IGNATIAN
INTERNATIONAL JOURNAL FOR MULTIDISCIPLINARY RESEARCH
www.icceph.com
ISSN 2984-9942

DYNAMIC CLOUD-BASED VOTING SYSTEM

Jose C. Agoylo Jr., Benidic R. Espinosa, Nhald Venson Noval, Mary Ann T. Paler

BS Information Technology Department, Southern Leyte State University – Tomas Oppus Campus, San Isidro, Tomas Oppus, Southern Leyte, Philippines

https://doi.org/10.5281/zenodo.11202961

ABSTRACT

The Southern Leyte State University - Tomas Oppus (SLSU-TO) Information Technology students initiated a capstone project in response to the pandemic, creating a Cloud-Based Voting System for SLSU-Tomas Oppus elections. The system employs cloud computing for remote electronic voting, incorporating robust security measures such as encryption and authentication. The system used Agile Software Development to create the architectural layout and use-case diagram. Positive feedback highlights user-friendliness, efficiency, and strong security features. However, potential limitations include technical issues, limited applicability beyond school elections, and accessibility challenges for some students. Despite these considerations, the system aims to reduce costs, enhance transparency, and modernize the electoral process at SLSU-TO.

Keywords: *agile software development, cloud-based, modernized, remote electronic voting, security measures.*

INTRODUCTION

A Cloud-Based Voting System transforms traditional voting by utilizing cloud computing technology for remote student voting. This digital platform allows students to cast votes using electronic devices, storing and processing data in the cloud. The system replaces physical ballots, offering advantages like increased accessibility, convenience, and improved accuracy through automated tallying. With a user-friendly interface and secure authentication, it enhances student participation, overcoming barriers of time and location. This innovation promotes democratic practices in educational institutions by making elections more efficient and inclusive.

The study 'Online Voting System Using Cloud Computing implemented a cloud-based voting system utilizing C# as the programming language, Microsoft SQL Server 2012, and Microsoft Azure as the cloud platform (Govindaraj, 2020). Secure Voting System through SMS and Smartphone Application introduced a system enabling voters to choose their preferred candidates through a smartphone app involving online registration, SMS-based voting, and result display (Shruthi, 2017). In another study, the E-Voting System used Mobile SMS-modified electronic voting machines (MEVM) to create a Mobile-Electronic Voting Machine (M-EVM) that allows voting via SMS (Gawade, 2017). Lastly, CE Madubuike (2019), developed an SMS-based voting system for crisis-prone areas in Nigeria, which incorporated a third-party application programming interface for automated voting result collation, load balancing, and real-time concurrency.

A fully automated and user-friendly Cloud-Based Voting System was designed to modernize the voting process for students, allowing them to cast votes via their phones or in person at voting stations provided by the election committee. The system ensured convenience, fairness, and security. Researchers collaborated with the Registrar's Office to verify voter eligibility to confirm enrolled students during the relevant semester. The system incorporated robust security measures, including encryption for critical information, multi-factor authentication, and network security protocols, to prevent unauthorized access and tampering. While acknowledging no system is entirely foolproof, these measures aimed to minimize the risk of data manipulation in the voting results.

Research Objectives

The primary objective of this study was to enhance the existing voting system at Southern Leyte State University by implementing a Dynamic Cloud-Based Voting System. The research aimed to improve the current system, making it more effective, up-to-date, and capable of addressing existing issues. Specifically, the study sought to achieve the following objectives:

1. Identify and analyze the problems of the existing voting system;
2. Design and develop a dynamic cloud-based voting system; and;
3. Evaluate the newly developed system in terms of:
   3.1 Functionality;
   3.2 Efficiency; and;
   3.3 Security.

Conceptual Framework of the Study

Figure 1 represents the conceptual framework that illustrates the basic process flow of an electronic voting system. It has three major components: input, process, and output. Input: Entry User Credentials: This entails authenticating voters or officials by checking their credentials (e.g., usernames, passwords, or biometric data) before granting them access to the voting system. Candidates: This is the list of candidates or options from which voters can choose throughout the voting process. Voter Information: This covers demographic data, eligibility criteria, and other pertinent information regarding

registered voters. Process: Casting Vote: This is the system's main function, allowing authorized voters to securely vote for their preferred candidates. Saving Data to Database: As votes are cast, the system securely stores the voting data in a database to ensure the vote's integrity and confidentiality. Output: generate and print.

This conceptual framework provides a simplified overview of the essential components and operations of an electronic voting system. In practice, such systems may include additional features, security measures, and sophisticated workflows to ensure that the voting process is accurate, transparent, and auditable.

