WildVote: Technologian Smart Voting System

by

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Engr. Johnalyn L. Figueras (Adviser)

A Project Design Presented in Partial Fulfillment
of the Requirements for the Degree
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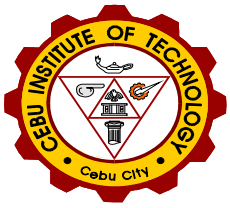

CEBU INSTITUTE OF TECHNOLOGY

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has been approved

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ABSTRACT

The study seeks to address the pressing need for a more efficient and secure voting system by proposing a web-connected smart voting system that leverages biometric technology, specifically fingerprint data for verification. This innovation is crucial considering the inefficiencies and security vulnerabilities present in current voting systems, such as traditional paper-based methods and existing electronic systems. By integrating advanced technology, including a Raspberry Pi 4, LCD touchscreen, and real-time database, the system aims to provide a seamless, secure, and transparent voting experience. Previous research has highlighted the limitations of traditional voting systems and the potential benefits of smart voting systems, yet there remains a knowledge gap in understanding how biometric authentication can effectively address security concerns in voting. The researchers' study aims to fill this gap by evaluating the effectiveness of biometric authentication, specifically fingerprint data, in enhancing the security and efficiency of a smart voting system. They hypothesize that integrating biometric authentication into the system will significantly improve security measures, mitigate fraud risks, and promote voter confidence in the electoral process, ultimately enhancing the integrity of elections. This study is particularly relevant to the technologian community of Cebu Institute of Technology - University, as it explores cutting-edge technology solutions for improving electoral processes.

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CHAPTER 1

INTRODUCTION

Student elections play a pivotal role in shaping the leadership and governance of academic institutions, serving as a cornerstone of democratic engagement within university communities. At Cebu Institute of Technology - University (CIT-U), the Supreme Student Government oversees the implementation of elections to determine student representatives for the upcoming academic years. However, recent trends have revealed concerning declines in voter turnout, raising questions about the effectiveness of current electoral processes. Ensuring robust participation and maintaining the integrity of student elections are paramount to upholding democratic principles and fostering an inclusive campus environment.

1.1 PROBLEM BACKGROUND

In recent years, the Commission on Elections (COMELEC) of CIT-U's Supreme Student Government has observed a troubling decline in voter participation rates. With only 38.1% and 26.90% turnout reported in the past two years, respectively, there is a pressing need to address the underlying factors contributing to this trend. The low voter turnout not only undermines the legitimacy of elected student representatives but also diminishes the representation of student voices in decision-making processes. Moreover, the current validation process undertaken by COMELEC technical commissioners is both time-consuming and repetitive, potentially diverting resources from other essential governance tasks.

To confront these challenges, the researchers' study proposes the implementation of WildVote: The Technologian Smart Voting System. By introducing innovative biometric authentication, specifically fingerprint verification,

- This system aims to streamline the validation process and enhance the security and efficiency of student elections at CIT-U.
- The research seeks to investigate whether this technology can outperform traditional human intervention, thereby revitalizing student engagement and safeguarding the integrity of the electoral process.
- Additionally,
    - The researchers aim to identify the most common reasons why some technologians did not participate in the 40th CIT U SSG Elections. Understanding these factors is crucial for addressing barriers to voter engagement and developing targeted strategies to increase participation rates among CIT-U's technologian community.

1.2 PROJECT GOAL AND OBJECTIVES

Project Goal

The project aims to develop a user-friendly, secure, and transparent voting system to enhance accessibility and efficiency, enabling students to participate in the electoral process easily and confidently.

Objectives

- Design a user-friendly touchscreen interface that simplifies the voting process for all students, including those with limited technological expertise, by prioritizing intuitive navigation and clear instructions.

- Implement a real-time feedback system that displays accurate voting counts immediately after each vote is cast, fostering transparency, and enabling voters to verify their actions in real-time.
- Integrate robust fingerprint authentication mechanisms to verify the identity of voters, ensuring the authenticity of each vote and mitigating the risk of fraudulent voting practices.
- Design the voting system to be lightweight, portable, and easily deployable in diverse voting locations within CIT-U, considering factors such as size, weight, and ease of setup and dismantling.
- Improve the accessibility of real-time voting statistics by implementing clear and visually appealing screen displays, encouraging active engagement and participation among technologists throughout the voting process.
- Conduct thorough surveys within the technologian community to gather quantitative and qualitative data on voting preferences, barriers to participation, and user satisfaction, facilitating informed decision-making and system refinement based on user feedback.

1.3 SIGNIFICANCE OF THE STUDY

This study holds significant implications for various entities within the Cebu Institute of Technology – University (CIT-U) community and beyond:

- CIT-U Supreme Student Government's COMELEC
    - This study offers an advanced voting system to improve the efficiency, security, and transparency of student elections.
- Technologian Community and Administration

- The project demonstrates CIT-U's commitment to technological innovation and serves as a model for improving voting processes in academic institutions.

- Future researchers
    - This study pioneers the integration of fingerprint scanning for verification in voting systems, offering a novel approach that fills a significant gap in existing research. It provides invaluable insights and serves as a reference for future research and innovation in this emerging field.

1.4 **THEORETICAL BACKGROUND**

TECHNOLOGY ACCEPTANCE MODEL (TAM)

The Technology Acceptance Model (TAM) elucidates users' acceptance and usage of technology, emphasizing **perceived usefulness** and **ease of use** as pivotal (Silva, Davis' Technology Acceptance Model (TAM) (1986), 2015; Sidanti, H., Murwani, F. D., Wardhana, E. T. D. R. W., & Sopiah, 2021). TAM's applicability spans diverse domains, including online purchasing (Sidanti, H., Murwani, F. D., Wardhana, E. T. D. R. W., & Sopiah, 2021) fintech services (Herlina, 2023), and academic systems (Abialam Koesnandy Hardjantho Hardjantho, 2015). While TAM has evolved to address cultural influences (Silva, Davis' Technology Acceptance Model (TAM) (1986), 2015)and expanded to include new variables (Sidanti, H., Murwani, F. D., Wardhana, E. T. D. R. W., & Sopiah, 2021), it acknowledges limitations, prompting extensions like TAM 2, TAM 3, and TAM 5 (Motasem ARMOUTI, 2023). Despite its evolution, TAM remains a valuable tool for predicting and enhancing technology acceptance (Jokonya, 2015) (Leong, 2003).

