

JNEC Online Voting System

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Abstract-----In the digital era, modernizing voting systems is crucial to enhance efficiency, security, and accessibility. The JNEC Online Voting System is designed to address the limitations of traditional desktop-based voting applications, such as the decentralized databases that require manual result calculations from each polling station. This proposed system introduces a centralized database that automates vote counting and result declaration, thus eliminating inaccuracies and administrative inefficiencies. The proposed system was developed using the Laravel framework, a robust PHP framework, along with MariaDB for secure and centralized data management, the JNEC Online Voting System streamlines the entire voting process. Voters can cast their votes by scanning barcodes on employee IDs and student cards, while administrators can create election events and manage candidates and voters efficiently. The main reason JNEC Online Voting System is to exhibit a Voting system to be connected to organizations and to replace the existing paper voting system as it consumes time to vote, vote count, and result declaration and to replace the decentralized desktop-based voting

I. INTRODUCTION

The JNEC Online Voting System transformed the electoral process by transitioning from traditional standalone desktop applications to a centralized web-based platform, offering a secure and efficient voting method. Traditional desktop voting systems, while secure, present significant administrative challenges due to the need for separate database setups for multiple voting stations, leading to complexity and inefficiencies. The fragmented nature of these systems can cause delays in vote counting and result declaration, highlighting the need for a more integrated solution.

The new system addresses these issues by centralizing vote management into a single, secure web-based platform, simplifying the process and reducing administrative burdens. Utilizing the Laravel framework and PHP, the system ensures robust and secure application development, while a MariaDB database manages data efficiently. This centralization enhances transparency and

streamlines vote counting and result declaration processes, making the electoral process more user-friendly and secure.

This advancement in electoral technology is crucial for the JNEC community, reducing administrative overhead and enhancing voting efficiency. Voters can cast votes securely by scanning identification cards, and administrators can manage events and oversee voter registration. The system's flexibility and robust security measures improve accuracy and reliability, fostering greater voter confidence, participation, and transparency.

II. LITERATURE REVIEW

Voting is a cornerstone of democracy, rooted in ancient Greece where citizen participation was mandatory [1]. However, historical democratic systems excluded certain groups from voting rights. The evolution of voting methods aims to enhance accessibility, accuracy, and security [1]. Modern challenges include human errors in hand-counting and logistical risks in traditional paper voting and decentralized databases in desktop applications.

Estonia pioneered the EU's first country-wide internet voting (i-voting) system in 2005, demonstrating progress in electoral processes [4]. The JNEC Online Voting System integrates essential elements for a secure and user-friendly experience, inspired by Estonia's robust e-government foundation supported by the eID (Electronic ID Card) [4]. Estonia's emphasis on secure encryption techniques and a user-friendly voting app aligns with the goals of the JNEC system.

The development of the JNEC Online Voting System is a significant improvement, utilizing Laravel frameworks and PHP to enhance data management, and user experience, and provide secure online voting [2], [3]. A centralized database overseen by an administrator ensures secure vote storage and management, distinguishing it from traditional methods [2], [3].

The proposed Barcode system in the JNEC Online Voting System aims to modernize the electoral process by enhancing data management efficiency and security. While inspired by Estonia's success in e-voting, which utilizes digital ID cards and strong encryption, the Barcode system introduces a different technological approach to secure storage and validation of electoral data [10]. This advancement aims to improve overall system integrity by providing unique identifiers for votes, complementing Estonia's emphasis on digital security in online voting [4].

Laravel's robust technical architecture facilitates reliable application development, enhancing scalability and efficiency [2], [3]. It is favored for its interactive and intuitive nature, making it suitable for diverse web development projects [3]. PHP, chosen as the backend language, offers compatibility with various databases and extensive community support, further bolstering the Online Voting System's development.

In conclusion, the literature review underscores the potential benefits of the JNEC Online Voting System, emphasizing enhanced data centralization and secure online voting practices. The adoption of Laravel and PHP aligns with industry standards, ensuring scalability and user-friendly interfaces. Attention to data security and privacy throughout development remains crucial, supported by insights from existing studies for successful system implementation.

III. METHODOLOGY

The development of the JNEC online voting system incorporated a methodology known as reverse engineering. We opted for reverse engineering methodology due to the existing system being developed using a desktop application with decentralized data management. The reverse engineering process involved a meticulous analysis of the current system to comprehend its design, functionality, and implementation details, aiming to identify both strengths and weaknesses to inform the development of a more secure and data-centralized online voting system.