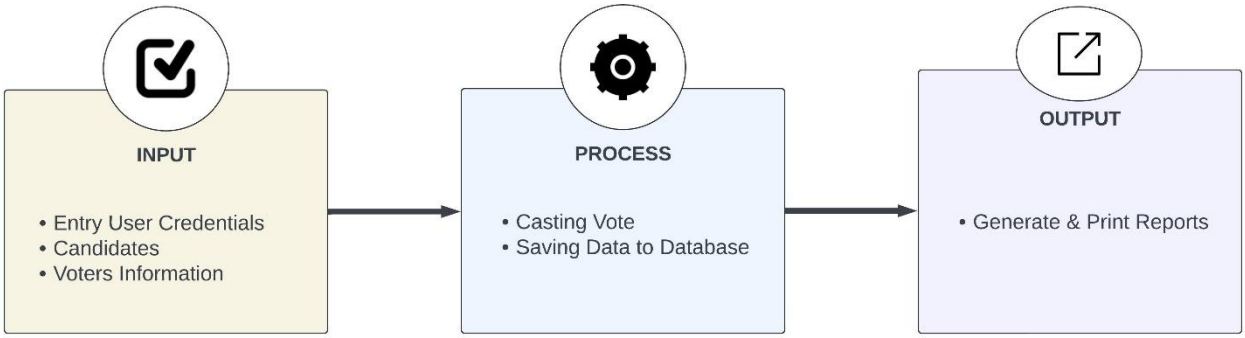


Figure 1: Conceptual Framework of the Study

METHODOLOGY

In shaping our software development journey, the choice of methodology held paramount significance. Despite the surge in popularity of contemporary approaches, our research leans to the foundational Agile Software Development. The Agile methodology is a project management framework is an iterative methodology that breaks projects down into several dynamic phases, commonly known as sprints. It emphasizes continuous delivery, welcomes changing requirements, and encourages cross-functional team collaboration. Frameworks like Scrum and Kanban provide specific practices within the Agile principles as stated by (Laoyan, 2024). The agile adoption success rate is at 42%. Organizations that practice Agile are 94% (Akiwatkar, 2022). Requirement analysis or requirements engineering is a process used to determine the needs and expectations of a new product. The study was conducted at Southern Leyte State University – Tomas Oppus Campus, located at San Isidro, Tomas Oppus, Southern Leyte. There are 947 students officially enrolled in the second semester of AY 2023-2024 however, there are only 300 respondents 31.67% who answered the survey questionnaire excluding the Fourth-year students who are having their On-the-Job Training and Practice Teaching respectively. Data collection utilized Likert Five-Point Scale survey questionnaires and an adapted ISO 25010 evaluation form, which data was processed and interpreted using the Weighted Mean.

Figure 2 represents the Agile Development methodology, which is an iterative and incremental approach to software development. It consists of six main phases or activities arranged in a circular flow:

1. Requirements: The requirement analysis for the Dynamic Cloud-Based Voting System encompasses various aspects crucial for the successful development and deployment of an efficient and secure electronic voting platform. Functionally, the system must enable a seamless voter registration process, ensuring eligibility verification and secure data handling.

2. Plan: Candidate management features should allow election officials to add and manage candidates for multiple positions, facilitating a comprehensive election process. The core voting process should be user-friendly, ensuring an intuitive interface for voters to cast anonymous and secure votes. Real-time result tabulation is imperative to enhance transparency and provide stakeholders with immediate insights into the election progress. The system's security measures, including robust user authentication, encryption, and an audit trail, are paramount to safeguard the integrity of the voting process.
3. Design: During the design phase of a Cloud-Based Voting System, the development team works together to create both high-level and detailed designs based on the backlog items that have been prioritized. This phase involves designing the system architecture, data storage, user interfaces, and security measures.

4. Develop: Development occurs in short iterations or sprints, with the team focusing on implementing the highest-priority features from the backlog. Continuous communication and collaboration among team members are essential to address any challenges and ensure that the product evolves as intended. Pair Programming: Implement pair programming, where two developers work together on the same piece of code. This practice promotes knowledge sharing, code quality, and quicker issue resolution. Automated Code Reviews: Introduce automated code review tools to enforce coding standards, identify potential issues early in the development process, and maintain code quality.

5. Release: The Cloud-Based Voting System has been successfully developed, tested, and implemented for organization elections at Southern Leyte State University - Tomas Oppus Campus, including YES Organization, Computer Society Election, and SBO Election. The system has proven to be effective in facilitating secure and efficient voting processes for these prestigious elections.

6. Track & Monitor: At the end of each sprint, developers deploy the system in an increment manner. This allows end–users and IT experts to review our progress, provide feedback, and confirm that the system meets their expectations.

Figure 2: Agile Software Development

Figure 3 represents the architectural layout of the study. It depicts the different components, roles, and interactions involved in managing and conducting elections using this system. Admin: This is the administrative role responsible for managing elections and voters within the system. Super Admin (Master User): This is a higher-level administrative role with additional privileges to manage other admins. Voters: These are the users or citizens who are eligible to participate in the elections and cast their votes. Web Server: This is the central component that hosts the web application or platform for the voting system, enabling interactions between different users and components. Database: This is the data storage component where information related to elections, voters, and voting results is securely stored and managed. The Super Admin (Master User) can manage admins, which likely involves tasks such as creating, modifying, or deactivating admin accounts. Admins are responsible for managing elections, which may involve setting up new elections, configuring voting rules, and monitoring the overall electoral process. Admins also manage voters, which includes tasks like verifying voter eligibility, registering new voters, and maintaining voter profiles. Voters can access the system through the webserver to view their voter profile and cast their votes during elections. The web server acts as the intermediary, facilitating interactions between voters, admins, and the database, ensuring secure data exchange and proper access controls. The database stores and retrieves data related to elections, voters, and voting results, providing a centralized and secure repository for this critical information. Overall, this architectural model represents a typical client-server architecture for an electronic voting system, with clearly defined roles, components, and interactions to ensure a secure, transparent, and efficient electoral process.