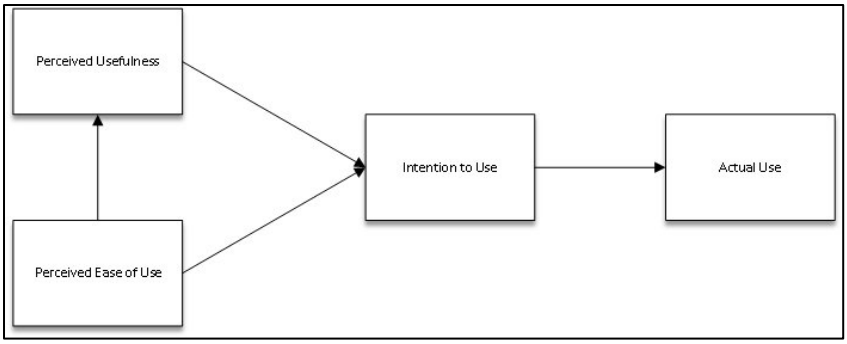


Figure 1: Block Diagram for TAM

Analysis on TAM Framework

According to the study, it was defined that "perceived usefulness" indicates how much a person thinks that using a specific system would improve their work performance. In our research, perceived usefulness refers to the extent to which the smart voting system enhances the voting procedure. If voters and election administrators think that the WildVote system will speed up voting, enhance security, and improve efficiency, they are more inclined to implement it. Perceived Ease of use pertains to the extent to which an individual feels that utilizing a system would require minimal effort. For the smart voting system to be effective, both voters and administrators need to be able to easily navigate and understand the system. Higher adoption rates are probable if the interface is easy to use and the registration and voting process is simple.

The TAM framework is directly applicable to our study on the WildVote system. Here's how it relates:

- Voters: For voters, the perceived usefulness could be evaluated based on whether the system makes voting more accessible and efficient compared to traditional methods. If voters find that the system reduces wait times and increases the security of their votes through fingerprint verification, they will perceive it as useful.
- Administrators: For election administrators, the perceived usefulness could include how the system streamlines the validation process and reduces the administrative burden. By automating the voter verification process, administrators can focus on other essential tasks, thereby finding the system highly beneficial.

By applying TAM, the study can also identify specific areas where the system may need improvements. If voters find certain aspects of the system cumbersome or if administrators encounter challenges in managing the system, these insights can guide further refinements to enhance ease of use and perceived usefulness.

Keywords

Technology Acceptance Model (TAM), perceived usefulness, ease of use, online purchasing, fintech services, academic systems, cultural influences, TAM 2, TAM 3, TAM 5, technology acceptance, user behavior, predictive models, technological adoption.

INFORMATION SYSTEM SUCCESS MODEL

The DeLone and McLean Information System Success Model (ISSM) evaluates information system success across several dimensions: system quality, information quality, service quality, user satisfaction, and net benefits (Abidin Abidin, 2023; Gibran, Budiyanto, & Yuana, 2023). While these dimensions are broadly applicable, their impacts vary by context. For example, user satisfaction primarily influenced net benefits in a FinTech platform (Abidin Abidin, 2023), whereas consumer habits were more significant than information quality in tourism (CHANG, LIU, & HWANG, 2011). In healthcare, information and service quality significantly affected perceived usefulness and user satisfaction, impacting performance (Park, et al., 2013). Thus, while ISSM is robust, its dimensions' importance can vary, necessitating context-specific evaluations. Its adaptability across environments, from healthcare to digital libraries, highlights its utility in improving information systems (Ahmad & Sharma, 2023; Alzahrani, Mahmud, Ramayah, Alfarraj, & Alalwan, 2017; Tingliao & Lianghua, 2015).

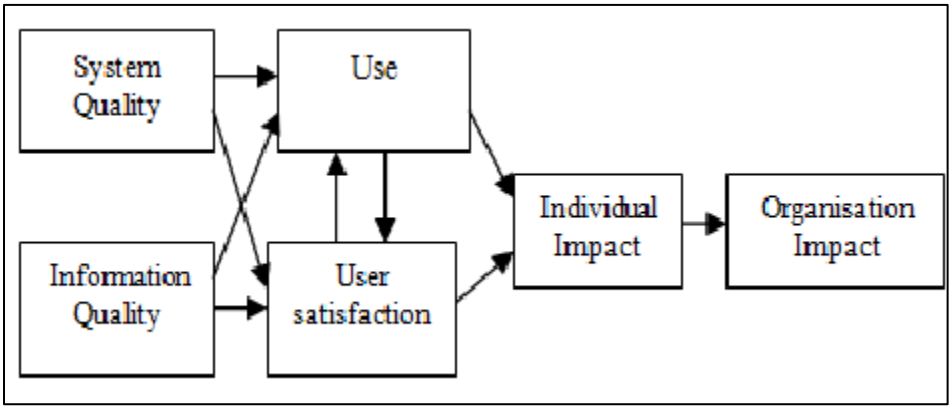


Figure 2: DeLone and McLean Information Systems Success Model Diagram

Analysis on ISSM Framework

There are few terms that are required to be defined and here are the following:

- System Quality: This dimension refers to the performance of the system in terms of reliability, ease of use, and functionality. For a voting system, this includes how well the system performs during the election process, its reliability in handling multiple users, and its overall user interface design.
- Information Quality: This aspect deals with the quality of the information produced by the system. In the context of a voting system, information quality would encompass the accuracy of voter data, the integrity of the voting results, and the real-time availability of election data.
- User Satisfaction: This dimension measures how satisfied users are with the system. User satisfaction is influenced by both system quality and information quality, as well as the overall experience of using the system.

