will overcome this issue by allowing students and staff of UiTMCK to vote for their preferred candidates using an internet-connected computer.

2 Literature Review

A Paper-Based Voting System

Any democracy must have an open voting process that satisfies the demands of the populace in order to assign power to the most qualified candidate [8]. In traditional paper-based election, the impossibility to trace the content of a vote to the identity of the voter who has cast it is ensured by physically breaking the link between the voter and their ballot when the latter is cast into the ballot box. Further, confidentiality measures (such as ballot booths) may be set in place for voters to be able to make their choices in private prior to casting their vote [9]. It also raises the risk of invalid votes. Several online news pages reported that problems have occurred since before the election process which is at the stage of preparing the final voter list, reports of fraud committed by candidates, as well as hundreds of officers who have died due to suspected fatigue after serving at the polling station [10].

In UiTMCK, the voting process still uses this method. Students have to line up and register first according to their respective faculties. Then, they will be given a queue number and enter the voting booth individually. Students will start voting by nominating the candidate they like according to their respective faculties. Next, the students will insert the ballot paper into the ballot box and exit the voting room. After all the voting process is completed, the votes will be counted manually by the person in charge of the voting event. The person may exploit and manipulate the votes in favour of their preferred candidates which tempers with the expected free and fair elections. Therefore, the current system consumes a lot of time since users have to queue in order to vote and hand counting the votes also takes a lot of time and manpower.

B   Internet Voting System

Low voter turnout remains one of the pressing problems in the voting system. The reason for the low voter turnout is the limited time and place of the event, as well as distrust in the way and method of voting. The most promising way to eliminate these problems is by using electronic voting [11]. Kumar and Begum [12] comprehensively present an overview of electronic voting operations. Rikwith et al. [13] contribute to the improvement of the voting system's performance through the integration of face recognition and biometric authentication, aiming to minimize malpractices in voter identification. Subsequent research endeavours aim to advance the security of online voting systems, employing a ranked-choice technique wherein each cast ballot undergoes encryption using the exponential ElGamal cryptosystem [14, 15].While online voting aims to provide a web-based interface through which voters can cast their ballots and obtain election results, electronic voting refers to the registration process being carried out electronically, such as using biometrics and coded voter cards that can be scanned by an electronic device to authenticate the voter. As a result, after the election, an electronic voting system may require human clerks to count the ballots. Electronic ballots may improve speed in vote collation and tallying and reduce the overall cost of the voting exercise [16].

3   Methodology

The Agile technique was adopted for this study because of its iterative procedure, which enables the modification of functionality at any point. The fundamental aspect of Agile is to break down the project into brief and manageable iterations. Changing requirements midway through the project can be a nightmare. Agile, on the other hand, embraces change. The development team and stakeholders collaborate continuously, allowing them to adapt to changing requirements. The aim is to achieve a functional product by the end of each iteration, facilitating regular tests as well as adaptation of the project. After each iteration, there is a demo where the users interact with the E-Voting MAS. Their feedback is then used to make adjustments and set priorities for the next iteration.

The subsequent procedures illustrate the sequential stages of the Agile methodology in a generic context.

A   User Requirements

The requirements of the mobile app, like the features, were obtained from literature and users. Apart from that, research data such as the existing voting process were obtained from several students of UiTMCK. User requirements and system requirements are detailed as follows:

- The system should require all eligible voters to register and authenticate their identity before participating in any election activities.
- The registration process should verify the user's status as an active student or staff member of UiTMCK, ensuring that only authorized individuals can participate.
- The E-Voting MAS should generate real-time reports on voter turnout, providing election commission personnel with accurate and transparent information on the number of participants.
- The reporting system should offer insights into voting trends, helping the election commission to make informed decisions and adjustments for future elections.
- The system should incorporate user education features, including tutorials and guidance, to ensure that all users, including students and staff, are familiar with the E-Voting MAS.