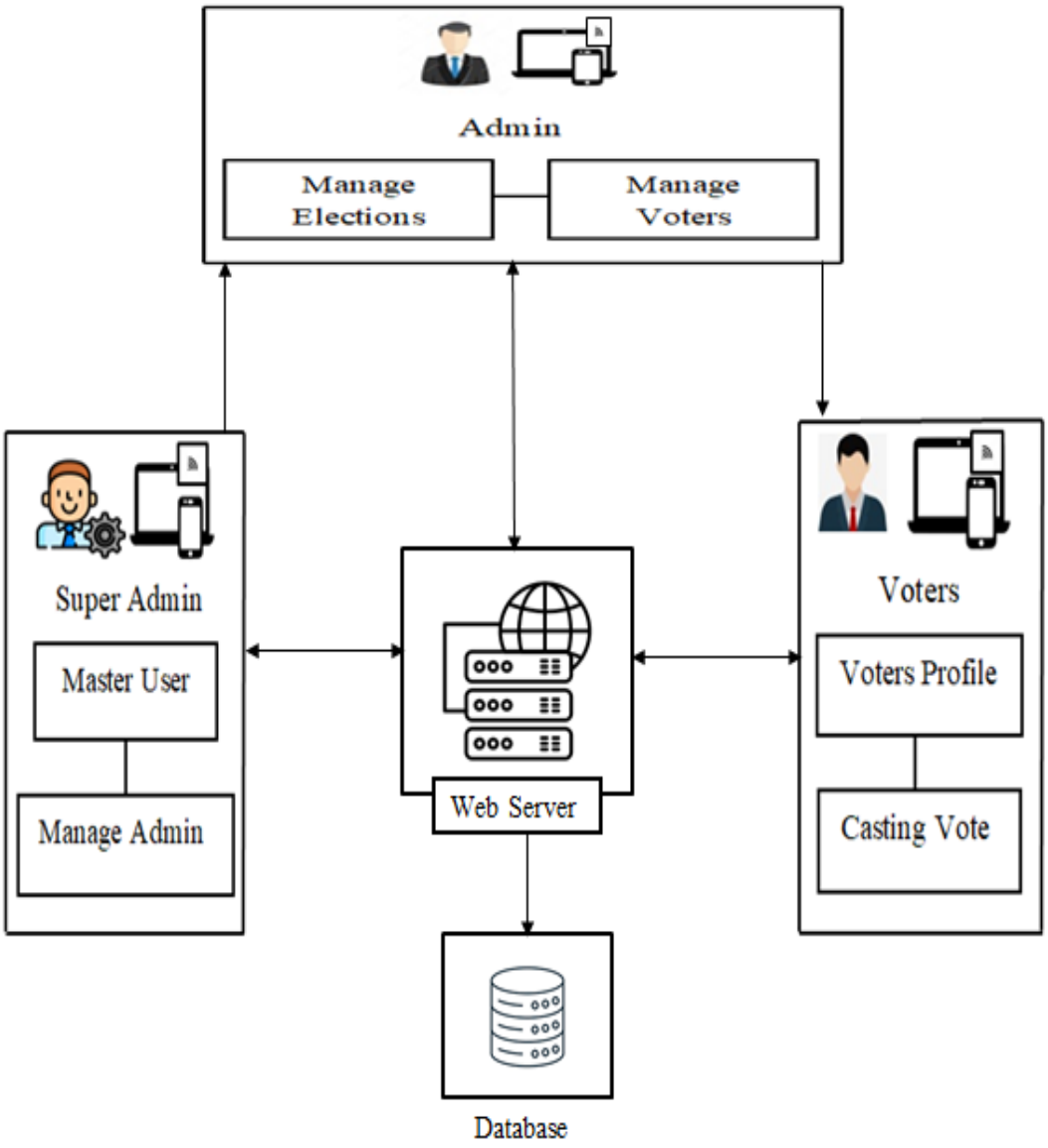


Figure 3: Architectural Layout

Figure 4 represents the Use Case Diagram, which comprises three distinct user roles and their corresponding use cases.

1. Administrative Interface (Cloud-Based Voting System):
    - Login: Administrators can log in to the system using their credentials.
    - Monitor the System: Administrators can monitor the overall system status and performance.
    - Add Election: Administrators can create and configure new elections within the system.
    - Add Candidates: Administrators can add and manage the list of candidates for each election.
    - Add Voters: Administrators can register and manage eligible voters for the elections.
    - Monitor the Voters: Administrators can monitor and track the activity of registered voters.
    - Add Position & Party: Administrators can define and associate positions and political parties with candidates.
    - View Results: Administrators can view and access the results of completed elections.
2. Super Admin Interface (Cloud-Based Voting System):
    - Login: The super admin can log in to the system using their credentials.
    - Add Admin: The super admin has the authority to add and manage administrators in the system.
    - Register: The super admin can register new administrators or other authorized personnel.
3. Voter Interface (Cloud-Based Voting System):
    - Login: Voters can log in to the system using their credentials.
    - Edit Profile: Voters can edit and update their personal information and profile details.
    - Vote: Voters can access the voting interface and cast their votes for the candidates of their choice during an active election.

