

Design and Implementation of a Secured, Real-Time Internet-based Voting System

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Abstract: The Internet of Voting system presented in this paper represents a modern solution to the challenges faced by the traditional electoral processes. In an era characterized by technological advancements, this system harnesses digital innovation to enhance the efficiency, security, and accessibility of elections. Evolving from a rich history of voting systems, this digital platform integrates several influential works and leverages cutting-edge technology to create a user-friendly interface with robust security measures. The system addresses critical issues that have plagued traditional paper and electronic ballots, such as voter confusion and fraud, by implementing stringent encryption techniques, password renewal mechanisms, and real-time prevention of duplicated votes. It enables the elimination of multiple registrations, streamlining the voter registration process. Online voting systems have gained prominence as a means of conducting elections efficiently, reducing logistical challenges, and increasing voter accessibility. The system offers three distinct categories for voting: Regional Elections, Local Elections, and Presidential Elections, each with its own set of independent candidates.

Keywords: Secured, Real-Time, Online, Encryption, Hosting.

I. INTRODUCTION

The relevance of a secured, online, real-time voting system in the contemporary democratic landscape cannot be overstated. Traditional voting methods, including manual paper ballots and electronic voting machines, are beset with significant limitations that impede the efficiency, accessibility, and security of the electoral process. As technology continues to advance and the internet becomes an integral part of our lives, there exists a compelling opportunity to enhance and revolutionize the way we conduct elections. In this context, one of the most pressing problems faced by traditional voting systems is the lack of accessibility and convenience for voters. Physical polling stations necessitate the allocation of substantial time and effort for citizens to cast their votes. This can lead to decreased voter turnout, particularly among individuals facing mobility challenges or residing in remote areas. Additionally, traditional methods are susceptible to errors in voter registration, vote counting, and result tabulation, which cast doubts on the accuracy and integrity of election outcomes. Furthermore, security concerns loom large over existing voting systems. Instances of fraud, tampering, and cyber-attacks pose significant threats to the legitimacy of election results. Ensuring the confidentiality, integrity, and

authenticity of votes in the digital era has become an urgent priority for preserving the core principles of democracy.

II. RELATED WORKS

Researchers have explored various methodologies to enhance online voting systems, including stringent identity verification to prevent multiple registrations [1]. Additionally, advancements in technology, such as battery-free wireless voting systems utilizing motion-powered Bluetooth buttons, have been introduced [2]. Early online voting systems focused on usability and security, introducing intuitive user interfaces and advanced encryption techniques [3]. However, challenges persist, particularly regarding scalability and practical implementation [4]. Biometric authentication has emerged as a promising method to prevent duplicate votes and enhance security. The Online Election Management System leverages image classification and dual authentication to streamline voting processes and prevent fraud. Despite these advancements, the complexity of some systems may deter voters [5]. Efforts to address these challenges continue, with ongoing research focusing on improving user experience and security measures. The Online Voting System integrates robust encryption techniques, multi-factor authentication, and real-time text verification to ensure the integrity of the voting process [6]. By prioritizing simplicity and security, this system aims to increase voter turnout and eliminate the risk of multiple registrations. Authors in [7] propose a fingerprint voting system with Arduino. In the proposed system, a voter's identity can be proved instantly. All voters' information was stored securely to register in the system. The authors' main objective is to enhance security in order to prevent duplication and provide a system which reduces the burden for people on conducting a voting. However, the implementation was not online. It is devoid of real-time monitoring of vote cast.

On the other hand, the authors in [8] proposed an Online Election Management System application. The system has a centralized database to keep the details or records of all the voters, candidates and final Results. It was implemented based on image classification technique and sending the passwords to voters via email, for login. However, this system does not provide for correction in case of login error.

Smart voting system was proposed by the authors in [9]. Using Android applications, each voter's facial image, finger print, and ID are coded for individual recognition. Like the

system in [8], a central database was used by [9] to store voter's coded information. Dual authentication using both facial recognition and fingerprint was employed. However, this system was not internet-based and did not provide seamless real-time monitoring.

