



Electronic Voting System for the Supreme Student Government (SSG) of one of the Maritime Higher Education Institution in Negros Occidental, Philippines

**Dyna E. Drilon¹; John Albert M. Morin²; John Augustus P. Diesto³;
Crimary C. Mahinay⁴; Kristine T. Soberano⁵**

^{1, 2, 3, 4}MIT Students, State University of Northern Negros, Sagay City, Negros Occidental, Philippines

⁵MIT Professor, State University of Northern Negros, Sagay City, Negros Occidental, Philippines

¹[iamdynamdrilon@gmail.com](mailto:iamdynadrilon@gmail.com); ²johnmandoladozz@gmail.com; ³johndiesto102@gmail.com;

⁴crmrymhny@gmail.com; ⁵ksoberano@sunn.edu.ph

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Abstract: This study focused on developing an Electronic Voting System for the Supreme Student Government (SSG) of a Maritime Higher Education Institution in Negros Occidental. The research was conducted in response to the limitations of the existing manual voting system, which was observed to be time-consuming, labour-intensive, prone to errors, and vulnerable to security issues. The study employed a descriptive research design, using a self-made validated questionnaire administered to selected respondents. Stratified random sampling was used to ensure representation across different departments and year levels. The evaluation of the manual voting system revealed inefficiencies in vote counting, delays in result generation, additional manpower requirements, and concerns regarding security and accuracy. On the other hand, the developed Electronic Voting System was evaluated using the ISO/IEC 25010 software quality model in terms of functional suitability, usability, reliability, performance efficiency, and security. The results showed that the system obtained an overall mean rating interpreted as "Excellent," indicating high acceptability among respondents. The findings suggest that the Electronic Voting System significantly improves election processes by enhancing efficiency, accuracy, and security while reducing workload and operational costs. The study concludes that the implementation of the system is beneficial in modernizing election procedures and improving overall election management.

Keywords: Electronic Voting System, Manual Voting System, ISO/IEC 25010, System Evaluation, Election Automation

I. INTRODUCTION

In today's digital era, many institutional processes have become automated, including election procedures. Traditional voting systems commonly rely on manual casting and counting of votes, which require significant time, effort, and manpower. Manual election processes are often vulnerable to delays, counting errors, and procedural inefficiencies, making them less reliable compared to automated systems [3]. In addition, manual handling of ballots increases the risk of miscounting, loss of votes, and unauthorized access to confidential election records.

The right to vote is recognized as an essential democratic process that allows individuals to select leaders who can represent their interests and guide their organizations effectively. However, maintaining a transparent, accurate, and secure election process remains a challenge in many institutions. According to Aouragh et al. [2] electronic voting systems help strengthen election integrity by minimizing opportunities for ballot manipulation and improving the organization of election procedures. Automated election systems also contribute to faster processing and more accurate generation of results.

Technological advancements in information and communication technology have significantly transformed institutional operations. Many educational institutions now adopt digital systems to improve operational efficiency, reduce workload, and enhance the accuracy of services. Studies on digital transformation indicate that automation improves processing speed, minimizes human error, and increases overall efficiency in organizational activities [3]. In educational settings, automated systems are increasingly utilized to support administrative processes and encourage students' awareness of modern technologies.

In response to these developments, the researchers developed an Electronic Voting System for the Supreme Student Government (SSG) of one of the Maritime Higher Education Institutions in Negros Occidental. The system allows votes to be cast and counted electronically through a private computer network. It aims to simplify election procedures, reduce the time required for vote tallying, minimize inconsistencies in vote counting, and improve the security and confidentiality of election data. The proposed system also seeks to lessen the workload of election personnel and reduce costs associated with printing and handling paper ballots.

To ensure the effectiveness and acceptability of the system, the study utilized the ISO/IEC 25010 software quality model, which evaluates software in terms of functional suitability, usability, reliability, performance efficiency, and security. According to the International Organization for Standardization [5], these quality characteristics are essential in determining whether a software system effectively meets user needs and operational requirements.