The Information Systems Success Model is highly relevant to the study of the WildVote smart voting system. Here's how it relates:

1. System Quality
    a. Reliability and Performance: The WildVote system needs to function reliably during election day operations, highlighting the importance of both reliability and performance. The biometric authentication feature needs to confirm voter identities consistently and reliably with precision.
    b. Ease of Use: User-friendly interface is necessary for voters and election administrators to easily navigate the system. If the system is easy to use, it will probably improve users' overall experience and satisfaction.

c. Functionality: The system must facilitate every essential voting task, including voter registration, voting, and vote tallying, with no technical problems.

2. Information Quality
    a. Precision: The WildVote system needs to guarantee that voter information is precise and current. The accuracy of the election outcome needs to be preserved, guaranteeing that every vote is accurately tallied.
    b. Real-Time Data: Giving immediate updates on the voting progress and outcomes can improve transparency and confidence in the electoral process. Voters and officials need quick access to accurate information.
3. User satisfaction
    a. Voter satisfaction while using the WildVote system is a key indicator of its success. If voters perceive the system as safe, productive, and user-friendly, their contentment will be elevated, possibly boosting voter participation in upcoming elections.
    b. Administrator Satisfaction: The system's satisfaction among election administrators is crucial as well. If the system streamlines their responsibilities, decreases the time needed for voter confirmation, and improves the entire election procedure, their contentment will probably be high.

This alignment with the ISSM not only ensures a thorough evaluation of the system's performance but also highlights areas for potential improvement, ultimately contributing to the successful implementation and acceptance of the smart voting system.

Keywords

Information System Success Model (ISSM), DeLone and McLean, system quality, information quality, service quality, user satisfaction, net benefits, FinTech platforms, tourism industry, healthcare CRM systems, digital libraries, online travel agencies, context-specific evaluations, perceived usefulness, organizational performance.

DIFFUSION OF INNOVATION THEORY

Rogers' Diffusion of Innovation (DOI) theory explains the adoption and spread of new ideas and technologies within a population, highlighting factors such as **relative advantage**, **compatibility**, **complexity**, **trialability**, and **observability** (Yu, 2022). The theory describes the innovation adoption lifecycle through an "S-curve" (Bakkabulindi, 2014; Yu, 2022). While traditional factors like relative advantage and compatibility are crucial, recent studies indicate that trialability and observability gain importance in socially embedded contexts (Tan, 2020). DOI theory applies beyond technology to fields like education and organizational change, supported by empirical studies (Chen, 2024; Yates, 2004). Despite evolving social and technological landscapes, DOI remains a robust tool for understanding and facilitating innovation spread, adaptable to various fields (Fagan, 2011) (Miller, 2018) (Sonis, 2009) (Wonglimpiyarat & Yuberk, 2005)

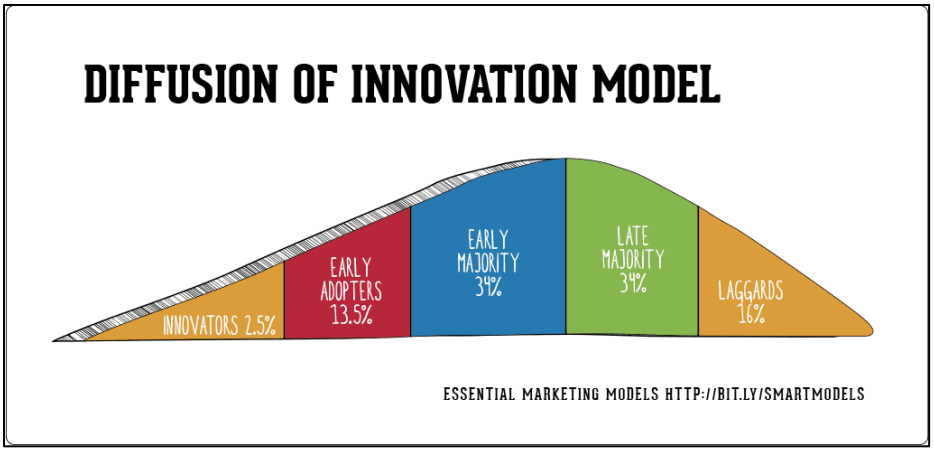


Figure 3: Robert's Diffusion of Innovation Theory

Analysis on DOI Theory of Innovation

The Diffusion of Innovation Theory can be effectively applied to the study of the WildVote: The Technologian Smart Voting System to understand the adoption process among different user groups at CIT-U.

- **Innovators:** These are the first individuals to adopt an innovation. They are willing to take risks and are often viewed as visionaries. Their early adoption is crucial as it sets the stage for broader acceptance.
- **Early Adopters**: This group follows the innovators. They are more judicious in their adoption decisions but are still quick to embrace new technologies. They often serve as opinion leaders within their communities.
- **Early Majority**: Individuals in this group adopt new innovations before the average person. They are more deliberate and take time to see evidence of benefits before committing.
- **Late Majority**: These individuals are skeptical about innovations and will only adopt after the majority of society has accepted the new technology. They are more cautious and often require extensive proof of effectiveness.

- **Laggards**: The last group to adopt an innovation, laggards are resistant to change and prefer traditional ways. They require substantial evidence and pressure from other groups to adopt new technology.

Utilizing the Diffusion of Innovation Theory to examine WildVote offers valuable understanding on how various user groups at CIT-U adopt the platform. By comprehending the traits and requirements of every group, researchers can customize their tactics for implementation to tackle issues and promote widespread acceptance. For example, by showcasing the system's trustworthiness and advantages through trial runs with those who embrace new ideas and adopt them early on, a base of credibility and proof can be established to convince the majority of users. Moreover, by targeting communication and providing support tailored to their concerns, laggards can eventually be persuaded to accept the system. In the end, this theory assists in strategically scheduling the implementation of the WildVote system for the highest possible adoption rates and a smooth transition to a more secure and efficient voting process at CIT-U.

Keywords

Diffusion of Innovation (DOI) Theory, adoption and spread of technologies, relative advantage, compatibility, complexity, trialability, observability, innovation adoption lifecycle, S-curve, social embeddedness, empirical studies, education, organizational change, innovation spread, technological adaptation.