In [10] the authors proposed a cryptographic technique for an authenticated, end-to-end verifiable and secret ballot election. The authors proposed a secure and verifiable voter registration and authentication mechanism. The proposed scheme prevents ballot stuffing attack. It also allow the publishing of the final tally without revealing the tally from individual Direct-Recording Electronic (DRE) machines using secure multi-party computation and non-interactive zero-knowledge (NIZK) proof. This was achieved by using blockchain and cloud server. However, the system lacks the ability to provide remote updating of login details of voter in a situation of login error.

An electronic voting system was proposed in [11]. Blockchain technology was proposed to realize a decentralized system. Confidentiality and reliability were central to this electronic system. Online and real-time monitoring of vote counts were not considered in this work.

Leveraging on the background information provided by existing works, which includes the merits and drawbacks found in existing literature. Our work in this paper proposes an online, real-time voting system that provides multilevel voter authentication and security of vote count.

The remaining part of this paper is arranged as follows: section III describes the method used to achieve the set objectives. Section IV discuss results obtained, and section V gives the conclusion of the paper.

III. METHODOLOGY

In the pursuit of developing a secure, real-time online voting system, a comprehensive methodology was employed, ensuring a systematic and well-structured approach. This section presents a clear and concise description of the procedures and software requirements involved. It aims to make the methodology understandable to readers of varying technical backgrounds. The development environment heavily relied on XAMPP, a popular open-source software stack that includes Apache, MySQL, PHP, and Perl. XAMPP provided the necessary infrastructure to host the web application, manage the database, and execute PHP scripts. For the coding and development phase, Visual Studio Code, a lightweight and versatile source code editor, was utilized. Its user-friendly interface and support for various programming languages, including HTML and PHP, made it an ideal choice. HTML served as the foundation for creating the web interface. It allowed for the structuring of web pages, defining content elements, and establishing the layout of the voting platform. PHP was instrumental in the dynamic functionality of the online voting system. It enabled server-side scripting, data processing, and interaction with the MySQL database. The MySQL relational database management system was employed for securely storing and managing voter data, candidate information, and election-related records. MySQL's scalability and security features made it suitable for this purpose.

The development process was meticulously guided by a thoughtfully designed flowchart and algorithm, meticulously

crafted to ensure clarity and efficiency at every stage. Figure 1 shows a comprehensive visual representation of the system's workflow, delineating each crucial step with precision.