This study aims to develop and evaluate an Electronic Voting System for the Supreme Student Government (SSG) of one of the Maritime Higher Education Institutions in Negros Occidental. Specifically, the study seeks to assess the limitations of the existing manual voting system, develop an automated election platform, and evaluate the developed system based on the ISO/IEC 25010 software quality model. Through this study, the researchers aim to contribute to the modernization of election procedures by providing a more efficient, accurate, reliable, and secure voting system for student government elections.

A. Objectives of the Study

This study aims to develop and evaluate an Electronic Voting System for the Supreme Student Government (SSG) of one of the Maritime Higher Education Institutions in Negros Occidental, Philippines.

Specifically, the study aims to:

1. Assess the limitations and challenges of the existing manual voting system;
2. Develop an Electronic Voting System for the SSG elections;
3. Determine the effectiveness of the developed system in simplifying voting and vote tallying procedures;
4. Evaluate the developed Electronic Voting System in terms of:
 - a. functional suitability,
 - b. usability,
 - c. reliability,
 - d. performance efficiency, and
 - e. security based on the ISO/IEC 25010 software quality model; and
5. Determine the overall acceptability of the developed Electronic Voting System.

II. METHODOLOGY

This section presents the research design, participants and sampling technique, research instruments, data collection procedure, data analysis, validity and reliability testing, and ethical considerations employed in the study. It describes the systematic procedures undertaken to ensure that the objectives of the research were achieved accurately, ethically, and reliably.

A. *Research Design*

This study employed a quantitative descriptive research design to evaluate both the existing manual voting system and the developed Electronic Voting System for the Supreme Student Government (SSG) of one of the Maritime Higher Education Institutions in Negros Occidental. The descriptive research design was appropriate because the study aimed to assess the current election process and determine the acceptability and effectiveness of the developed system based on the respondents' evaluation.

The study focused on identifying the limitations of the manual voting system and evaluating the developed Electronic Voting System using the ISO/IEC 25010 software quality model in terms of functional suitability, usability, reliability, performance efficiency, and security.

B. *Participants and Sampling Technique*

The participants of the study were selected students from different departments who had previous experience participating in manual SSG elections. The respondents were drawn from the total student population of 2,857 enrolled from first year to fourth year during the second semester of Academic Year 2024–2025.

Stratified random sampling was utilized in selecting the respondents to ensure proper representation from different departments and year levels within the institution. This sampling technique was appropriate because it allowed the researchers to divide the population into specific groups or strata and randomly select participants from each group. Through this method, the researchers ensured that the selected respondents accurately represented the target population and minimized sampling bias.

A total of 351 respondents participated in the assessment of the existing manual voting system, while 187 respondents evaluated the developed Electronic Voting System.

C. *Research Instrument*

The study utilized two research instruments for data gathering. The first instrument was a researcher-made structured questionnaire designed to assess the limitations and challenges encountered in the existing manual voting system. The questionnaire consisted of ten (10) close-ended questions focusing on manpower requirements, vote counting accuracy, time efficiency, budget requirements, ballot security, election procedures, and students' awareness of new technologies.

The second instrument was a structured questionnaire based on the ISO/IEC 25010 software quality model used to evaluate the developed Electronic Voting System. The evaluation focused on five software quality characteristics, namely functional suitability, usability, reliability, performance efficiency, and security. Since the questionnaire was adapted from the established ISO/IEC 25010 software quality standards, no separate validity and reliability testing were conducted.

A 5-point Likert scale was used in evaluating the Electronic Voting System, where:

- 5 – Strongly agree
- 4 – Agree
- 3 – Neutral
- 2 – Disagree
- 1 – Strongly disagree

The use of these instruments enabled the researchers to gather relevant information regarding the effectiveness, usability, and acceptability of the developed Electronic Voting System.

D. *Validity and Reliability of the Researcher-Made Questionnaire*

Since the first instrument was researcher-made, it underwent validity and reliability testing to ensure the quality, clarity, and consistency of the questionnaire items used in assessing the existing manual voting system.

To establish content validity, the questionnaire was reviewed and validated by selected experts in the fields of Information Technology, research, and system evaluation. The validators examined the questionnaire items based on their relevance, clarity, appropriateness, and alignment with the objectives of the study.