Figure I: Shows each phase involved during the development of the system:

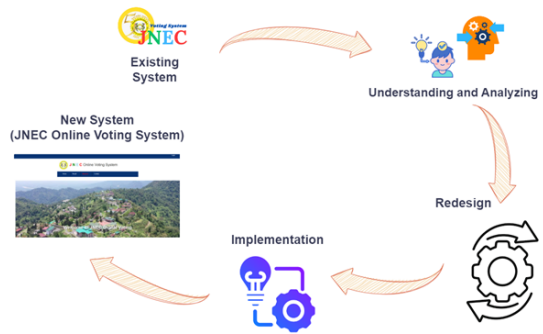


Figure I: Methodology Process Model

Phase 1: Existing System - JNEC Voting System

We identified significant issues with the current desktop application-based JNEC Voting System, including decentralized and redundant data structures leading to data inconsistencies and integrity challenges. The system's standalone nature lacks modern web technology integration, limiting accessibility, security, and real-time data management. Transitioning to a centralized, web-based JNEC Online Voting System will unify data storage, ensuring consistency and reliability while improving accessibility, providing real-time updates, and streamlining the voting process. This transformation promises a more efficient, secure, and user-friendly experience for JNEC's staff and students.

Phase 2: Understanding and Analysing

During the Understanding and Analysis Phase, our team defined clear aims, objectives, and problem statements to improve the security, user experience, and efficiency of the JNEC Online Voting System. We conducted thorough discussions, brainstorming sessions, and extensive research on best practices in online voting systems, studying existing methodologies and technologies.

Phase 3: Redesign of Existing System

During the design phase of our project, aligned with the SDLC, we embarked on a detailed process of redesigning the JNEC Online Voting System. This phase laid out the architecture and functionality, setting the stage for the subsequent implementation phase and ensuring a systematic and structured approach to achieving our project goals. For the JNEC Online Voting development, we used Draw.io (diagrams.net), a free, open-source, and versatile diagramming application, to create the use case diagram and describe the functional requirements of the system.

Phase 4: Implementation phase of our new system

During the implementation phase of our project, aligned with the SDLC, we transformed the detailed design specifications into a fully functional online voting system. Using the Laravel framework and PHP for the backend, we translated the architectural blueprints and user interface designs into code.

This involved setting up databases, developing backend functionalities for voter registration, candidate management, and secure voting processes, and integrating front-end components for a seamless user experience. Rigorous testing ensures each module's functionality and compatibility across devices and browsers.

Phase 5: Development of new system

The final phase of our project culminated in the successful development of the JNEC Online Voting System. Leveraging insights from reverse engineering and a structured approach across the analysis, design, and implementation phases, we significantly improved the voting experience at Jigme Namgyel Engineering College. Developed using the Laravel framework and PHP for the backend, the system features robust security measures and a streamlined user interface.

IV. USE CASE DIAGRAM

The use-case diagram visualizes a use-case: the JNEC Online Voting system interaction with the users. The use case in this proposed Online voting system mainly consists of casting a vote and viewing the results. The Figure below shows the use case diagram for the actions that the actors (Admin, voters) can perform in our JNEC Online Voting System.

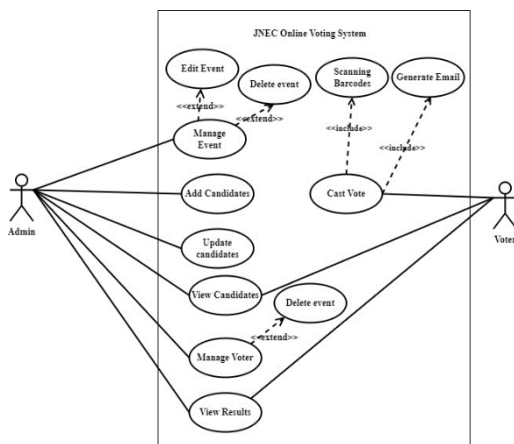


Figure II: Use case Diagram

V. ENTITY-RELATIONSHIP DIAGRAM

An Entity-Relationship Diagram (ERD) is a visual representation of entities, their attributes, and the relationships between them. In the JNEC online Voting system, there are four entities consisting of the admin entity, event entity, voter's entity, and candidate's entity. The figure below shows the relationships among the entities in this system.