SOFTWARE DEVELOPMENT LIFE CYCLE (SDLC)

The Software Development Life Cycle (SDLC) is a structured process guiding software development from conception to deployment, ensuring software meets user requirements,

budget constraints, and quality standards (Leloudas, 2013). It includes phases like **design**, **development**, **testing**, and **deployment**, serving as a roadmap for project activities (Sawarkar & Rajput, 2022). There are various SDLC models, such as Waterfall, V-Model, Spiral, Agile, and Hybrid, each with unique benefits and challenges (2023). Some studies propose new models, like the Open Agile Software Development Life Cycle (OASDLC), to optimize practices (Misra & Singh, 2015). The choice of an SDLC model depends on project-specific factors, emphasizing the importance of selecting the appropriate model based on project requirements and organizational context (Akinsola, et al., 2020). The SDLC's role in project management, quality assurance, and adaptability to changing needs highlights its significance in software engineering.

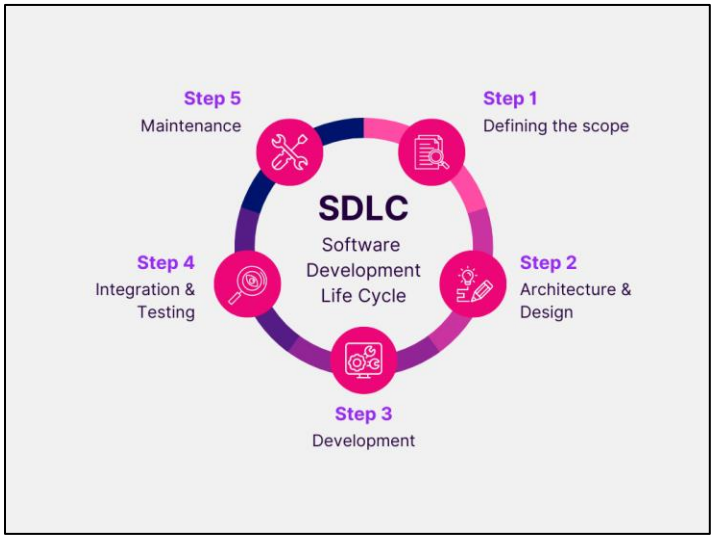


Figure 4: SDLC Diagram

Analysis of the Software Development Life Cycle (SDLC)

Software Development Life Cycle (SDLC):

- Phases: The SDLC consists of planning, analysis, design, implementation, testing, deployment, and maintenance.
- Application: Applying SDLC ensures efficient and systematic development of software applications.

For the development of the WildVote: The Technologian Smart Voting System, the SDLC provides a structured approach:

- Planning: Define objectives, scope, and feasibility of the smart voting system.
- Analysis: Identify system requirements and user needs, including fingerprint technology integration.
- Design: Create system architecture, user interface, and security protocols.
- Implementation: Develop the software with integrated biometric authentication.
- Testing: Conduct thorough testing to ensure functionality, security, and reliability.
- Deployment: Roll out the system for use in CIT-U elections.
- Maintenance: Provide ongoing support and updates to address any issues and improve the system.

Using the SDLC ensures that the development of the WildVote system is methodical, addressing all necessary aspects to create a secure and efficient voting platform for CIT-U.

Keywords

Software Development Life Cycle (SDLC), software development, user requirements, project phases, design, development, testing, deployment, Waterfall model, V-Model, Spiral model, Agile methodology, Hybrid approaches, Open Agile Software Development Life Cycle (OASDLC), project management, quality assurance, software engineering, project-specific factors, organizational context.

BIOMETRIC AUTHENTICATION

Biometric authentication relies on unique biological characteristics to verify identity, offering higher security compared to traditional methods like passwords or PINs (Judith et al., 2016; Tanimoto et al., 2019). Its traits are difficult to replicate or steal, enhancing security (Preetha & Sheela, 2020). However, compromised biometric data cannot be reset like a password, raising privacy concerns (Tanimoto et al., 2019). While generally secure, biometric systems are not immune to attacks, prompting research into visual cryptography, cancelable biometrics, and multimodal systems to enhance security (Judith et al., 2016; Preetha & Sheela, 2020; Sarkar & Singh, 2020; Shin & Seto, 2015). These methods aim to protect biometric templates without compromising usability (Mayron et al., 2013; UDROIU & DAN-ȘUTEU, 2021). Despite these advancements, cancelable biometrics' security criteria remain indefinite, lacking systematic study on biometric authentication safety (Shin & Seto, 2015). In summary, biometric authentication offers significant security advantages due to the uniqueness of biometric traits (Ali et al., 2023; Spanakis et al., 2016). However, irreversible data leakage poses challenges, necessitating ongoing research into protective technologies and system evaluations (Sarkar & Singh, 2020;

Tanimoto et al., 2019). The future will likely involve advanced measures to address these concerns (Preetha & Sheela, 2020).

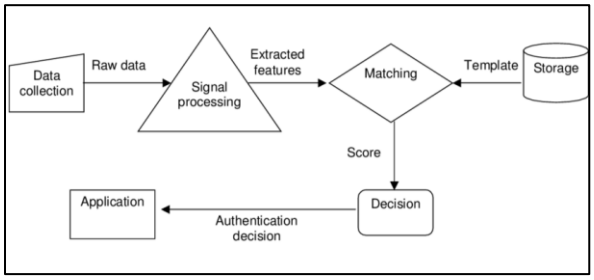


Figure 5: Generic model for Biometric Authentication

Analysis of the Software Development Life Cycle (SDLC)

Biometric Authentication Frameworks:

- FVC Framework: The Fingerprint Verification Competition (FVC) framework provides benchmarks for evaluating fingerprint verification systems. It offers standard datasets, protocols, and performance metrics.