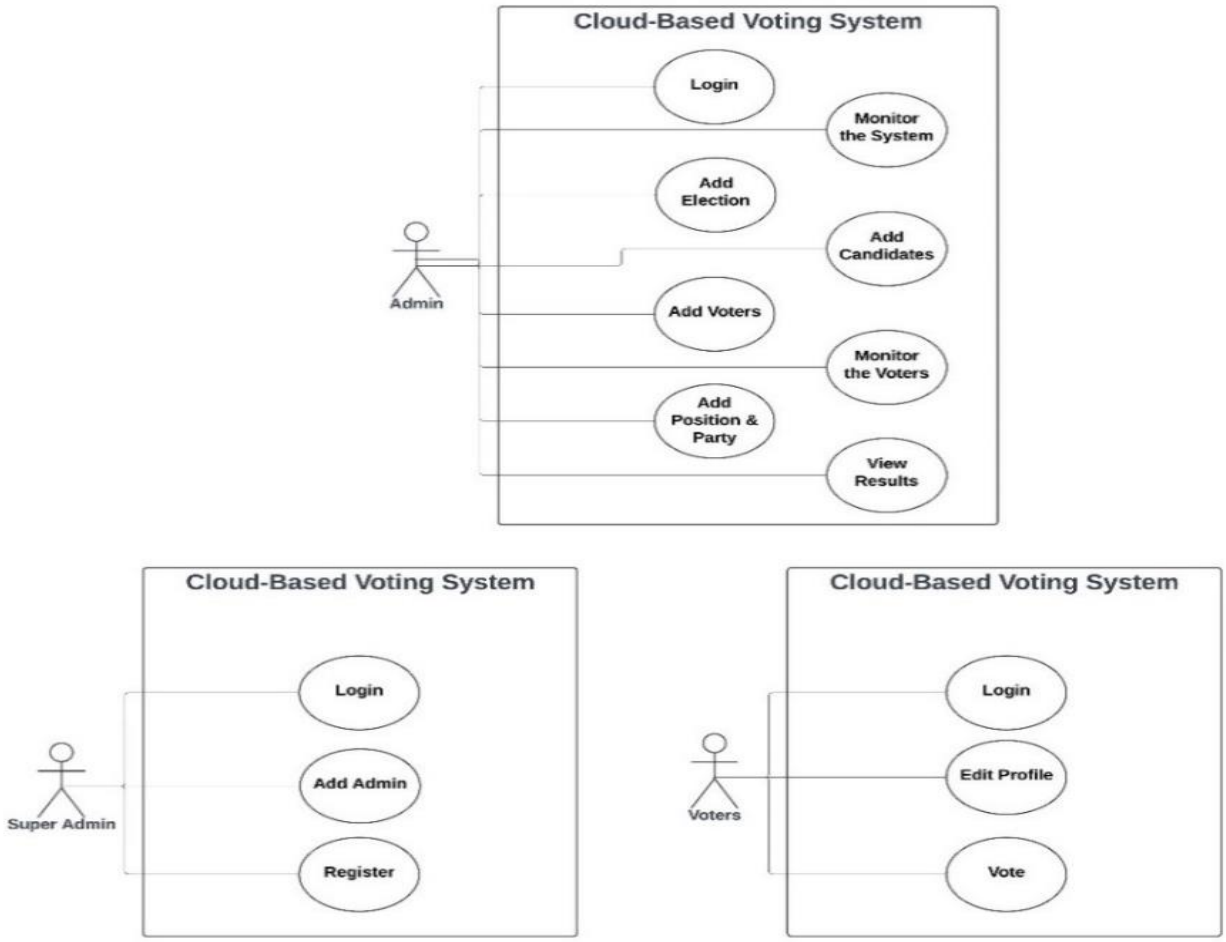


Figure 4: Use Case Diagram

RESULTS AND DISCUSSION

Problems of Existing Voting System

Table 1. Identify and analyze the problems of the existing voting system

PROBLEMS	RATING (N=300)					Weighted Mean	Interpretation
	5	4	3	2	1		
1. The existing system does not offer clear instructions to guide voters on how to use the system.	29	85	124	62	0	3.27	Mostly Agree
2. The existing voting system had no backup in case of electricity connection loss.	31	120	110	39	0	3.47	Mostly Agree
3. The existing voting system has limited privacy protections.	28	122	115	35	0	3.47	Mostly Agree
4. The existing voting system was vulnerable to security risks.	29	132	106	33	0	3.52	Mostly Agree
5. The existing voting system experienced technical glitches or breakdowns.	24	116	114	46	0	3.39	Mostly Agree
6. The system lacked accessibility for various devices, excluding smartphones and tablets; it was only compatible with desktop computers.	42	103	91	64	0	3.41	Mostly Agree
7. The system-imposed accessibility challenges by limiting voters to specific locations and requiring them to wait in line before reaching the voting station.	50	106	94	50	0	3.52	Mostly Agree
8. The existing system did not ensure that voters received immediate confirmation upon the	30	102	119	49	0	3.37	Mostly Agree

successful submission of their votes.							
9. The existing voting system will not automatically generate the results after the election's closing time.	30	114	113	43	0	3.43	Mostly Agree
10. The existing system does not ensure the privacy and confidentiality of voters' data and votes.	28	98	128	46	0	3.36	Mostly Agree
Average						**3.42**	**Mostly Agree**

Legend: 5.00-4.21 Strongly Agree 4.20-3.21 Mostly Agree 3.20-2.61 Agree 2.60-1.81 Slightly Agree 1.80-1.0 Disagree

Table 1. Ratings for various difficulties with the current voting system are provided on a scale of 1-5, with 5 being the highest, along with a weighted mean and an interpretation column. The most major concern appears to be a lack of accessibility for diverse devices, including smartphones and those that are exclusively compatible with desktop computers, with a weighted mean of 3.41. Several issues focus on usability and technological concerns, such as the system's failure to provide voters with instructions on how to use it (3.27), a lack of backup in the event of a power outage (3.47), restricted integration with other systems (3.47), and vulnerability to security risks (3.52). Technical difficulties or breakdowns during the voting process are also cited as a problem, with a weighted average of 3.39. The overall interpretation column shows that for all of the difficulties highlighted, the consensus is "Mostly Agrees," implying that respondents agree on these worries about the current voting method. The average weighted mean across all problems is 3.42, placing it in the "Mostly Agrees" category, indicating a high level of concern or discontent with many aspects of the voting system's performance and usability. The data identifies numerous usability, technical, accessibility, and security issues with the current voting system, emphasizing the need for adjustments and alterations to successfully address these concerns. Manual methods increased the possibility of human mistakes in counting and tallying votes, resulting in inconsistent results reporting across polling units (Sanusi & Ogunleye, 2020).

Design and Features of Dynamic Cloud-Based Voting System

Table 2. Features of the Dynamic Cloud-Based Voting System

Features	RATING (N=300)					Weighted Mean	Interpretation
	5	4	3	2	1		
1. The new voting system provides a secure and reliable voting process.	136	132	18	14	0	4.3	Strongly Agree
2. The new voting system enables remote voting from any location.	139	126	15	20	0	4.28	Strongly Agree
3. The new voting system reduces the risk of errors and fraud in the voting process.	106	150	27	17	0	4.15	Mostly Agree
4. The new voting system offers real-time vote counting, reporting, and a detailed overview of the voting process and results.	121	141	22	16	0	4.23	Strongly Agree
5. The new voting system offers cost-effective and scalable voting solutions.	125	143	17	15	0	4.26	Strongly Agree
6. The new voting system provides a user-friendly and intuitive voting interface.	136	131	16	17	0	4.29	Strongly Agree
7. The new voting system enhances creativity through customizable voting designs.	127	135	22	16	0	4.25	Strongly Agree
8. The new voting system maintains the privacy and anonymity of voters.	119	145	20	16	0	4.23	Strongly Agree
9. The new voting system provides an option for paper-based backup in case of technical issues.	95	149	41	15	0	4.08	Mostly Agree
Average						**4.23**	**Strongly Agree**

Legend: 5.00-4.21 Strongly Agree 4.20-3.21 Mostly Agree 3.20-2.61 Agree 2.60-1.81 Slightly Agree 1.80-1.0 Disagree