B   System Requirements

Software
- Windows 11 64-bit programming language
- Android Studio
- Firebase

Hardware
- Computer with at least 8GB RAM
- Android emulator
- Smartphone with an operating system of at least Android 5 (Lollipop)

C   Design

A use case describes how someone who uses a process or system will accomplish a goal. Although it is most usually associated with software application systems, it may be used for any process. It describes how visitors will interact with the website to achieve tasks. It defines how a system responds to a request from the user's point of view. Each use case is stated as a succession of simple actions that begin with the user's aim and finish with that goal being met. Based on Figure 1 below, there are eleven use cases and three actors that are available in the E-Voting MAS application.
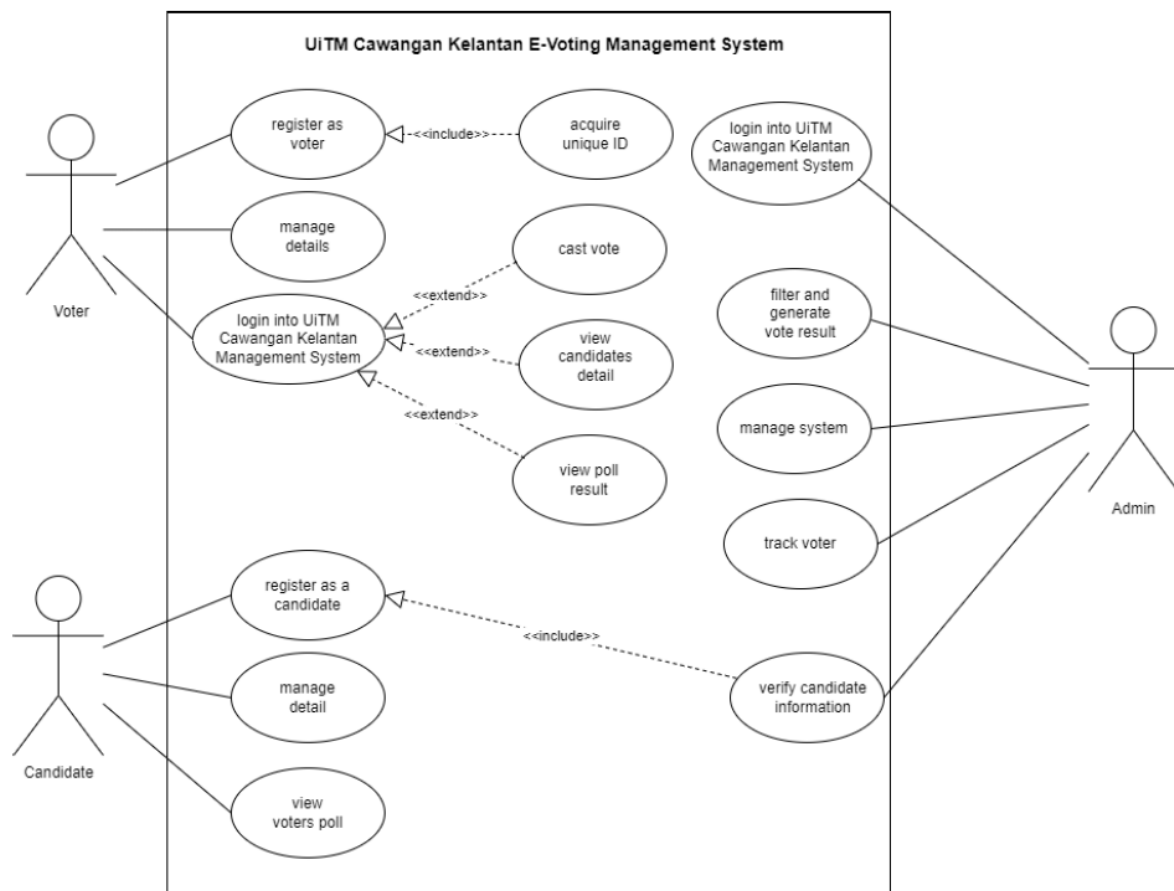

Figure 1: Use Case Diagram of E-Voting MAS application

Use Case 1: Login as Voter
  i.   The system shall allow UiTMCK E-Voting MAS members to login after the student id has been verified.
  ii.   The system shall display an error and notification if the input is incorrect.
  iii. The voter can cast vote by picking their candidates based on the voter's faculty.
  iv.   The voter can view the candidate's details.
  v.   The voter can view the poll result after an admin publishes it.

Use Case 2: Register as a voter.
  i.   Voters need to register as a member of UiTMCK E-Voting MAS using student id and password.
  ii.   The system shall display a pop-up notification after the registration has been done.
Use Case 3: Manage detail.

    i.   Voters can manage their details.

Use Case 4: Register as a candidate.
    i.   Candidates must register themselves first.
    ii.   Admin will verify candidates' information. After the verification is done, the candidates can login into UiTMCK E-Voting MAS.
    iii.   Candidates can manage their details like add or edit their manifesto.
    iv.   Candidates can view voters' poll and results of the election published by the admin.