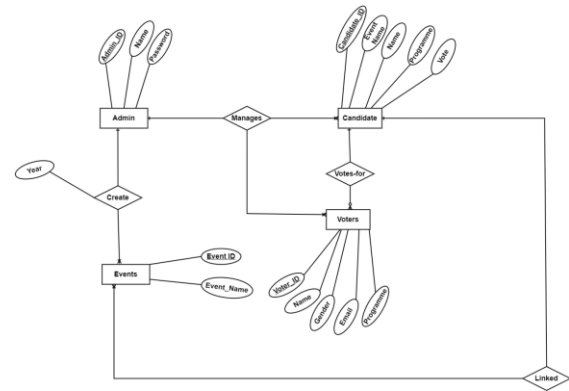


Figure III: Entity-Relationship Diagram

VI. SYSTEM FUNCTIONALITY

The JNEC online voting system is designed for simplicity, security, and reliability. Voters start by selecting an election event from the system's homepage. At the polling station, they present their voter card with a unique barcode for verification. If a card is unavailable, the admin manually verifies the voter's ID against the database. Once verified, the admin sends a secure, one-time voting link to the voter's registered email.

Upon receiving the email, the voter clicks the unique link to access the secure voting section. There, they select their preferred candidates and securely submit their vote. The system employs measures like unique voting links, encrypted emails, and a tamper-proof database to ensure integrity and confidentiality. Real-time updates allow admins to track voter turnout, and automated tallying produces accurate election results at the end of voting.

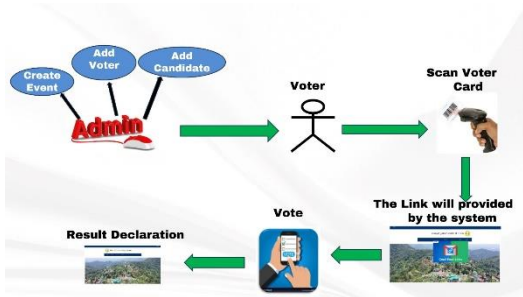


Figure IV: Working Model

VII. RESULT

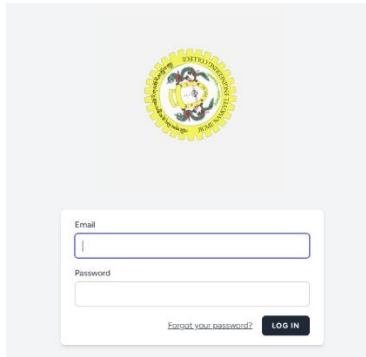


Figure 5: Admin Login page

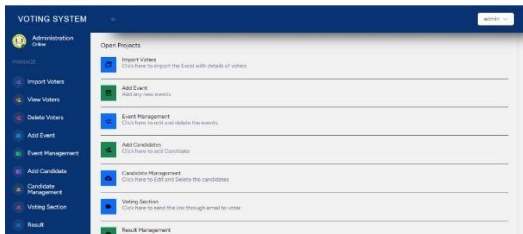


Figure 6: Admin home page

Add Voters

Choose File No file chosen Import

VoterID:

Name:

Gender:

Programme:

Email ID:

Add

Figure 7: Import/Add New Voters

Add Event

Event:

Year:

Submit

Figure10: Create Events

Event Details

Sl No	Event	Year	Actions
1	Girls Councilor	2023	Edit Delete
2	Chief Councilor	2025	Edit Delete
3	Club Secretary	2025	Edit Delete

Figure 11: Manage Events

Search Candidate

Enter Voter ID:

Search

VoterID: 05220172

Name: Nidup Zangmo

Gender: Female

Programme: Diploma in Computer System And Network

Email: 05220172.jnec@rub.edu.bt

Girls Councilor

Choose File Candidate.jpeg

Add to Candidates

Figure 12: Add Candidates

Candidates List

Select Event:

View Candidates

Event Name	Candidate Name	Programme	Image	Action
Girls Councilor	Nidup Zangmo	Diploma in Computer System And Network		Edit Delete
Girls Councilor	Samben Lhamo	Diploma in Computer System And Network		Edit Delete

Figure 13: Manage Candidates

Figure 14: Voter verification to vote



Figure 15: Voting Link

Candidate Name	Department	Image	Vote
Nidup Zangmo	Diploma in Computer System And Network		<input type="button" value="Vote"/>
Samten Lhamo	Diploma in Computer System And Network		<input type="button" value="Vote"/>

Figure 16: Voting page

Name	Image	Vote Count
Nidup Zangmo		0
Samten Lhamo		2

Figure 17: Result Declaration Page

Name	Image	Vote Count
Nidup Zangmo		0
Samten Lhamo		2

Figure 18: Result Declaration Page for all voters

CONCLUSION

The development of the JNEC Online Voting System addresses the critical need for a centralized database to securely collect and organize votes at Jigme Namgyal Engineering College. This project provides an efficient platform for elections, ensuring voting process integrity and security while enhancing user experience for students and staff.