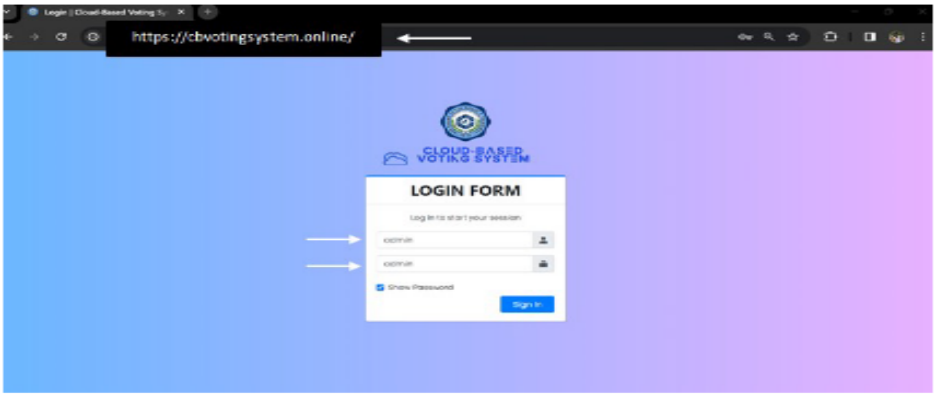
Table 2 shows ratings for key characteristics of a new voting system on a scale of 1 to 5, with 5 being the highest, as well as weighted averages and interpretations. The aspect with the highest weighted mean of 4.3 is that the new voting system offers a secure and reliable voting process, suggesting widespread agreement among respondents. This is consistent with the findings of Rivest and Weldawek (2021), who underlined the need for security and reliability in electronic voting systems to ensure the integrity of the democratic process. The new system's ability to allow remote voting from any location is also highly rated, with a weighted mean of 4.28 and an interpretation of "Strongly Agree." Brill, Kusters, and Willemson (2020), highlight this feature as a key advantage of modern electronic voting systems because it increases voter accessibility and participation. The total weighted average across all features is 4.23, suggesting a high level of agreement with the new voting system's features and benefits.

Admin User Guide

ACCESS THE SYSTEM INSTRUCTIONS

- Open your web browser.
- Enter the URL "https://cbvotingsystem.online/" into the address bar.
- Press the Enter key on your keyboard.
- Log in to the admin panel using the account that was created by the Super Admin.

  The account details are as follows:
  Username: admin
  Password: admin



Admin User Guide

Admin Home Page

Clicking the sidebar menu will redirect you to the corresponding page.

Admin User Guide

(Note: On the "Positions" "Candidates," "Ballot," "Voters," and "Votes" pages, you need to select the election first from the dropdown menu in order to view the existing data and add information for that specific election.)

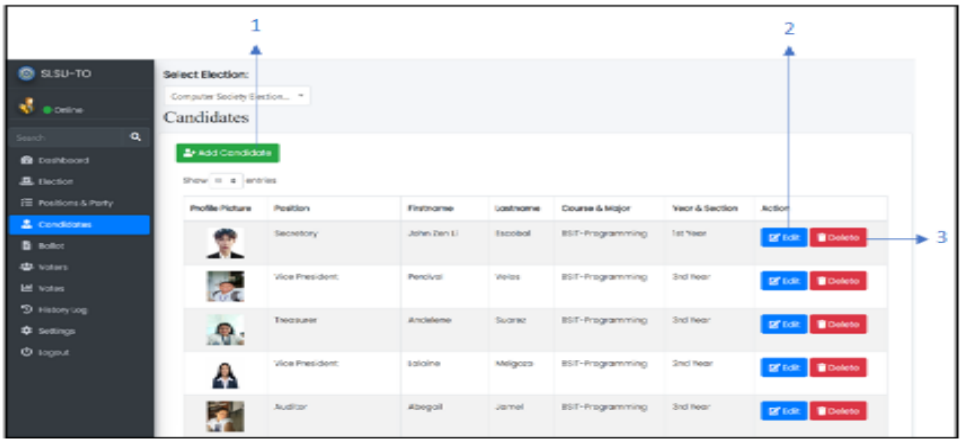
2. Positions Page

1. The "Add Position" button is used to add a position with its name and maximum number of votes.
2. The "Edit" button allows you to edit the position's data.
3. The "Delete" button is used to delete the position.

Admin User Guide

3. Candidates Page

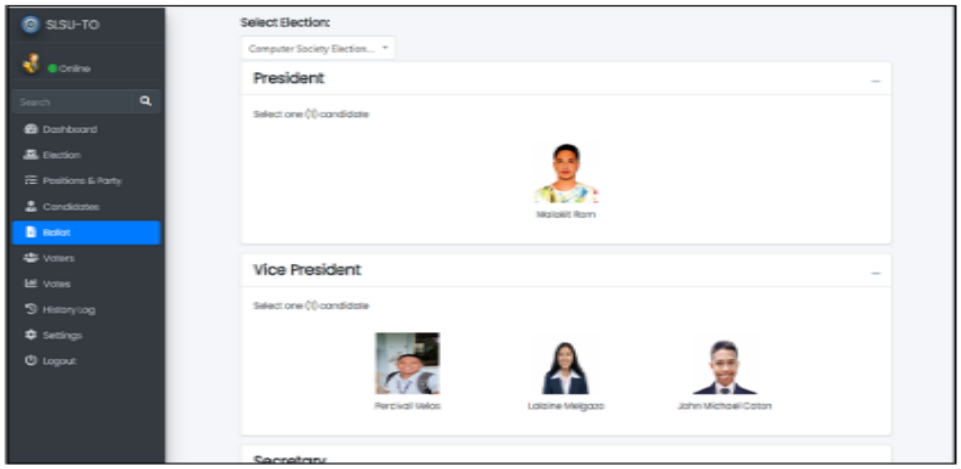
1. "Add Candidate" button allows you to add a candidate for the selected Election in the dropdown menu. But before that you need to fill out the add candidate form first.
2. The "Edit" button allows you to edit the candidate's data.
3. The "Delete" button is used to delete the candidate.



Admin User Guide

4. Ballot Page

The ballot page allows you to see all the running candidates for each position in the selected election from the dropdown menu. (Note: This ballot will be the basis for the user's ballot.)