Use Case 5: Login as Admin
    i.   The system should allow the admin to login into the system after account verification.
    ii.   The system will display "error" if the input is incorrect.

Use Case 6: Admin filter and generate vote results.
    i.   Admin will count the vote results for each candidate.
    ii.   Admin will publish the results for each session.

Use Case 7: Admins manage system.
    i.   Admin manages queries sent by users of the UiTMCK E-Voting MAS.
    ii.   Admins can add, delete, and edit candidates' details and publish it into the system.
    iii.   Admins can add, delete, and edit lists of faculties in UiTMCK.

Use Case 8: Admins track voter.
    i.   Admins can track candidates and view the voting process.

D   Development

Activities 1:
    a) Develop the coding, UI, and functions for UiTMCK E-Voting MAS
    b) Output: UiTMCK E-Voting MAS is developed.

Activities 2:
    a) Develop the database.
    b) Output: Database for UiTMCK E-Voting MAS is developed.

E   Test

The objective is to ensure the proposed system's goals are achieved. Any remaining features that could not be included in the first iteration were addressed in the succeeding iteration or subsequent iterations, depending on priority. The developer presented a functional program with the features finalized for that iteration at the conclusion of the first iterations. At the end of each iteration, the user was delivered a working software that was incrementally enhanced and updated with the features shortlisted for that iteration. This approach allowed users to interact and work with a functioning software at the end of each iteration and provided feedback on UiTMCK E-Voting MAS. Moreover, it allows the system to take up changes more easily and make course corrections if needed. By then, with this iteration in the testing phase, there were fewer problems with the proposed system.

4   Results

This section displays the interfaces of UiTMCK E-Voting MAS. It shows the features for each user which are voters, candidates, and admins. Each user has unique roles and responsibilities.
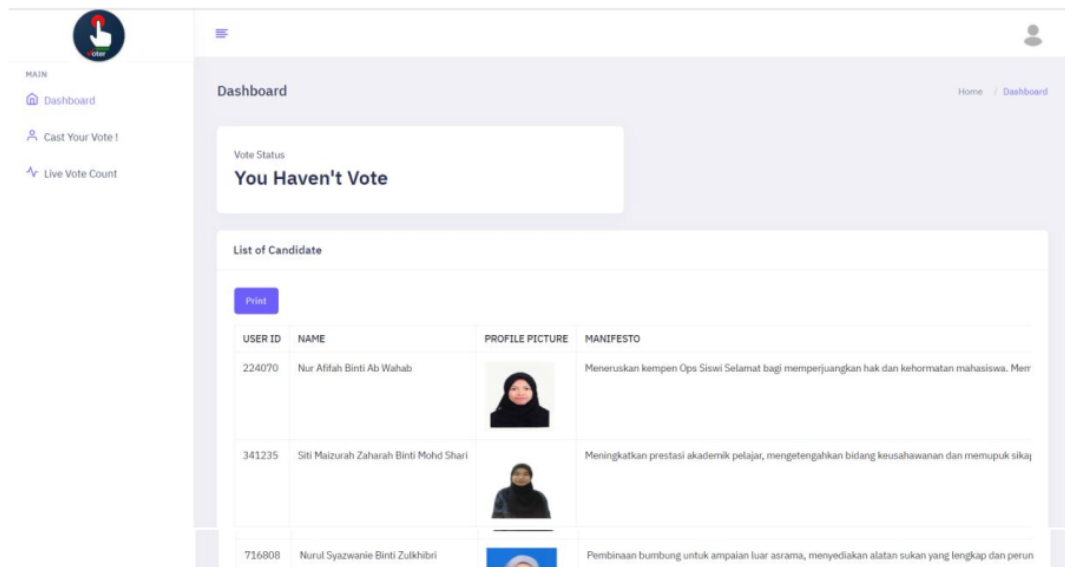
A   Voter