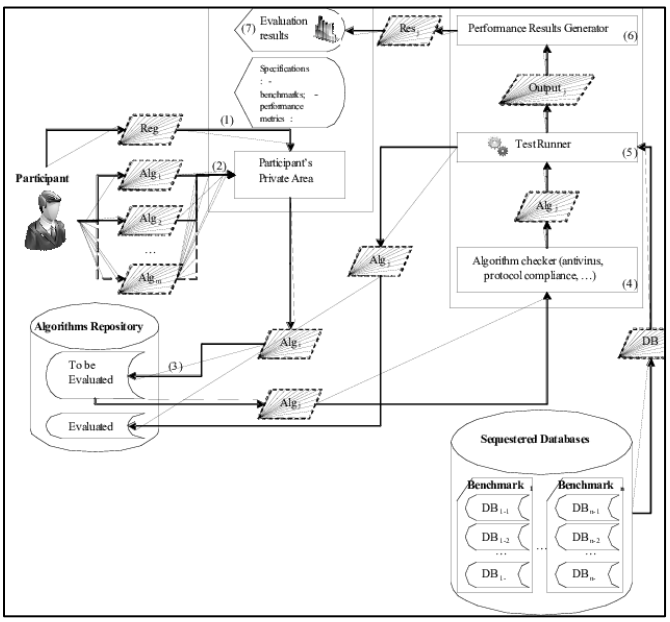


Figure 6: FVC Framework Architecture

- NBIS Framework: The National Institute of Standards and Technology (NIST) Biometric Image Software (NBIS) framework includes tools and algorithms for the evaluation and development of biometric systems. It focuses on image quality, feature extraction, and matching accuracy.

For the development and implementation of the WildVote: The Technologian Smart Voting System, leveraging established biometric authentication frameworks can enhance the system's performance and reliability:

- Standards Compliance: By adhering to standards set by frameworks like FVC and NBIS, the WildVote system ensures it meets industry benchmarks for fingerprint recognition accuracy and security.
- Algorithm Optimization: Utilizing algorithms and tools provided by these frameworks can optimize the fingerprint verification process within the voting system, improving both speed and accuracy.
- Performance Evaluation: Applying the evaluation methodologies from these frameworks allows for rigorous testing and validation of the biometric component of WildVote, ensuring it is robust and reliable under various conditions.
- Reliability Assurance: Incorporating best practices from FVC and NBIS helps in building a system that can be trusted by the student body, addressing concerns over the security and integrity of the voting process.

By integrating the principles and methodologies from biometric authentication frameworks, the WildVote system can achieve a higher standard of performance, thereby contributing to the overall goal of enhancing voter turnout and confidence in the electoral process at CIT-U.

Keywords

Biometric authentication, security process, biological characteristics, identity verification, passwords, PINs, data privacy, visual cryptography, cancelable biometrics, multimodal systems, biometric templates, system safety, usability, data leakage, protective technologies, security enhancements.

1.5 REVIEW OF RELATED LITERATURE

Considerations on Network Monitoring

According to (Tozzi, 2023), network latency as a measure of delays in data movement across a network. Tozzi thought we often imagine that networks can move data in real time, but there is always a delay because it takes some time for packets (units of information used to transfer data over a network) to travel across the network.

On a healthy network, those delays can be measured in milliseconds, which are one one-thousandth of a second. Network latency rates below 100 milliseconds are typically considered to be good, and those of 50 milliseconds are considered very good. At those levels, the delays in transferring data across the network are virtually imperceptible to humans, and applications designed to operate in near-real time can do so effectively.

Understanding network latency is essential to making sure the WildVote: The Technologian Smart Voting System runs smoothly during high voting periods. Rapid data transfers over the network are necessary for the biometric authentication and real-time voting procedures. It is imperative to maintain network latency below 100 milliseconds in order to facilitate a smooth user experience and ensure an effective and fast voting process. The system can efficiently accommodate real-time changes and interactions by keeping

latency levels low, which improves the smart voting system's overall dependability and efficiency at CIT-U.

User-centered Design

According to (Dhandapani, 2016), UCD is a versatile and effective approach to design that can be applied to a wide range of products and services. Its user-focused methodology not only improves the usability of products but also contributes to their commercial success. The ongoing development of UCD methodologies, such as the integration with other models and the LSE approach, demonstrates the dynamic nature of this field and its potential for continued innovation in product design.

Using a User-Centered Design (UCD) approach is crucial in the context of WildVote: The Technologian Smart Voting System to make sure the system satisfies the requirements and expectations of its users, which include CIT-U students and election administrators. By keeping the user experience front and center, the smart voting system's design may be made more user-friendly and accessible, improving the voting process. Furthermore, as UCD approaches continue to advance, they can offer important insights into how to successfully incorporate biometric authentication into the system, improving user experience overall and boosting system uptake. This strategy supports the objective of developing a safe, effective, and user-friendly voting platform that promotes increased voter turnout.

Human-Computer Interaction (HCI)

According to (Bankar, 2023), Human-Computer Interaction (HCI) is a multidisciplinary that focuses on the design of computer technology and, in particular, the interaction between humans (the users) and computers. While traditionally HCI has been concerned with computers, its scope has broadened to cover almost all forms of information technology design. Interestingly, while HCI's roots are in usability—how easily a user can operate a system—it has evolved to encompass a broader user experience (UX), which includes emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors, and accomplishments that occur before, during, and after use. This evolution reflects a shift from a one-size-fits-all approach to a more nuanced, user-centered design (UCD) that considers the specific needs and contexts of different users. Moreover, the integration of positive psychology into HCI aims to enhance user satisfaction by focusing on positive user experiences beyond mere functionality.

Human-computer interaction (HCI) principles are essential for creating a functional and interesting voting platform in the context of WildVote: The Technologian Smart Voting System. Through an emphasis on usability and the wider facets of user experience (UX), the system may be customized to satisfy the various demands of CIT-U's election administrators and students. By ensuring that the system is not only functional but also easy to use and enjoyable, the user-centered design (UCD) approach promotes higher voter turnout. Furthermore, the voting system can offer a positive and captivating user experience by incorporating positive psychology into the design, which will increase user happiness and adoption. This thorough attention to HCI principles advances the study's objective of creating a safe, effective, and user-friendly voting platform.

Trust and Technology Adoption

According to (AlHogail, 2018), identifies trust as a pivotal element in the adoption of various technologies across different sectors. The research collectively underscores the significance of trust in influencing organizational and individual decisions to adopt new technologies, such as financial technologies (FinTech), supply chain management systems, self-service hotel technologies (SSHTs), Internet of Things (IoT) products, health-related technologies, blockchain, and collaboration technologies. Interestingly, while trust is a common factor across these studies, the context and the trust are conceptualized and operationalized vary. For instance, trust in FinTech is linked to organizational factors like senior management support and competence. whereas in the context of supply chain management, technology trust and interorganizational trust are seen as influencing post-adoption utilization.