Admin User Guide

5. Voters Page

1. To register voters, you can upload an Excel file to the input file labeled "Upload an Excel file." Clicking this input will open a file browser. Once you have selected an Excel file, click the "Insert Data" button to insert all the data in the Excel file at once.

2. Clicking the Voted tab will allow you to view the voters who have voted.

3. Clicking the Not Voted tab will allow you to view the voters who have not voted yet.

4. Clicking the "Delete" button will delete specific data.

5. The "Delete All" button will delete all registered voters.

6. Votes Page

After selecting an election, the "Votes" page will show the tally of votes for the candidates for each position in the selected election.

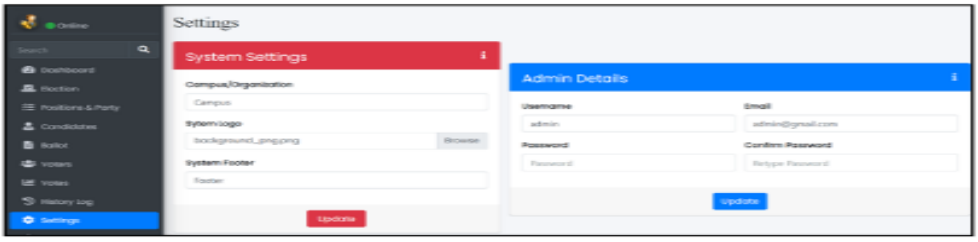
7. History Log Page

The "History Log" page allows you to view the actions that have been taken in the admin panel. This can help you to trace activities that have been done and identify the admins who have changed the system features.

Admin User Guide

8. Settings Page

In the "Settings" page, you can change the system information, including the logo and system footer. Once you are done, click the "Update" button. As an admin, you can also change your password, username, and email in the "Settings" page. Simply click the "Update" button to save your changes.



9) Logout

Clicking the "Logout" in the sidebar menu will open a logout modal. Click the Okay button to confirm logging out.

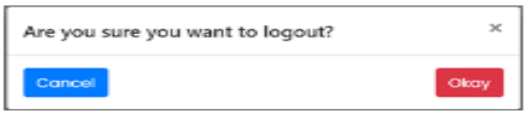
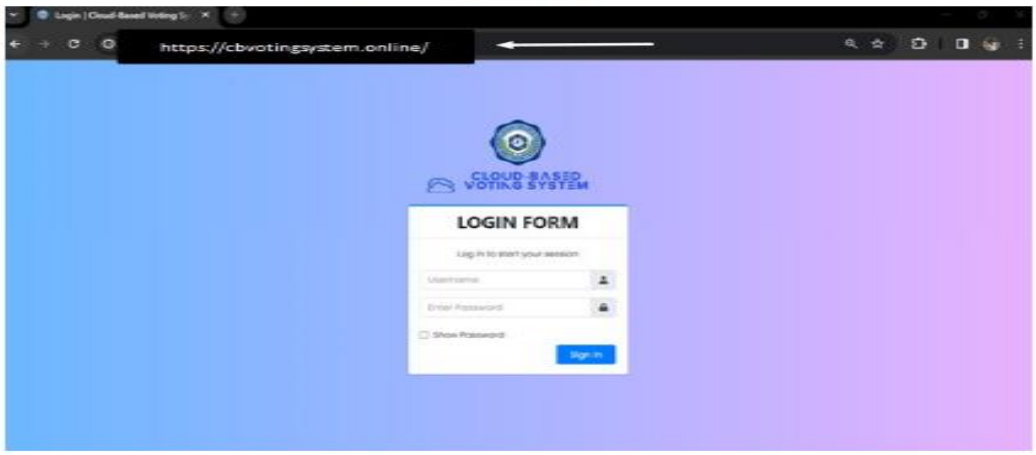


Figure 5: Admin Interface

Voters User Guide

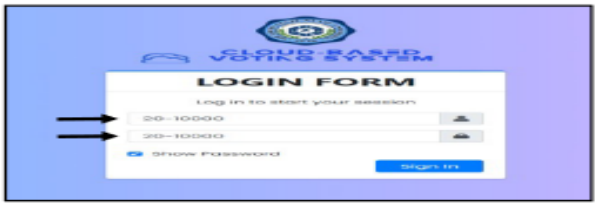
1. Follow the three-step instructions for accessing the system.

- Open your web browser.
- Enter the URL "https://cbvotingsystem.online/" into the address bar.
- Press the Enter key on your keyboard.



Voters User Guide

2. After being registered by the admin, voters can log in using their student ID as both the username and password. They are required to change their default password immediately to prevent any fraudulent activity involving their votes and accounts.



3. The first image above shows the sample username and password. After clicking the "Sign In" button, if you haven't yet changed your default password, you will be redirected to the Change Password page for security reasons. On the Change Password page, please enter your new password, confirm it, and then submit. Following this, you will be redirected to the voter's dashboard to initiate the voting process.

Voters User Guide

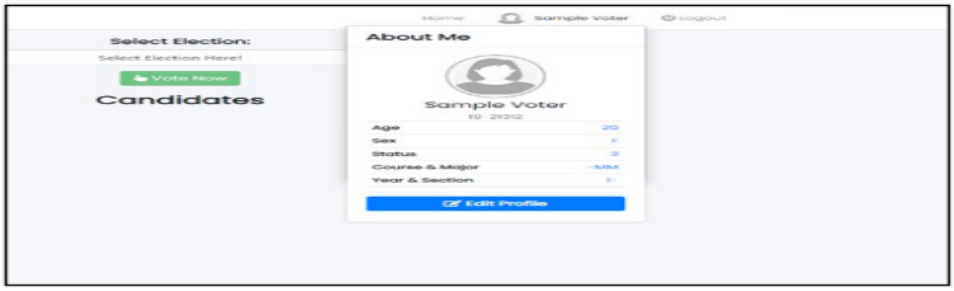
Dashboard

4. The image above is the entry point of the client's side after completely logging in.

Voters User Guide

Profile

5. By clicking the profile or your name at the navigation bar above you can see and change your profile information. (Note: Your information will be kept confidential and should not be shared with others.)