Figure 2: Voter's Dashboard A

Figure 2 it shows the status of the voter either the voter has voted or not. There is also a list of candidates which have the candidates' names, candidates' ids, candidates' profile pictures and candidates' manifestos. By having this information, voters can read and choose wisely their preferred candidate. Voters can also print the list of candidates.
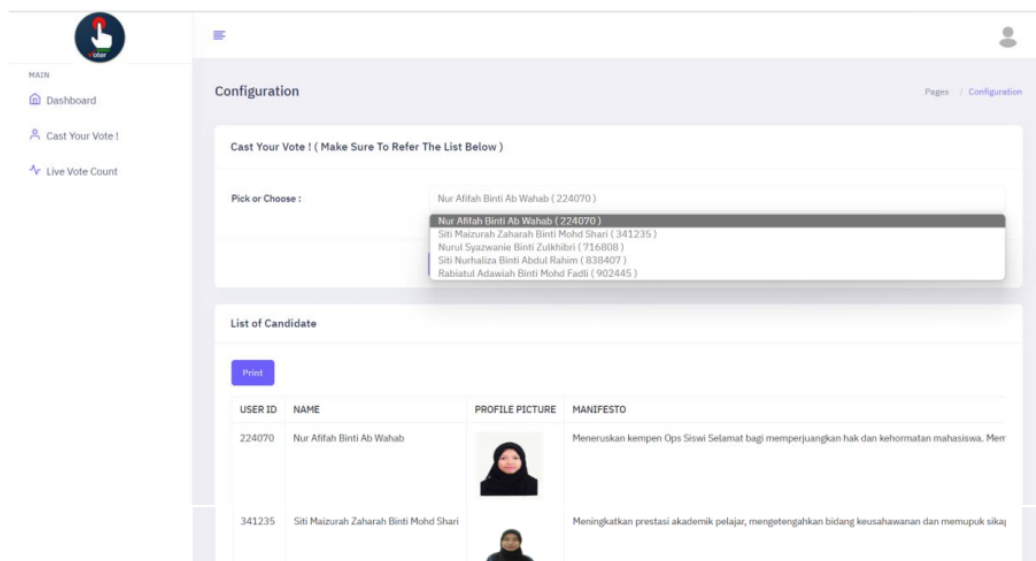

Figure 3: Voter's Dashboard B

If voters want to cast their votes, they need to click on "Cast Your Vote!" at a sidebar, as shown in Figure 3. Then, they pick or choose the candidates they want. If the voter has voted, there is a pop-up message showing that the voter is only allowed to vote once.
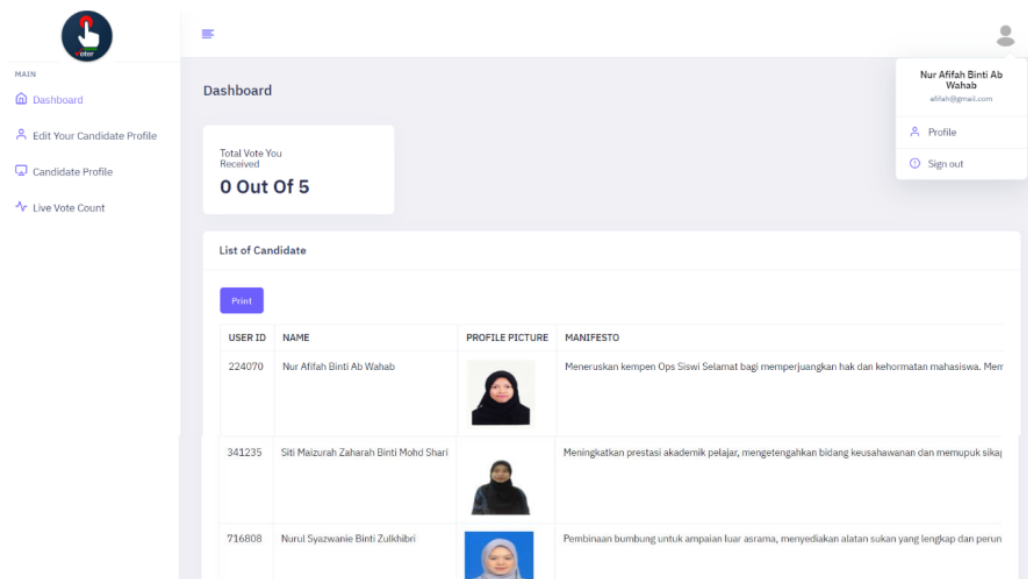
B   Candidates