Based on the evaluation of the experts, the questionnaire obtained a Content Validity Index (CVI) of 0.92, indicating excellent content validity. The comments and recommendations of the validators were incorporated to further improve the questionnaire. Revisions included refining the wording of several items and adding statements related to ballot security and confidentiality.

To determine reliability, a pilot test was conducted among selected students who were not included in the actual respondents of the study. Cronbach's Alpha was used to measure the internal consistency of the researcher-made questionnaire.

The questionnaire obtained an overall Cronbach's Alpha coefficient of 0.89, indicating high reliability and confirming that the instrument was acceptable for actual data gathering.

The results imply that the researcher-made questionnaire was both valid and reliable in assessing the limitations and challenges of the existing manual voting system.

E. System Development

The researchers utilized the Agile and Iterative Development approach in developing the Electronic Voting System for the Supreme Student Government (SSG). According to Ally [1], Agile development promotes overlapping phases, continuous feedback, collaboration, and adaptability to changing system requirements throughout the software development lifecycle. Similarly, iterative development allows the system to be developed through repeated cycles of refinement and improvement until the desired functionality and quality are achieved.

Figure 1 illustrates the Agile and Iterative Development approach utilized in the development of the Electronic Voting System.

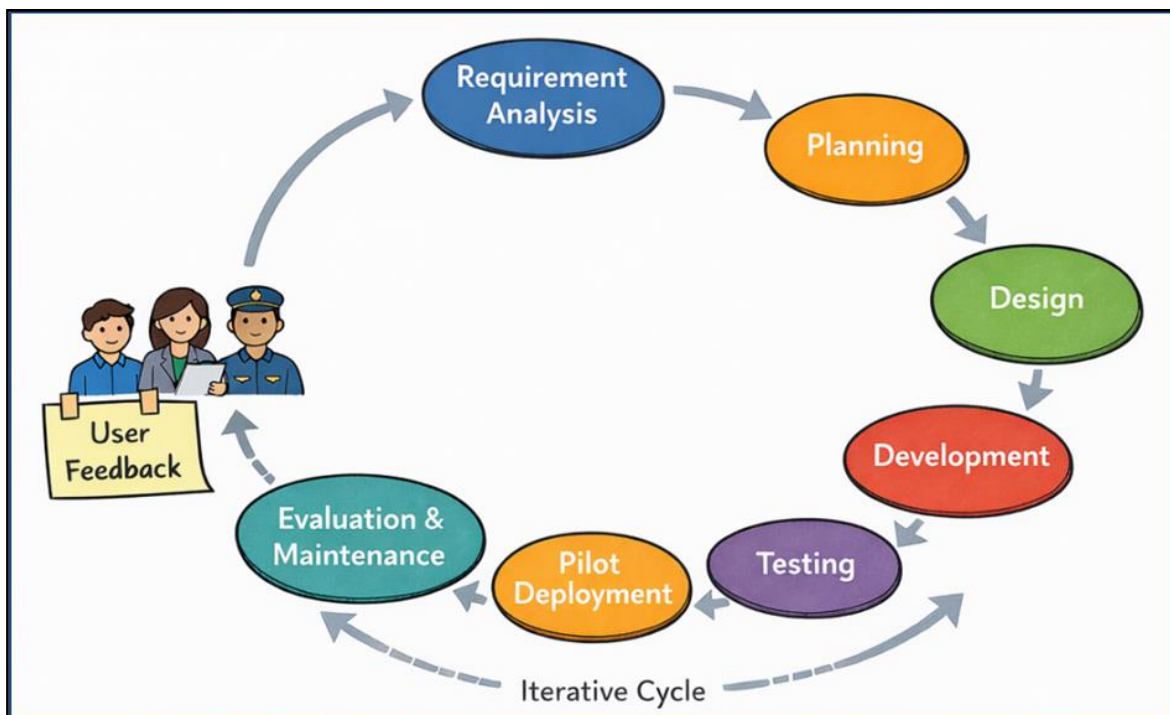


Fig. 1: Agile and Iterative Development

The Agile and Iterative approaches were selected because they support flexibility, continuous improvement, and active user involvement during system development. Through this approach, the system was developed in incremental cycles, allowing each feature to be tested, evaluated, refined, and improved before proceeding to the next development stage. This process ensured that the system remained efficient, reliable, secure, and aligned with the needs of the users.