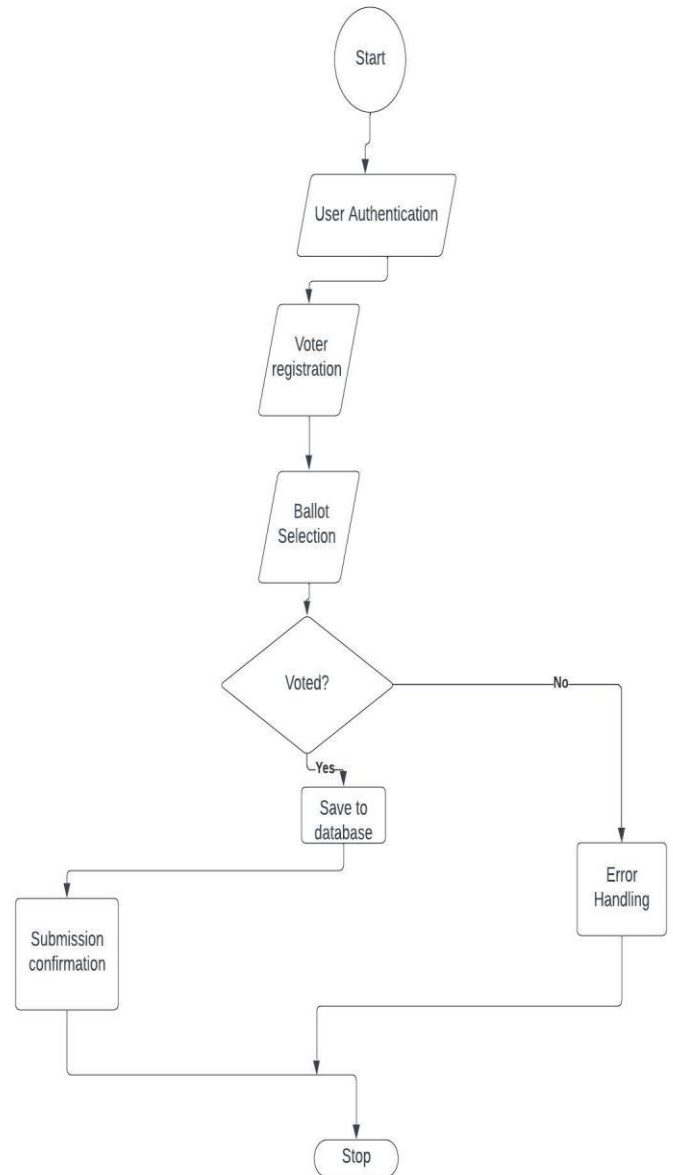


Fig. 1. Implementation Flowchart

From the initial user registration to the intricate candidate selection process and finally to the seamless execution of the voting mechanism, every aspect of the system's functionality was meticulously outlined. This visual roadmap not only provided a clear understanding of the system's architecture but also served as a guiding beacon, facilitating seamless communication among the development team members. It enabled them to collectively translate the conceptual framework into a tangible and robust online voting system, ensuring its efficacy and reliability in real-world scenarios.

The project's primary objective was to design and develop a prototype for a secured online real-time voting system, with specific aims to create a user-friendly interface, prototype a database, and host the system for real-time operation. These objectives were effectively realized, and the outcomes are detailed below. The initial target was the

creation of an intuitive and user-friendly web interface crafted using HTML and PHP.

As shown in Figure 3, the interface offers multiple functionalities. Registered voters can securely login through the login session. If a user forgets their password, a "Forgot Password" link provides assistance. Furthermore, for new voters, there is an option to register. It's essential to note that while real-world voters are typically pre-registered, the registration feature was implemented for illustrative purposes. Addressing the second objective involved the development of a prototype database. The database structure, exemplified in Figure 6, accommodates data for approximately 70 registered voters. Several critical features are integrated into the database, including data validation to ensure data integrity. For instance, cellphone numbers are restricted to 10 digits, enforcing data quality. The database also securely stores essential information, such as voter details and data related to various political groups, a crucial aspect of the election process. The ultimate project goal was to establish a real-time system.