Trust is essential to the acceptance of the WildVote: The Technologian Smart Voting System by CIT-U election administrators and students. Encouragement of users to switch from paper ballots to the new biometric authentication system depends on fostering faith in the security, dependability, and efficacy of the system. The researchers can encourage user trust by making sure the system is open, easy to use, and backed by the administration of the university. This trust will be crucial in overcoming reluctance to change and guaranteeing that the WildVote system is successfully adopted and used. Acknowledging the role that trust plays in the adoption of new technologies, the study can put methods into place to boost user confidence, which will increase voter engagement and involvement.

Database Management

The question of whether it is acceptable to have multiple databases within a single application depends on the specific requirements and architecture of the system in question. According to Nurnawati and Ermawati (2018), in the context of integration databases, a single database is designed to serve multiple applications, ensuring that changes in data are synchronized across all client applications. This approach negates the need for additional integration layers but requires a schema that accommodates all client applications. Conversely, Wanghong et al. (1998) describe a C++ program information database that supports multiple analysis tools by linking several incremental databases, suggesting a modular approach where different databases serve different purposes within the same overarching system. Interestingly, while these papers do not directly address the use of multiple databases within a single mobile application, they highlight the importance of flexibility, security, and the completeness of attributes in database design (Nurnawati & Ermawati, 2018), as well as the significance of user experience in mobile app development, according to Patidar and Suman (2021). These considerations could influence the decision to employ multiple databases if doing so would enhance the application's functionality or user experience. The researchers of this study used three databases: MongoDB Atlas, Firebase, and Cloudinary. MongoDB Atlas is used to store the users registered on the system and allow the system to communicate with the authentication of the credentials used on our Password Login. Firebase is used to communicate with authentication and registration of Fingerprint. Cloudinary is used to store or upload pictures of the candidates on the database. The reason why the researchers would use multiple databases is because

one database could overload the data sent and received causing the system to occur problems.

Considerations of Real-Time Data Processing

In the context of real-time data processing, several considerations are paramount. According to Shukla (2017), the continuous nature of data streams necessitates methodologies that can handle millions of data points per second, with proper stream preparation and aggregation techniques being crucial for performance. Additionally, KEKEVİ and AYDIN (2022) highlight that the timeliness of data processing is critical, as the value of information often decreases as time elapses, making real-time analytics a focus area for developers and researchers. Contradictions arise with traditional batch processing frameworks like Hadoop's MapReduce, which, while scalable and fault-tolerant, are not suited for real-time stream processing due to their batch-oriented nature. This has led to the development of new architectures and technologies that enable high-speed processing with low latency, essential for immediate decision-making (Hassan & Hassan, 2022; Ounacer et al., 2017). Lipowski and Romaniuk (2006) discuss the use of GPUs for general real-time data processing, highlighting the shift from traditional CPU architectures to stream architectures, which are more effective for handling large data sets. Furthermore, Sasmal (2023) notes that the integration of real-time data processing with machine learning algorithms is an emerging area of interest, as it allows for the development of adaptive decision-making systems that can handle the velocity and volume of data streams. Modupe et al. (2024) also point out that edge computing is a transformative approach that brings computation closer to data sources, reducing latency and enabling real-time analytics at the edge of networks.

In the context of the WildVote: The Technologian Smart Voting System, real-time data processing plays a crucial role in ensuring the efficiency and reliability of the voting process. By leveraging advanced data processing techniques, such as those discussed by the cited authors, the WildVote system can handle the influx of voter data in real-time, facilitating immediate decision-making and enhancing the overall voting experience. The integration of machine learning algorithms, as suggested by Sasmal (2023), could further optimize the system's performance by enabling adaptive decision-making based on voter behavior and trends. Additionally, the adoption of edge computing, as highlighted by Modupe et al. (2024), could minimize latency and ensure seamless real-time analytics, particularly in environments with limited network connectivity. By incorporating insights from these advancements in real-time data processing, the WildVote system can elevate the standards of voting technology, offering CIT-U students a modern and efficient voting experience.

Optimal speed for website to load in 2023

According to (Das, 2023), a website’s speed is crucial for its ranking on Google, traffic, and conversion rates. Statistics show that 40% of visitors will leave a site if it takes more than three seconds to load. Fast load times reduce bounce rates, improve user satisfaction, and enhance SEO rankings. Ideally, a website should load as quickly as possible, with average load times in 2023 being 2.5 seconds on desktops and 8.6 seconds on mobile devices. Tools like BrowserStack's Speed Lab can help evaluate and optimize website performance to ensure faster load times and better user experiences.

Website speed is a critical factor in determining user experience, conversion rates, and search engine rankings. Research indicates that 40% of visitors will leave a website if

it takes longer than three seconds to load, and a 1-second delay in page load time can result in a 7% reduction in conversions. Faster load times lead to better search engine rankings, as Google considers website speed as a ranking factor. Key metrics for monitoring web page speed include Time to First Byte (TTFB), First Contentful Paint (FCP), Largest Contentful Paint (LCP), Cumulative Layout Shift (CLS), and Total Blocking Time (TBT). Tools like Google PageSpeed Insights, BrowserStack SpeedLab, and browser developer tools can be used to test and optimize website speed. Factors like choosing the right hosting provider, optimizing assets, and implementing caching can all contribute to faster website loading times. Website speed optimization offers benefits like a higher conversion rate, lower bounce rate, and improved user experience. A study by Portent found that a B2B site that loads in 1 second has a conversion rate three times higher than a site that loads in 5 seconds. Research emphasizes the need for a reliable and valid speed performance measurement system that expresses sufficient internal consistency regarding its involved metrics. Analyzing website speed involves checking the loading speed of website pages using services like Google PageSpeed Insights, GTmetrix, WebPageTest, or Pingdom, and identifying factors that slow down website loading, such as large images, unnecessary JavaScript, and lack of caching. The goal of analyzing website speed is to create the best user experience, reduce bounce rates, and increase conversion rates. Developers should pay special attention to server speed, API usage, and caching, and follow optimization rules for images, media, widgets, and plugins. Ten tips for improving website speed include using Google Search Console to check if page speed is impacting SEO, running a free page speed test, and addressing common issues like optimizing images, minifying CSS and JavaScript, and leveraging browser caching.