The Electronic Voting System was developed using PHP as the primary programming language. MySQL was utilized for database management, while HTML, CSS, JavaScript, and Bootstrap were used in developing the graphical user interface of the system. XAMPP served as the local development environment during the system development and testing phases.

The system follows client-server architecture in which users access the voting platform through a web browser connected to a centralized database server. The administrator manages election settings, candidate

information, and monitoring functions, while authorized students securely access the system to cast their votes electronically.

1) *Requirements Gathering and Analysis*

The development process began with an assessment of the existing manual voting system used by the institution during Supreme Student Government elections. The researchers analyzed common issues encountered in the manual election process, including slow vote counting, excessive manpower requirements, ballot handling difficulties, security concerns, and possible human errors.

Consultations and informal discussions were conducted with selected students, faculty members, and election personnel to identify the specific needs and expectations for the proposed system. These activities enabled the researchers to determine the necessary features and functionalities required for the Electronic Voting System.

Based on the gathered information, the researchers identified the major system requirements, which included secure vote casting, automated vote counting, user authentication, controlled system access, confidentiality of election records, and generation of accurate election results. Non-functional requirements such as reliability, usability, performance efficiency, and security were also considered throughout the development process.

The identified requirements were continuously reviewed and refined during each iteration of the development cycle to ensure that the system effectively addressed the needs of the users and complied with the objectives of the study.

2) *Iterative System Planning*

After identifying the system requirements, the researchers proceeded with iterative system planning. Unlike traditional linear development models, Agile planning allowed the researchers to organize development activities into smaller and manageable stages while remaining flexible to modifications and improvements.

The researchers planned the major components of the system, including the voter interface, administrator functions, database management, authentication mechanisms, and automated vote tallying processes. Timelines, development priorities, and system resources were also identified to ensure proper organization throughout the project implementation.

Security measures were incorporated during the planning stage to ensure the confidentiality, integrity, and protection of election data. The researchers also considered the operational requirements of the institution, including system accessibility, network setup, and user management procedures.

3) *Incremental System Design*

The Electronic Voting System was designed incrementally, allowing the researchers to improve individual components of the system in successive development cycles. The design focused on creating a simple, user-friendly, and efficient interface that would allow students to navigate and use the system with minimal difficulty.

The researchers designed interfaces for voter login, candidate selection, vote confirmation, and result generation. Administrative interfaces were also developed to allow election personnel to manage candidates, monitor election activities, and generate election reports.

Database structures were designed to securely store voter information, candidate profiles, election records, and vote results. Access control mechanisms were integrated into the design to ensure that only authorized users could access sensitive election information.

Each component of the system was reviewed and revised during development to improve usability, functionality, and security.

4) *Iterative Development and Implementation*

The development and implementation of the Electronic Voting System followed an iterative approach. The researchers first developed the core system features, including user authentication, secure vote casting, and automated vote counting functionalities.

After the successful implementation of the core components, additional features such as result dashboards, election monitoring tools, and report generation modules were gradually integrated into the system. A centralized and secure database was implemented to support real-time vote processing and storage.

The researchers continuously tested each newly developed feature to verify its functionality, stability, and security before integrating it into the complete system. This iterative process enabled the researchers to identify and resolve technical issues early during development.

5) *Continuous Testing and Validation*

Testing and validation activities were conducted throughout the system development lifecycle to ensure that the Electronic Voting System functioned properly and met user requirements.

Functional testing was performed to verify that the system accurately executed voting operations, vote recording, and result generation. Usability testing was also conducted to evaluate the ease of use, accessibility, and user-friendliness of the system interfaces.

Security testing was performed to assess the protection of election records and prevent unauthorized access to the system. Performance testing was likewise conducted to evaluate the responsiveness, processing speed, and stability of the system during voting operations.

Feedback from users and evaluators was collected after each development cycle and utilized to improve system performance, interface design, and functionality.

6) *Incremental Deployment*

The Electronic Voting System was deployed incrementally to minimize operational risks and identify potential issues before full implementation. Initially, the system was introduced through pilot testing and mock election activities to simulate actual election scenarios within the institution.