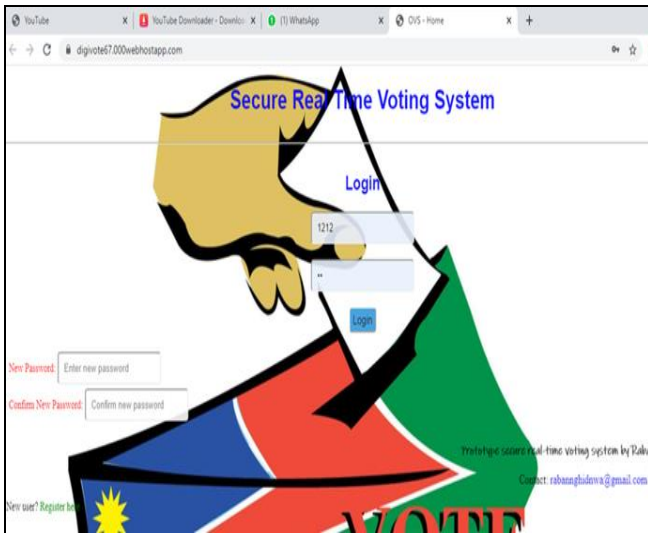


Fig. 2. Login Interface

Figure 7 unveils the backend of the hosting company, featuring the "Powered by 000Webhost" logo at the bottom right corner of Figures 3, 4, 5 and 6. Hosting the web application with the support of 000Webhost brings two significant advantages. Firstly, it grants global accessibility to the system, making it available for voters worldwide. Secondly, it facilitates real-time vote counting. As votes are cast, the system provides instant and up-to-the-minute results, ensuring the timely availability of voting outcomes. To streamline the operations and provide transparency in the system's processes, a comprehensive flowchart and algorithm were created. Figure 1 illustrates the detailed flowchart, while the algorithm forms the system's backbone. The flowchart outlines the sequential steps in the voting process, from voter registration to vote counting. The development of the system required several essential software tools. XAMPP was employed to create a local web server for testing and development, ensuring the application's compatibility with a web server environment. Visual Studio Code served as the primary integrated development environment for coding the system. The combination of HTML, PHP, and MySQL was essential for

building the web application and managing the database efficiently. In summary, the project successfully achieved its objectives by creating an easily navigable interface, crafting a prototype database, enabling real-time hosting, and implementing a comprehensive flowchart and algorithm. These accomplishments set the stage for a secure online voting system that can potentially enhance the democratic process through improved accessibility, user-friendliness, and real-time result tabulation.

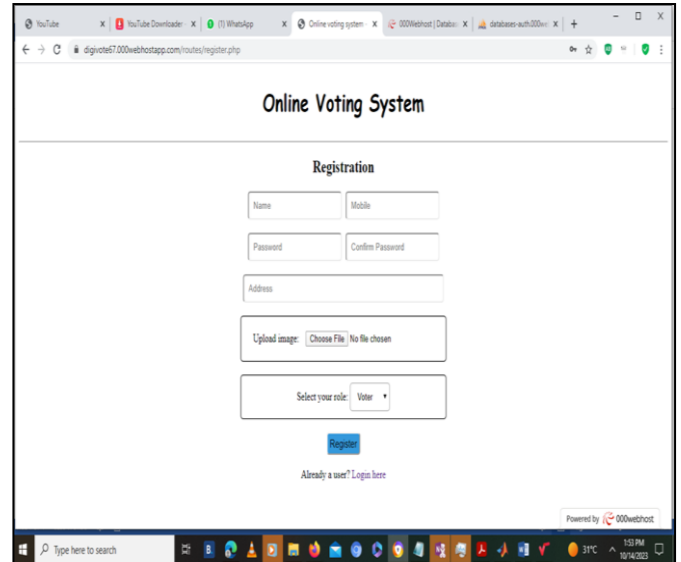


Fig. 3. Registration tab

Figure 3 provides a detailed view of the registration tab, a crucial entry point for users to join the platform securely and conveniently. Here, users are prompted to input essential personal information, including their full name, mobile number, and a secure password, which they confirm to ensure accuracy. Additionally, users are prompted to provide their address, enhancing the platform's data integrity and enabling accurate user identification. Moreover, the registration process allows users to personalize their profiles by uploading an image, fostering a sense of identity and community within the platform. This feature not only adds a personal touch to the user experience but also aids in user recognition and engagement. Furthermore, Figure 3 includes a vital component: the renewal link. Positioned conveniently at the bottom of the registration tab, this link serves as a fail-safe mechanism for users who may have forgotten their passwords. By clicking on this link, users are guided through a secure process to renew their passwords, ensuring uninterrupted access to the platform while upholding stringent security measures. In essence, Figure 3 encapsulates the user-centric design philosophy of the platform, prioritizing ease of use, data integrity, and security. It exemplifies a seamless registration process that empowers users to join the platform with confidence and convenience, laying a solid foundation for their engagement and participation in the voting process.

In Figure 4, the voting page presents an intuitive interface designed to facilitate a seamless and transparent voting experience.