keywords

Time to First Byte (TTFB), First Contentful Paint (FCP), Largest Contentful Paint (LCP), Cumulative Layout Shift (CLS), Total Blocking Time (TBT), Google PageSpeed Insights, BrowserStack SpeedLab, Browser developer tools, Right hosting provider, Optimizing assets, Implementing caching, Higher conversion rate, Lower bounce rate, Improved user experience, Portent study, B2B site, Reliable speed performance measurement, Internal consistency, Google PageSpeed Insights, GTmetrix, WebPageTest, Pingdom, Analyzing website speed, Large images, Unnecessary JavaScript, Lack of caching, Best user experience, Reduce bounce rates, Increase conversion rates, Server speed, API usage, Optimization rules, Images, media, widgets, plugins, Ten tips, Google Search Console, SEO impact, Free page speed test, Minifying CSS and JavaScript, Leveraging browser caching.

1.6 DEFINITION OF TERMS

- Academic systems: Structures and processes used within educational institutions to manage and deliver educational programs and services, including student information systems, learning management systems, and administrative applications.
- Agile methodology: A project management and software development approach focused on iterative development, collaboration, and flexibility to adapt to changing requirements.
- Biological characteristics: Distinctive physical or behavioral traits of an individual, such as fingerprints, facial features, voice, or gait, used in biometric authentication for identity verification.
- Biometric authentication: A security process that uses an individual's unique biological characteristics to verify their identity, enhancing security by making it difficult to impersonate someone else.
- Biometric templates: Digital representations of biometric characteristics used in authentication systems to compare and verify an individual's identity.
- Cancelable biometrics: Biometric systems designed to provide privacy and security by allowing biometric templates to be transformed or "canceled" and reissued, preventing misuse if compromised.
- Compatibility: The degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters.
- Complexity: The degree to which an innovation is perceived as difficult to understand and use, affecting its rate of adoption.

- Context-specific evaluations: Assessments tailored to the particular conditions or environments in which a system or technology is used, ensuring relevance and accuracy in findings.
- Cultural influences: The impact of shared beliefs, values, and practices of a group on the acceptance and use of technologies and systems.
- Data leakage: The unauthorized transmission or exposure of data from within an organization to an external entity, often leading to breaches of privacy and security.
- Data privacy: The practice of protecting personal information from unauthorized access or disclosure, ensuring that individuals have control over how their data is collected, used, and shared.
- Deployment: The process of distributing and installing software or systems to be used in a specific environment or by end-users.
- Design: The phase in software development focused on defining the architecture, components, interfaces, and data for a system to satisfy specified requirements.
- Development: The process of creating software applications through programming, coding, testing, and debugging to meet defined requirements and design specifications.
- Digital libraries: Online databases of digital objects, which can include text, visual material, audio material, and other digital media formats, accessible for research, education, and reference.
- Education: The process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits through various pedagogical methods.

- Empirical studies: Research based on observed and measured phenomena, derived from real-world evidence rather than theory or pure logic.
- Fingerprint authentication: A biometric security process that uses an individual's unique fingerprint patterns to verify their identity, commonly used for access control and secure transactions.
- FinTech platforms: Financial technology platforms that leverage software and technology to offer financial services, enhancing efficiency, security, and accessibility.
- Fintech Services: Financial services provided through technology platforms, including online banking, mobile payments, and digital investment platforms.
- Healthcare CRM systems: Customer relationship management systems designed specifically for healthcare organizations to manage patient information, improve care coordination, and enhance patient engagement.
- Hybrid approaches: Methods that combine elements of various software development models, such as Agile and Waterfall, to tailor the development process to specific project needs.
- Identity verification: The process of confirming an individual's identity, typically through credentials such as passwords, PINs, or biometric data, to ensure that they are who they claim to be.
- Information quality: The degree to which information is accurate, reliable, and fit for its intended use, affecting decision-making and system effectiveness.

- Innovation adoption lifecycle: The process through which an innovation is adopted over time, categorized into stages from innovators to laggards, often depicted as an "S-curve".
- Innovation spread: The dissemination and acceptance of new ideas, technologies, or practices within a population or organization.
- Kiosk: A small, self-service terminal that provides information or services, often used for tasks such as voting, ticketing, or information retrieval.
- Multimodal systems: Security systems that use multiple biometric identifiers, such as fingerprints and facial recognition, to enhance the accuracy and reliability of identity verification.
- Net benefits: The overall value derived from a system or technology, considering both the benefits and the costs associated with its implementation and use.
- NetLimiter: A software application used to control and monitor internet traffic on a network, allowing users to set limits and prioritize bandwidth usage.
- Observability: The degree to which the results of an innovation are visible and measurable to others, influencing its adoption rate.
- Online Purchasing: The process of buying goods or services over the internet, typically through an e-commerce website or mobile application.
- Online travel agencies: Businesses that operate on the internet to offer travel services, including booking flights, hotels, and car rentals, providing convenience and often lower prices.

- Open Agile Software Development Life Cycle (OASDLC): A software development model that integrates Agile principles with open-source collaboration, emphasizing flexibility, transparency, and community-driven development.
- Organizational change: The process through which organizations transform their structures, strategies, and processes to adapt to internal and external shifts.
- Organizational context: The specific circumstances, culture, and environment within an organization that influence how projects and processes are managed.
- Organizational performance: The measure of how effectively an organization achieves its goals, often evaluated through productivity, profitability, and customer satisfaction.
- Passwords: Secret strings of characters used to authenticate a user and grant access to systems, applications, or data, usually required to be kept confidential and regularly updated.
- Perceived usefulness: The degree to which a person believes that using a particular system or technology will enhance their job performance or personal effectiveness.
- PINs (Personal Identification Numbers): Numeric codes used for authenticating a user, often in conjunction with other security measures, to access accounts or systems.
- Predictive models: Mathematical or computational models used to forecast future events or behaviors based on historical data and statistical techniques.
- Project management: The application of knowledge, skills, tools, and techniques to project activities to meet project requirements and achieve desired outcomes.