The pilot implementation enabled the researchers to observe system performance, identify technical concerns, and evaluate user interaction with the system. Necessary revisions and adjustments were performed based on the observations and feedback gathered during the pilot testing phase.

Orientation and demonstration sessions were also conducted to familiarize students and election personnel with the features and procedures of the Electronic Voting System prior to actual implementation.

7) *Evaluation and Maintenance*

Following deployment, the Electronic Voting System continued to be monitored and evaluated during election activities to ensure proper system operation, reliability, and accuracy.

System maintenance activities included correcting identified issues, updating system functionalities, improving security measures, and optimizing system performance. Regular monitoring and maintenance were conducted to ensure that the system remained stable, secure, and effective for future election use.

The researchers also recommended continuous enhancement of the system through the integration of additional features and updated security mechanisms to further improve election management and user experience.

F. *Data Collection Procedure*

The researchers followed systematic procedures in conducting the study. Initially, an assessment of the existing manual voting system was conducted through the administration of the researcher-made questionnaire to identify its procedures, limitations, and common issues encountered during election activities.

Before the actual data gathering, permission to conduct the study was secured from the institution's Research Development Office, SSG COMELEC, SSG Adviser, and other concerned authorities. After approval was granted, the selected respondents were informed about the objectives and purpose of the study. An informed consent statement was provided to ensure that participation was voluntary.

The respondents were first asked to answer the researcher-made questionnaire regarding the existing manual voting system. Afterward, they were given an overview and orientation regarding the developed Electronic Voting System. They were then instructed to use the system and perform actual voting-related tasks to simulate the election process.

After the interaction phase, the ISO/IEC 25010-based evaluation forms were administered to the respondents to evaluate the developed Electronic Voting System. Participants were given sufficient time to answer the questionnaires independently and honestly based on their experiences in using the system.

After the completion of the questionnaires, the responses were collected, checked for completeness, organized, and prepared for statistical analysis. All gathered information was treated with confidentiality and used strictly for academic and research purposes only.

G. Data Analysis

Descriptive statistics were used to analyze the data. Frequency counts and percentages were used for the manual voting system, while weighted mean was used for the evaluation of the electronic system.

The interpretation scale for the weighted mean is as follows:

Weighted Mean Range	Verbal Interpretation
4.50 – 5.00	Excellent
3.50 – 4.49	Very Good
2.50 – 3.49	Good
1.50 – 2.49	Fair
1.00 – 1.49	Poor

H. Ethical Considerations

This study carefully followed the ethical research standards and guidelines to ensure protection, privacy, and dignity of all participants. Before collecting any data, all participants provided informed consent. Permission was obtained from the relevant authorities, such as SSG Comelec, SSG Adviser, and Research Development Office. Participants were reassured that their answers would remain confidential and used solely for academic purposes. No personal identifiers were collected, ensuring anonymity throughout the process. All participants were briefed on the purpose of the study, they could choose not to participate or withdraw at any point, without facing any consequences. All data collected were securely stored and accessible only to the researchers. All information was used strictly for research purposes and was never shared with unauthorized individuals.

III. RESULTS AND DISCUSSION

This section presents, analyzes, and interprets the findings of the study. It is divided into two parts: (1) survey results on the existing manual voting system and (2) evaluation of the developed Electronic Voting System. The results serve as a useful basis for comparing the system’s limitations and assessing the acceptability of the proposed solution. This comparison helps show how the suggested improvements can enhance overall performance and provide a better user experience.