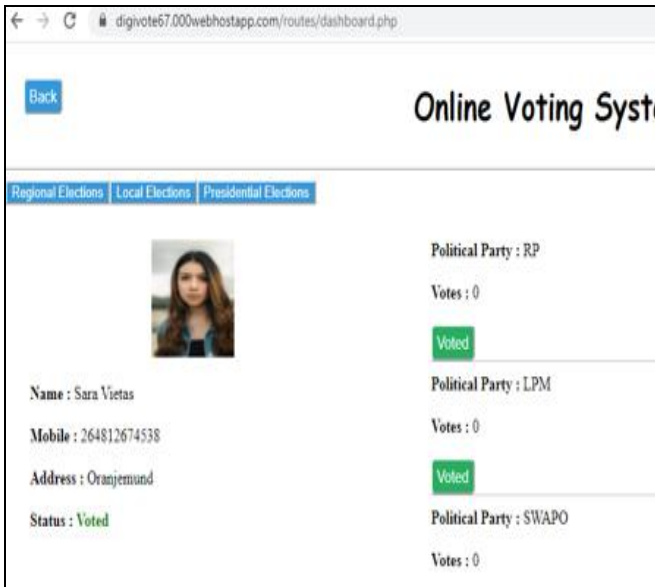


Fig. 4. Voting page

On the left side of the page, voters are greeted with their passport photo, providing visual confirmation of their identity and reinforcing the integrity of the voting process. This personal touch instils trust and confidence in the system, ensuring that the rightful individual casts each vote. Adjacent to the voter's photo, on the right side of the page, lies a comprehensive display of their personal details, reaffirming the accuracy of voter registration information and further enhancing the security of the voting process.

This transparency not only fosters trust but also allows voters to verify their details before proceeding, minimizing errors and ensuring a smooth voting experience. Furthermore, Figure 4 showcases the breadth of electoral choices available to voters. Divided into distinct categories such as regional, local, and presidential elections, the interface provides voters with a clear overview of the various voting options available to them. This categorization simplifies the voting process, allowing voters to navigate effortlessly through the ballot and make informed decisions in each electoral category. On the right side of the page, voters are presented with a comprehensive list of political parties participating in the elections. This display empowers voters to explore the ideologies, platforms, and candidates associated with each party, enabling them to make educated choices aligned with their values and preferences.

Overall, figure 4 exemplifies a user-centric voting interface that prioritizes transparency, accessibility, and choice. By providing voters with a visually engaging and intuitive platform to exercise their democratic rights, the system ensures a fair and inclusive electoral process that upholds the principles of democracy.

In Figure 5, the password reset tab offers a straightforward and secure means for voters to regain access to their accounts in case of a forgotten password. Once the voter clicks on the password renewal link, they are seamlessly redirected to this tab, where they are prompted to enter a new password. Within this tab, users encounter a user-friendly interface that guides them through the password reset process with clarity and efficiency. The tab prominently features a designated field where users can

input their chosen new password, ensuring that it meets the platform's security requirements.

Additionally, users may be prompted to confirm their new password to prevent inadvertent errors and enhance security. Furthermore, the tab may include informative prompts or tooltips to assist users in creating a strong and memorable password that adheres to best practices for online security.