Features such as a secure centralized database, user authentication, real-time voting updates, and automated result generation have made the JNEC Online Voting System user-friendly and reliable. It enables confident participation in elections, reduces administrative complexity, and ensures secure and efficient voting processes.

Using Laravel framework and PHP for backend development, alongside reverse engineering, facilitated a systematic and efficient development process. These technologies contributed to creating a robust, scalable voting system capable of handling increased user numbers while safeguarding voting data integrity.

The completion of the JNEC Online Voting System represents a significant milestone in modernizing voting processes at Jigme Namgyal Engineering College. It underscores the importance of embracing technology to enhance democratic engagement, fostering greater participation within the college community. This platform will ensure secure, efficient, and transparent elections, enhancing overall voting experiences and maintaining electoral process integrity at JNEC.

ACKNOWLEDGMENT

We sincerely thank Mr. Younten Tshering (HOD), Ms. Tashi Yangchen (Assistant Lecturer), and Mr. Sancha Bir Subba (Associate Lecture) for their invaluable guidance, support, and expertise throughout the development of the JNEC Online

Voting System. Their advice, assistance, and expertise have played a crucial role in the development and execution of our project and have been instrumental in shaping our project and ensuring its excellence.

We would like to express our deepest gratitude to all those who have contributed to the successful completion of our project. The accomplishment we have achieved is not solely attributed to the efforts of a single individual or their independent work, it is the result of a collective force and invaluable guidance that has paved the way for our success. Your support and guidance have made a significant impact, and we are truly fortunate to have you by our side. Thank you for being part of our journey and for helping us make our project a success.

REFERENCE

- [1] National Geographic Society. (n.d.). Democracy (Ancient Greece). National Geographic Society. Available: <https://education.nationalgeographic.org/resource/democracy-ancient-greece/>
- [2] Laravel. (n.d.). The PHP framework for web artisans. [Online]. Available: <https://laravel.com/docs/10.x>
- [3] Amini, M., Rahmani, A., Abedi, M., & Hosseini, M. (2021). Case study for adoption of Laravel framework as the best programming tool for PHP-based web development for small and medium enterprises. *Journal of Innovation & Knowledge, Special Issue*, 100-110. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3857736
- [4] Microsoft Corporate Blogs. (2019, May 10). Electronic voting: What Europe can learn from Estonia. Microsoft. Available: <https://blogs.microsoft.com/eupolicy/2019/05/10/electronic-voting-estonia/>
- [5] Shiva. (2024, April 24). Advantages of PHP over other programming languages. *Code360*. Available: <https://www.naukri.com/code360/library/advantages-of-php-over-other-programming-languages>
- [6] Tshering, Y., Wangchuk, T., Yangchen, T., Wangchuk, K. J., Dorji, & Pelzang, S. (2024). Innovative solutions for democratic processes: A case study on secure JNEC voting system. *International Journal for Research in Applied Science and Engineering Technology*, 4(1).
- [7] Hanif, F. (2023, June 26). Understanding the MVC architecture in Laravel: A comprehensive guide. Medium. Available: <https://fkrihnif.medium.com/understanding-the-mvc-architecture-in-laravel-a-comprehensive-guide-8f620cc139b6>
- [8] Web Tech Knowledge. (n.d.). Laravel hospital management project. Available: https://www.youtube.com/results?search_query=web+tech+knowledge+hospital+management+system
- [9] Stack Overflow. (n.d.). Laravel Jetstream multiple-user source with multiple routes. Available: <https://stackoverflow.com/search?q=laravel+jetstream>
- [10] Wikipedia contributors. (n.d.). Electronic voting in Estonia. In *Wikipedia, The Free Encyclopedia*. Available: https://en.wikipedia.org/wiki/Electronic_voting_in_Estonia
- [11] Tshering, Y. (2021). Electoral process using biometric fingerprint scanner that suits the Bhutanese election. *International Journal for Research in Applied Science and Engineering Technology*, 9(7), 168–180. Available: <https://doi.org/10.22214/ijraset.2021.3628>