A. Evaluation of the Manual Voting System

TABLE I
SURVEY RESULTS on the MANUAL VOTING SYSTEM

QUESTIONS	YES (%)	NO (%)
Are there more manpower needed during election period using the manual voting system?	89	11
Is there any incident of loss or miscounting of votes during election using the manual voting system?	88	12
Is the current manual voting system fast and accurate in calculating the numbers of casted votes?	44	56
Does the manual voting system require budget, and more time in printing of paper ballots?	77	23
Does the manual voting system require number of hours or more number of days to finish just by sorting out and counting of votes?	90	10
Do the students completely fill-up the paper ballot used in manual voting system?	33	67
Does the current manual voting system provide security for the ballots and for the votes as well?	35	65
Does the current manual voting system use tedious method in casting and counting of votes?	89	11
Does the current manual voting system give a time-consuming process in casting of votes during elections?	82	18
Does the current manual voting system bring up enhancement to the students’ awareness in terms of new technologies?	40	60

The survey result shows in Table 1, revealed several important observations about its efficiency, accuracy, and effects on student participation. Most respondents said that extra manpower is needed during elections

(89%), and that sorting and counting votes takes more time than expected (90%). Many also mentioned the extra cost of printing ballots (77%). Problems like lost or miscounted votes were common, reported by 88% of respondents, which raises concerns about reliability.

Vote counting was reported as slow and sometimes inaccurate (44%). Student participation also appears limited, as only 33% reported completing their ballots correctly, which could lead to incomplete vote counting. Most respondents felt that security measures were not enough (65%) and 89% said the process felt tedious. Casting votes was also seen as time-consuming (82%). On top of that, only 40% of students felt that the manual voting system improves their awareness of new technologies, suggesting it offers little exposure to modern digital methods.

Overall, these results show the weaknesses of the manual voting system, in terms of efficiency, accuracy, and security. They also highlight the need for improving the system, which could make the process faster, reduce errors, and help students become more familiar with technology. The results presented above serve as the basis for the researchers to develop an improved voting solution

B. Software Evaluation of the Electronic Voting System

To address the limitations identified in the existing system, the developed Electronic Voting System was evaluated using a standardized questionnaire guided by the ISO/IEC 25010 software quality model. The evaluation focused on key aspects such as functional suitability, usability, reliability, performance efficiency, and security. Respondents rated each aspect using a 5-point Likert scale, and the weighted mean was calculated to determine how acceptable the system is overall.

TABLE II
SOFTWARE EVALUATION RESULTS of the ELECTRONIC VOTING SYSTEM

Criteria	Mean	Interpretation
Functional Suitability	4.58	Excellent
Usability	4.58	Excellent
Reliability	4.56	Excellent
Performance Efficiency	4.63	Excellent
Security	4.63	Excellent
Overall Mean	4.60	Excellent

The results presented in Table 2 show that the developed Electronic Voting System achieved an overall mean score of 4.60, interpreted as “Excellent.” This suggests that respondents found the system highly acceptable.

In terms of functional suitability (4.58), the system clearly meets the essential requirements of an election platform. Respondents noted that it records votes accurately and generates reliable results, indicating that it performs its intended functions well. The system’s usability (4.58) was also rated excellent. Users found it is easy to navigate, with clear instructions and easy-to-use interface. Even those with limited technical experience were able to use the system without much difficulty, which speaks to its user-friendly design.

In terms of reliability (4.56), the system demonstrated stable and consistent performance, with only minimal errors or interruptions reported. This means it can be trusted to operate smoothly during actual election scenarios. Performance efficiency (4.63) received one of the highest scores. Respondents observed that the system processes votes quickly and efficiently, significantly reducing the time needed for both voting and vote counting. This directly addresses the delays commonly associated with manual voting. Lastly, the Security (4.63) was also rated high. The results indicate that the system effectively safeguards voter information while maintaining the confidentiality and integrity of each vote. This is a significant improvement over the manual system, where security measures were more limited.

Overall, the results show that the Electronic Voting System offers clear advantages over the traditional process. It streamlines operations, reduces the likelihood of human error, and provides stronger protection for sensitive election data. These findings are further supported by the system interfaces presented below.

C. System Interface Presentation

To further support the evaluation results, selected screenshots of the developed Electronic Voting System are presented below.