Figure 4: Candidate's Dashboard

Figure 4 illustrates the candidate's ability to access the aggregate number of votes she has gained. The candidate has the ability to access the details of other candidates as well as their respective manifestos. The list of candidates can be printed and saved by the candidates by clicking on the "*Print*" button. If candidates want to update their profiles, the candidates need to click on "*Edit Your Candidate Profile*". In this page, candidates can upload images, videos, and manifestos. In order to find out the outcome of the election, the candidate may access it by selecting the option "*Live Vote Count*" located in the sidebar. The candidates will find out whether they have won in the election or not. In addition, the candidates can also get real-time vote tallies for their fellow candidates.
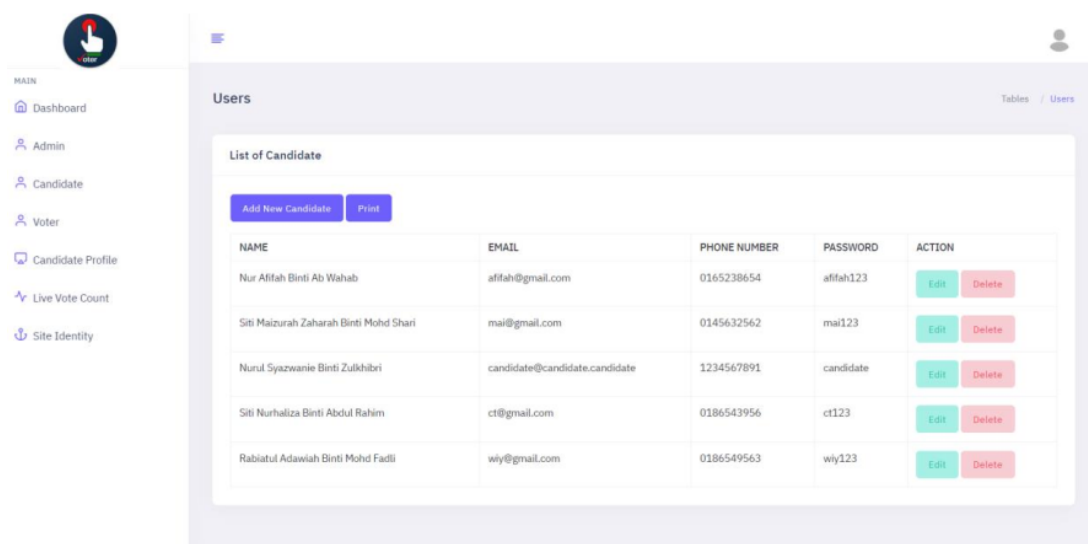
C   Admin

Figure 5: Admin's Dashboard

After the Admin has login into this system by entering their registered email and password, the admin will go to the dashboard page. In this page, the admin can view the total number of admins, the total number of candidates, the total number of voters, the total number of votes casted and the list of candidates. To know which candidate has won the election, admin can view it by clicking on "*Live Vote*

Count" in the sidebar. From this page, admins can view which candidates get the most votes. So, the candidate who gets the most votes will be the winner for the election. The admins can also generate reports of the election by saving and printing the results. Thus, it can be kept and referred to in the fuure. Figure 5 shows that the admins can print out the list of voters, candidates, and admins in this system to generate reports. The admin can also take actions to the list such as adding, editing, and deleting information.

In addition, UiTMCK E-Voting MAS is relevant to be used by any committee in UiTMCK. Admins of the system can update the system's logo, favicon, and background. If any authority has its own logo, favicon, and background, they can change it in this section by uploading their files. Admins can also change the website's name, description, and footer.

5 Conclusion

Introducing electronic voting system can make elections seem fairer by improving accessibility, accuracy, and security. Electronic systems offer features like multiple languages and tools for diverse needs, ensuring inclusivity. It also minimizes errors with built-in audit trails, fostering transparency and trust. Advanced security features may prevent fraud to maintain the integrity of the process. Quick results and real-time monitoring can reduce any uncertainty and build confidence in voters. In addition, robust voter verification methods enhance legitimacy. UiTMCK E-Voting MAS focuses on enhancing the present voting system by turning the current paper-based election process used by UiTMCK into an online system. The current method does not provide statistics on the number of predicted votes based on the student population, and not all students participate in these elections. For voters and election authorities, this is the most significant issue. This research proved that the UiTMCK E-Voting MAS can be carried out at UiTMCK using an E-Voting approach that combines convenience and security. It is envisaged that this technology application would address the previously stated difficulties. While this study has provided valuable insights into the current state of security in internet voting systems, there remain several avenues for future research to further strengthen the integrity and trustworthiness of such systems such as cybersecurity, privacy, and accessibility to ensure that the system is both trustworthy and inclusive. Public education and awareness campaigns about the security measures in place can further enhance the perception of fairness among voters and stakeholders.

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Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

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