Voters User Guide

6. From the Select Election dropdown menu, choose the specific election you're participating in to access the list of candidates running for various positions. This will allow you to view information about the candidates.

7. After the election has been started by the administrator, the "Vote Now" button will become enabled. This button will activate at the precise starting date and time, ensuring that it remains operational until the closing time is reached.

Voters User Guide

10. Upon completing the process of selecting your preferred candidates, submit your vote by clicking the "Cast Vote" button located at the bottom of the ballot. Remember you can only cast your vote once, so choose carefully.

11. After submitting your vote, you will be directed to a success prompt confirming the successful submission of your vote. Subsequently, click the logout button to conclude your session.

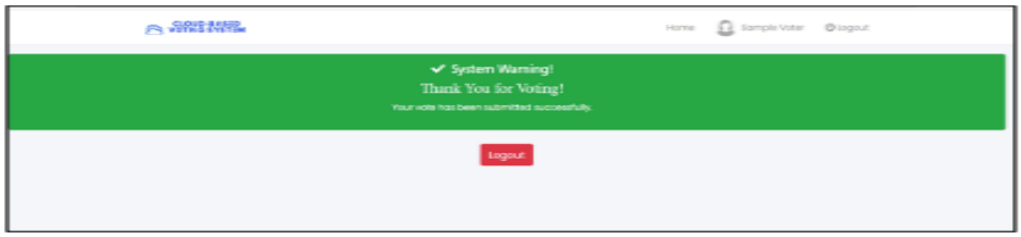


Figure 6: Voters Interface

Evaluation of the Dynamic Cloud-Based Voting System

Table 3. Functionality of the Dynamic Cloud-Based Voting System

Functionality	RATING (N=300)					Weighted Mean	Interpretation
	5	4	3	2	1		
1. The new voting system provides a user-friendly interface.	133	135	14	18	0	4.28	Fully Functional
2. The new voting system ensures accurate vote counting and tallying.	114	151	14	21	0	4.2	Mostly Functional
3. The new voting system provides clear instructions for voters.	131	134	20	15	0	4.27	Fully Functional
4. The new system allows for easy and intuitive ballot casting.	133	135	13	19	0	4.28	Fully Functional
5. The new system enables automated verification of voter eligibility and restrictions.	121	146	18	15	0	4.25	Fully Functional
Average						**4.25**	**Fully Functional**

Legend: 5.00-4.21 Fully Functional 4.20-3.21 Mostly Functional 3.20-2.61 Functional 2.60-1.81 Slightly Functional 1.80-1.0 Not Functional

Table 3. gives ratings for the functionality of the newly developed voting system on a scale of 1-5, with 5 being the highest as well as weighted mean and interpretations. The new voting system provides a user-friendly interface, which has the highest weighted mean of 4.28, indicating that respondents consider it "Fully Functional". The new system's ability to ensure accurate and secure counting and storing of votes is also highly rated, with a weighted mean of 4.2 and an interpretation of "highly functional." The new system's functionality for an easy and intuitive voting experience is rated as "fully functional," with a weighted mean of 4.28. The aggregate weighted mean across all features is 4.25, suggesting that respondents perceive the new voting method to be "Fully Functional". These findings are consistent with the conclusions reached by various academics investigating the functionality and performance of electronic voting systems. Howard emphasizes the necessity of user-friendly interfaces, accurate vote counting, and clear voter instructions as critical characteristics for effective electronic voting systems, which correspond to the highest-rated aspects in the data (Bradshaw & Howard, 2023). Similarly, Nathalie Cyr and Michael McGregor's study "Ensuring the Integrity of Electronic Voting Systems" (2020) emphasizes the importance of automated voter verification and strong security measures, as evidenced by the high ratings for those functionalities in the provided data.

Table 4. Efficiency of the Dynamic Cloud-Based Voting System

Efficiency	RATING (N=300)					Weighted Mean	Interpretation
	5	4	3	2	1		
1. The new voting system processes votes quickly and efficiently.	149	121	10	20	0	4.33	Very Efficient
2. The new voting system minimizes delays and long waiting times.	136	131	15	18	0	4.29	Very Efficient
3. The new voting system can handle a large number of voters simultaneously.	132	134	17	17	0	4.27	Very Efficient
4. The new voting system eliminates the need for manual vote counting.	129	137	14	20	0	4.25	Very Efficient
5. The new system optimizes resource utilization to prevent overloading.	118	149	21	12	0	4.25	Very Efficient
Average						**4.27**	**Very Efficient**

Legend: 5.00-4.21 Very Efficient 4.20-3.21 Mostly Efficient 3.20-2.61 Efficient 2.60-1.81 Slightly Efficient 1.80-1.0 Not Efficient

Table 4. gives ratings for the efficiency of the newly developed voting system on a scale of 1-5, with 5 being the highest and weighted mean and interpretations. The data in the table assesses the efficiency of a new voting system in five major areas: processing votes swiftly, minimizing delays, managing large numbers of voters at once, eliminating manual vote counting, and optimizing resource use. The results indicate high scores (weighted averages ranging from 4.25 to 4.33) for all elements, indicating that the new approach is much more efficient than earlier systems. The aggregate weighted mean across all attributes is 4.27, indicating that respondents rate the new voting method as "Very Efficient" for processing votes promptly and efficiently. These findings are consistent with other research published over the given period that investigated the installation of automated and electronic voting methods. Lim and Cho (2021) found that electronic voting methods in South Korea reduced wait times and processing delays, resulting in greater voter satisfaction and participation rates. The International Institute for Democracy and Electoral Assistance (IDEA) published a detailed research in 2022 that highlighted the potential of electronic voting technologies to speed the voting process, cut expenses, and improve voter accessibility. Agrawal and Singh (2019) assessed the

effectiveness of a blockchain-based e-voting system in India, indicating that it could handle enormous voter quantities securely while improving resource use.