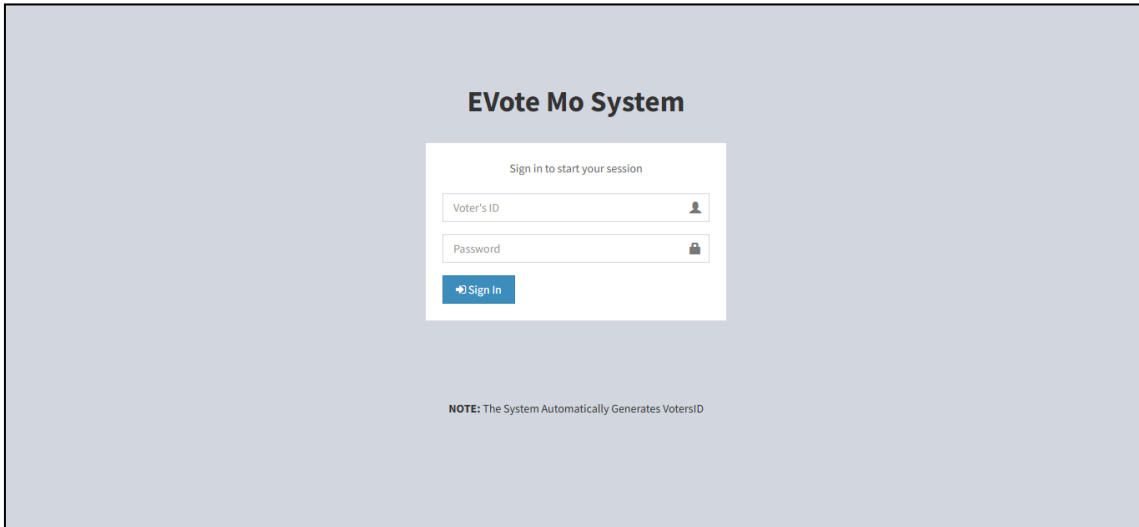


Fig. 2: Log-in Interface of the Electronic Voting System

The login interface ensures secure access by requiring authorized user credentials, supporting the system's security feature.

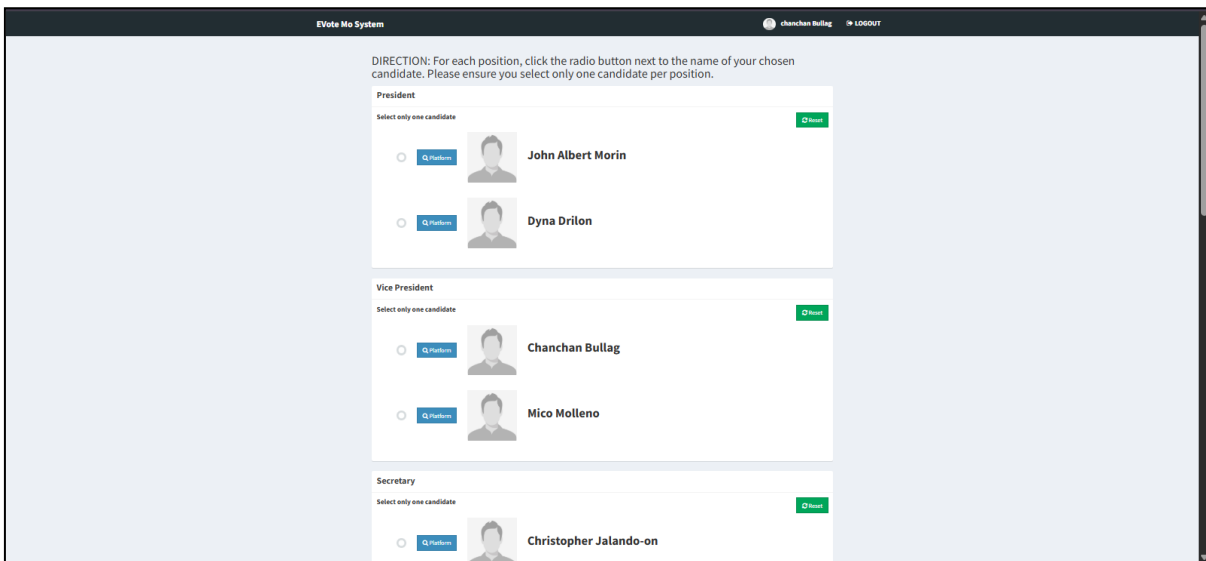


Fig. 3: Voting Interface Showing Candidate Selection

This interface allows users to easily select candidates, demonstrating the system's usability and functional suitability.