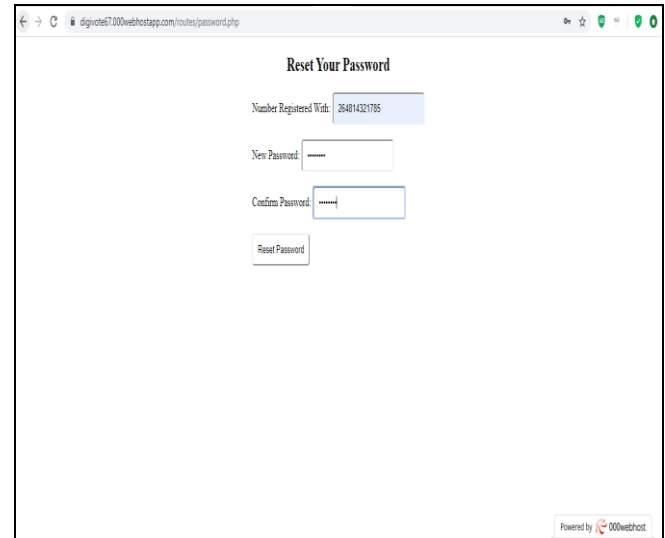


Fig. 5. Password Reset

This may include suggestions for incorporating a mix of alphanumeric characters, symbols, and uppercase and lowercase letters to enhance password strength and resilience against potential threats. By providing a user-friendly and secure interface for password reset, Figure 5 reinforces the platform's commitment to user privacy and security. It ensures that voters can regain access to their accounts swiftly and confidently, thereby preserving the integrity of the voting process and upholding trust in the platform's security measures.

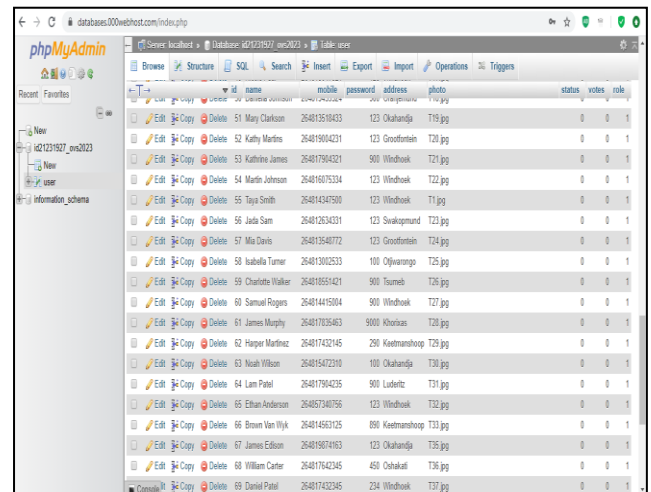


Fig. 6 Database with a sample size of 70 registrations

In Figure 6, the database interface provides a glimpse into the robust infrastructure supporting the voting system, showcasing a sample size of 70 fictitious voter registrations stored within the database. These registrations serve as essential test data, meticulously crafted to evaluate the functionality and reliability of the database in securely

storing and managing voter details. Within the database interface, users can access a comprehensive array of fields corresponding to each voter's registration information, including but not limited to their full name, mobile number, address, and uploaded image. Each entry is meticulously organized and indexed, facilitating efficient retrieval and manipulation of voter data as needed. Moreover, the database interface may feature tools and functionalities to streamline data management tasks, such as sorting, filtering, and querying capabilities. This empowers administrators and developers to perform in-depth analyses, identify patterns, and troubleshoot potential issues within the database with ease. Additionally, Figure 6 underscores the utilization of MySQL, a powerful and widely used relational database management system, to store and manage voter registrations. Leveraging the robust capabilities of MySQL ensures data integrity, scalability, and performance, laying a solid foundation for the seamless operation of the voting system. Furthermore, including a sample size of 70 registrations underscores the thoroughness and rigor of the testing process, ensuring that the database can effectively handle a realistic volume of voter data without compromising performance or security.

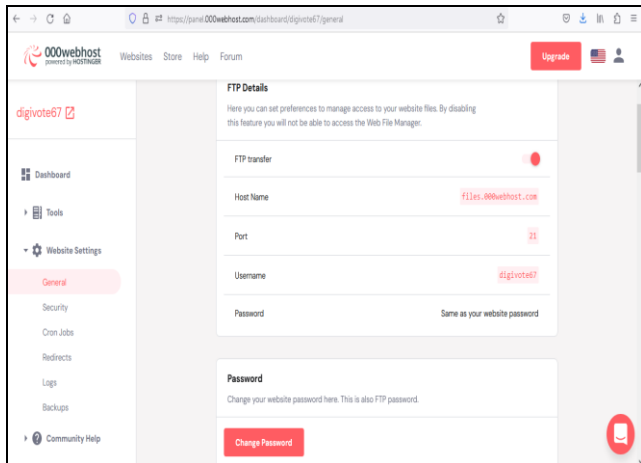


Fig. 7 Backend of the Hosting Company (000Webhost.com)