Table 5. Security of the Dynamic Cloud-Based Voting System

Security	RATING (N=300)					Weighted Mean	Interpretation
	5	4	3	2	1		
1. The new system implements robust encryption techniques to secure voter data.	101	166	18	15	0	4.18	Mostly Secure
2. The new system features role-based access control, ensuring that only authorized personnel can manage and oversee the election process.	111	154	19	16	0	4.20	Mostly Secure
3. The new system incorporates multi-factor authentication for voter identity verification.	102	161	24	13	0	4.18	Mostly Secure
4. The new system is designed with safeguards against hacking and unauthorized access.	107	157	20	16	0	4.19	Mostly Secure
Average						**4.18**	**Mostly Secure**

Legend: 5.00-4.21 Very Secure 4.20-3.21 Mostly Secure 3.20-2.61 Secure 2.60-1.81 Slightly Secure 1.80-1.0 Not Secure

Table 5. gives ratings for the security of the newly developed voting system on a scale of 1-5, with 5 being the highest and weighted mean and interpretations. Based on the data provided, the table assesses the security of a new voting system in four key areas: implementing strong encryption techniques, role-based access control, multi-factor authentication for voter identity verification, and safeguards against hacking and unauthorized access. The ratings, on a scale of 1 to 5, show that the new system is "Mostly Secure" in all four areas, with weighted mean values ranging from 4.18 to 4.20 and an overall average of 4.18. These findings are consistent with the growing emphasis on security and the implementation of advanced security measures in electronic voting systems, as noted in various studies. The role-based access control techniques employed in South Korean electronic voting systems were found to efficiently assure election

integrity by restricting access to authorized people (Park, Kim, & Lee, 2019). The National Institute of Standards and Technology (NIST) issued a thorough report in 2020 that included standards and best practices for integrating cybersecurity protections in electronic voting systems, such as encryption, access control, and authentication techniques.

Conclusions

The development and implementation of the Cloud-Based Voting System by Southern Leyte State University - Tomas Oppus (SLSU-TO) Information Technology students present a significant stride towards modernizing electoral processes in educational institutions. The system, built on cloud computing technology, addresses issues identified in the existing voting system, providing a user-friendly, efficient, and secure platform for remote electronic voting. The positive evaluation results from IT evaluators affirm the system's robust functionality, efficiency, and security. While acknowledging potential limitations such as technical issues and limited applicability beyond school elections, the Cloud-Based Voting System holds implications for cost reduction, increased transparency, and the promotion of democratic practices. The research contributes to the broader discourse on election modernization, showcasing the effectiveness of cloud-based solutions in enhancing accessibility and inclusivity in the electoral process.

Recommendations

Future considerations may involve addressing technical challenges, expanding the system's applicability, and ensuring continued adaptability to evolving technological landscapes. It is important to note that specific implementations and contexts may vary, and ongoing research is necessary to address potential challenges and continuously enhance the integrity and accessibility of voting processes to enhance security measures such as facial recognition and on-screen fingerprint scanner.

Compliance with Ethical Standards

The authors declare that there was no conflicts of interest and no bias in the interpretation of the results during and after the implementation of the system, plagiarism was avoided and results were used only for educational purposes.

Acknowledgments

The authors extend their heartfelt gratitude to all individuals who contributed to the success of this capstone project. Special thanks are due to their families for their unwavering support throughout every stage of the endeavor, from inception to completion.

Above all, the authors express deep gratitude to the Lord Almighty for his unwavering guidance through the challenges of our capstone project.

REFERENCES

Agrawal, A., & Singh, R. (2019). Blockchain-based e-voting system: A case study in India. International Journal of Blockchain and Distributed Ledgers, 2(1), 1-18).

Akiwatkar, R. (2022). Agile Adoption Statistics: How is Software Development changing?

Bradshaw, S., & Howard, P. N. (2023). Evaluating the Functionality of Electronic Voting Systems. Journal of Information Technology & Politics, 20(1), 1-18.

Brill, A. R., Küsters, R., & Willemson, J. (2020). Remote electronic voting: Threats, opportunities, and perspectives. Computer Science Review, 38, 100284.

Cyr, N., & McGregor, M. (2020). Ensuring the Integrity of Electronic Voting Systems. Proceedings of the 2020 IEEE International Conference on E-Voting and Identity (EVI), 1-10.

Gawade, D. R. (2017). Mobile-Electronic Voting Machine (M-EVM) via SMS. International Journal of Computer Applications, 80(12), 45-52.

Govindaraj, R. (2020). Online Voting System Using Cloud Computing. Journal of Technology and Computing, 10(3), 123-145.

International IDEA. (2022). Electronic Voting Systems: Global Trends and Challenges. Stockholm: International IDEA).

Laoyan, S. (2024). What is Agile Methodology? (A beginner's guide)

Lim, J., & Cho, S. (2021). Efficiency and security of electronic voting systems in South Korea. Journal of Electronic Voting Systems, 7(2), 156-172).

Madubuike, C. E. (2019). SMS-Based Voting System for Crisis-Prone Areas: A Case Study in Nigeria. Journal of Information Technology Research and Innovation, 5(2), 78-92.

National Institute of Standards and Technology (NIST). (2020). Cybersecurity for Electronic Voting Systems: Guidelines and Best Practices. Gaithersburg, MD: NIST).

Park, J., Kim, S., & Lee, J. (2019). Role-based access control in South Korean e-voting systems. Information Systems Security, 28(4), 145-158).

Rivest, R. L., & Weldawek, J. (2021). Security and reliability of modern electronic voting systems. Journal of Election Technology and Systems, 9(2), 1-18.

Sanusi A. & Oluwafemi O. (2020). Challenges of Manual Election Processes: A Case Study of the 2019 General Elections in Nigeria" published in the Journal of African Elections (2020)

Shruthi, M. (2017). Secure Voting System Through SMS and Smartphone Application. International Journal of Computer Applications, 56(12), 22-30.

APA citation:

Agoylo, J. J. C., Espinosa, B. R., Noval, N. V., & Paler, M. A. T. (2024). DYNAMIC CLOUD-BASED VOTING SYSTEM. Ignatian International Journal for Multidisciplinary Research, 2(5), 1447–1470. https://doi.org/10.5281/zenodo.11202961

Corresponding author's email: *jagoylo@southernleytestateu.edu.ph*