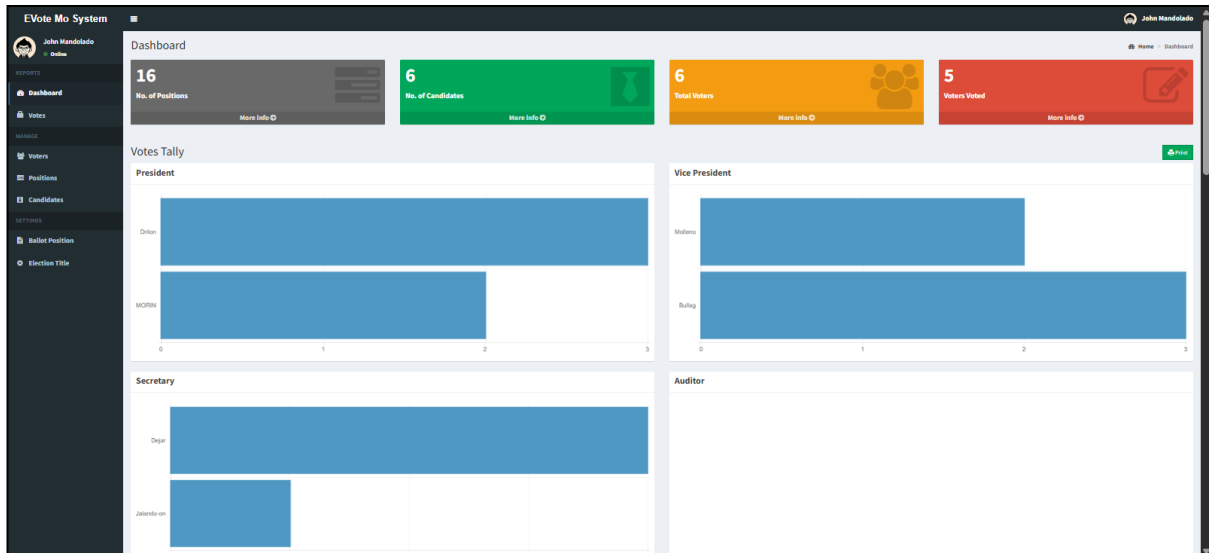


Fig. 4: Results Display Interface

The results page provides real-time vote counting, highlighting the system's performance efficiency and accuracy.

IV. CONCLUSION

Based on the findings of the study, the existing manual voting system was found to be inefficient, time-consuming, labor-intensive, and vulnerable to human errors and security risks. The respondents identified several issues associated with the manual election process, including delays in vote counting, additional manpower requirements, inaccuracies in vote tallying, and limited security measures. These limitations highlighted the need for a more reliable and efficient election system.

To address these concerns, the researchers developed an Electronic Voting System evaluated using the ISO/IEC 25010 software quality model in terms of functional suitability, usability, reliability, performance efficiency, and security. The results revealed that the system performed excellently across all evaluated criteria, indicating high acceptability among the respondents.

The developed Electronic Voting System significantly improved the election process by providing faster vote casting and automated vote tallying, reducing operational delays, minimizing errors, and strengthening election security. The system also contributed to a more organized, transparent, and dependable election process while reducing the workload of election personnel. Overall, the study concludes that the Electronic Voting System is a modern, reliable, accurate, and secure alternative to the traditional manual voting process for student government elections.

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Educational institutions are encouraged to adopt and implement the Electronic Voting System to improve the efficiency, accuracy, transparency, and security of student government elections.
2. Proper orientation and training programs should be conducted for election personnel, administrators, and students to ensure effective system utilization and smooth election implementation.
3. Continuous enhancement and maintenance of the system should be conducted to further improve functionality, usability, reliability, and security.
4. Future system upgrades may include additional features such as mobile accessibility, real-time result display, cloud-based backup systems, and advanced authentication mechanisms to improve accessibility and transparency.
5. Institutions implementing similar systems should establish a dedicated technical support team to address technical issues promptly and ensure system sustainability during election operations.
6. Future researchers are encouraged to conduct similar studies in other educational institutions and evaluate additional software quality characteristics and advanced security measures to further enhance electronic voting systems.

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