In figure 7, we are presented with a snapshot of the backend interface of 000Webhost, the hosting company powering the online voting system. This backend interface serves as a control center where developers are granted access to various tools and functionalities essential for managing and configuring the hosted website. The presence of the 000Webhost logo in the bottom left corner of the interface underscores the hosting provider's pivotal role in supporting the online platform. As a trusted hosting partner, 000Webhost offers reliable hosting capabilities, ensuring optimal performance and uptime for the voting system. Within the backend interface, developers can access a range of tools and settings designed to streamline website management and configuration. This includes website settings encompassing general configurations such as domain management, security settings, and other essential parameters. One noteworthy feature highlighted in Figure 7 is the capability to change the domain name. This functionality empowers developers to customize the website's URL according to their preferences or organizational requirements. Whether it's updating to a new

domain name or refining the existing one, developers can leverage this feature to maintain consistency and brand identity across the online voting platform. Moreover, the backend interface may offer additional control functionalities such as database management, file management, and access to server logs, providing developers with comprehensive oversight and control over the hosted website. Overall, Figure 7 exemplifies the robust infrastructure and management capabilities offered by 000Webhost, enabling developers to configure, manage, and optimize the online voting system easily and efficiently. By providing a user-friendly and feature-rich backend interface, 000Webhost facilitates seamless website management, empowering developers to focus on delivering a secure and reliable voting experience to users.

IV. RESULTS AND DISCUSSION OF RESULTS

The secured, online, real-time voting system's outcomes hinge upon accomplishing the predetermined project objectives. We will assess each objective individually in light of the results achieved. The primary goal was to design a user-friendly interface to facilitate the voting process. As evidenced by Figure 3, the designed interface offers a straightforward, intuitive experience. It caters to registered voters by providing a secure login mechanism. The "Forgot Password" link ensures ease of use, and prospective voters can efficiently register through a dedicated tab. These features collectively demonstrate the fulfilment of the first objective. Objective 2 centered around developing a prototype database to store voter data securely and manage the information related to various political groups. Figure 6 showcases the database structure, holding records for around 70 registered voters. The database's design not only ensures data integrity, as exemplified by restricting cellphone numbers to 10 digits, but also securely manages voter information and political group data. Thus, the second objective was effectively met.

The ultimate objective was to enable real-time functionality for the voting system. Figure 7 demonstrates the hosting of the web application via 000Webhost. This hosting not only enables global accessibility but, more crucially, supports real-time vote counting. As votes are cast, the system provides immediate results, thus satisfying the project's third objective. In summary, the secured, online, real-time voting system admirably met each project objective. The user-friendly interface ensures that voters can navigate the system with ease, while the database development ensures data accuracy and security.

V. CONCLUSIONS

In conclusion, the development of a secure, online, real-time Internet voting system has illuminated the immense benefits it offers to the electoral process. Through careful consideration of user-friendliness, data security, and real-time functionality, this system has surpassed its objectives. Its user-friendly interface, as demonstrated in Figure 3, significantly enhances accessibility and convenience for voters. The prototype database, showcased in Figure 6, exhibits robust data management and security measures. Real-time hosting via 000Webhost, depicted in Figure 7, ensures global accessibility and prompt results delivery. This

work highlights the importance of prioritizing usability, security, and real-time capabilities in online voting systems, thereby advancing electoral technology. By leveraging technology, this system makes the democratic process more efficient and accessible to a broader audience. Future research should focus on scalability, enhanced security measures, and innovative features to further improve the system's integrity and user experience. By addressing these areas, researchers can contribute significantly to the ongoing evolution of online voting systems, ultimately reshaping the electoral landscape for the better.

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