- Project-specific factors: Unique elements and considerations relevant to a particular project, such as scope, resources, timeline, and stakeholder needs.
- Protective technologies: Tools and mechanisms designed to safeguard data, systems, and networks from security threats, including encryption, firewalls, and intrusion detection systems.
- Quality assurance: The systematic process of ensuring that products and services meet specified requirements and standards through planned and systematic activities.
- Raspberry Pi 4: A small, affordable computer used for a variety of programming and electronics projects, known for its versatility and ease of use.
- Relative advantage: The degree to which an innovation is perceived as better than the idea, program, or product it replaces, influencing its rate of adoption.
- S-curve: A graphical representation of the adoption of an innovation over time, showing initial slow growth, rapid uptake, and eventual leveling off as saturation is reached.
- Security enhancements: Improvements made to existing security measures to increase the protection of data, systems, and networks, often in response to emerging threats and vulnerabilities.
- Security process: Procedures and mechanisms designed to protect data, systems, and networks from unauthorized access, attacks, and damage, ensuring the confidentiality, integrity, and availability of information.
- Service quality: The measure of how well the service delivered matches customer expectations, impacting user satisfaction and overall effectiveness.

- Social embeddedness: The extent to which an innovation is integrated into social practices and networks, affecting its adoption and sustained use.
- Software engineering: The systematic application of engineering approaches to the development, operation, and maintenance of software, ensuring quality and efficiency.
- Spiral model: A software development model combining elements of both design and prototyping in stages, aiming to combine the advantages of top-down and bottom-up concepts.
- System quality: The measure of how well a system performs its intended functions, including aspects like reliability, performance, and ease of use.
- System safety: The overall security and integrity of a system, ensuring it operates as intended and is protected from threats, vulnerabilities, and unauthorized access.
- TAM 2, TAM 3, TAM 5: Extensions of the Technology Acceptance Model (TAM) that include additional factors influencing technology adoption, such as social influence, cognitive instrumental processes, and organizational variables.
- Technological adaptation: The process by which individuals or organizations adjust and modify their practices and processes to incorporate new technologies.
- Technological adoption: The acceptance and integration of new technologies into regular use by individuals or organizations.
- Technology acceptance: The process by which users come to accept and use a technology, influenced by factors such as perceived usefulness, ease of use, and social influence.

- Testing: The phase in software development where the system is evaluated to ensure it meets the required standards and functions correctly, including identifying and fixing defects.
- Tourism industry: The sector of the economy dedicated to the provision of services related to travel and accommodation for tourists.
- Traditional Voting Systems – it means the use of ballot, papers, Google Forms, MS Forms etc. to vote on an election.
- Trialability: The degree to which an innovation can be experimented with on a limited basis before making a full commitment to its adoption.
- Usability: The ease with which users can effectively interact with a system or technology, often assessed through factors such as intuitiveness, efficiency, and satisfaction.
- User behavior: The actions and interactions of users with a system or technology, influenced by factors such as usability, design, and personal preferences.
- User satisfaction: The degree to which users are happy with a system or technology
- Voting System - also known as an electoral system or election method, is a set of rules and procedures used to determine the outcomes of an election. The system specifies how votes are cast, counted, and translated into the election results.

CHAPTER 2

METHODOLOGY

2.1 BLOCK DIAGRAM

2.1.1 System Architecture

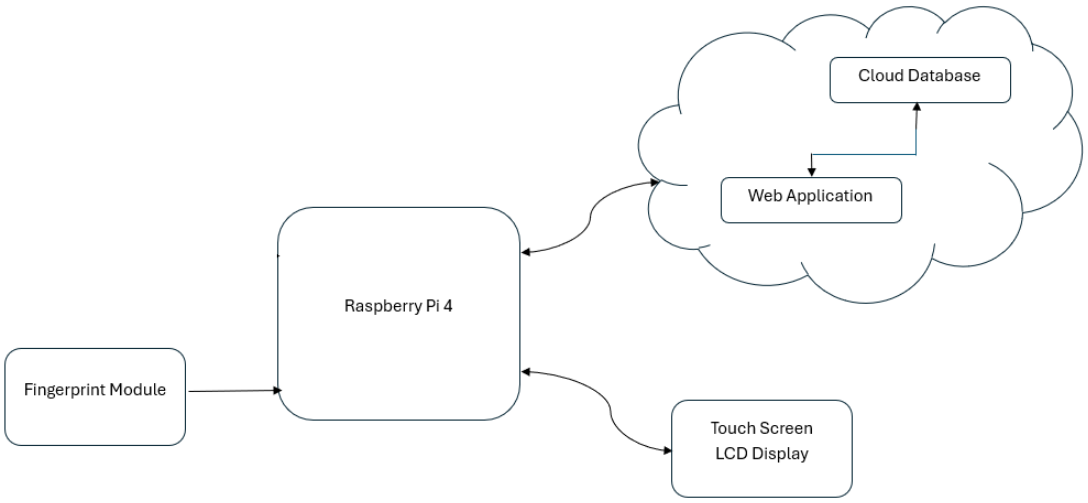


Diagram 1: System Architecture Block Diagram

The foundation of our project is built upon essential components, namely the Raspberry Pi 4, a fingerprint module, and a touchscreen display. The Raspberry Pi 4 acts as the central processing unit, powered by a dedicated supply, overseeing computations, data processing, and the overall functionality of our voting system. Its compact yet robust design makes it the core element, facilitating a seamless voting process.

Integral to our system is the fingerprint module, which plays a critical role in capturing fingerprint images during our user authentication. The incorporation of fingerprint authentication technology enhances security and personalization, elevating the voting experience. The Raspberry Pi 4 connects to the internet through its WiFi Module,

gaining access to our web application and its cloud database. The web application interacts with a cloud database to read and write data.

To offer an intuitive and user-friendly interface, we utilize a touchscreen display. This not only serves as the visual gateway for voters but also ensures an interactive and responsive voting experience. In concert, these components synergize, harmonizing hardware and software to create a robust and accessible voting system.

2.1.2 Web Application

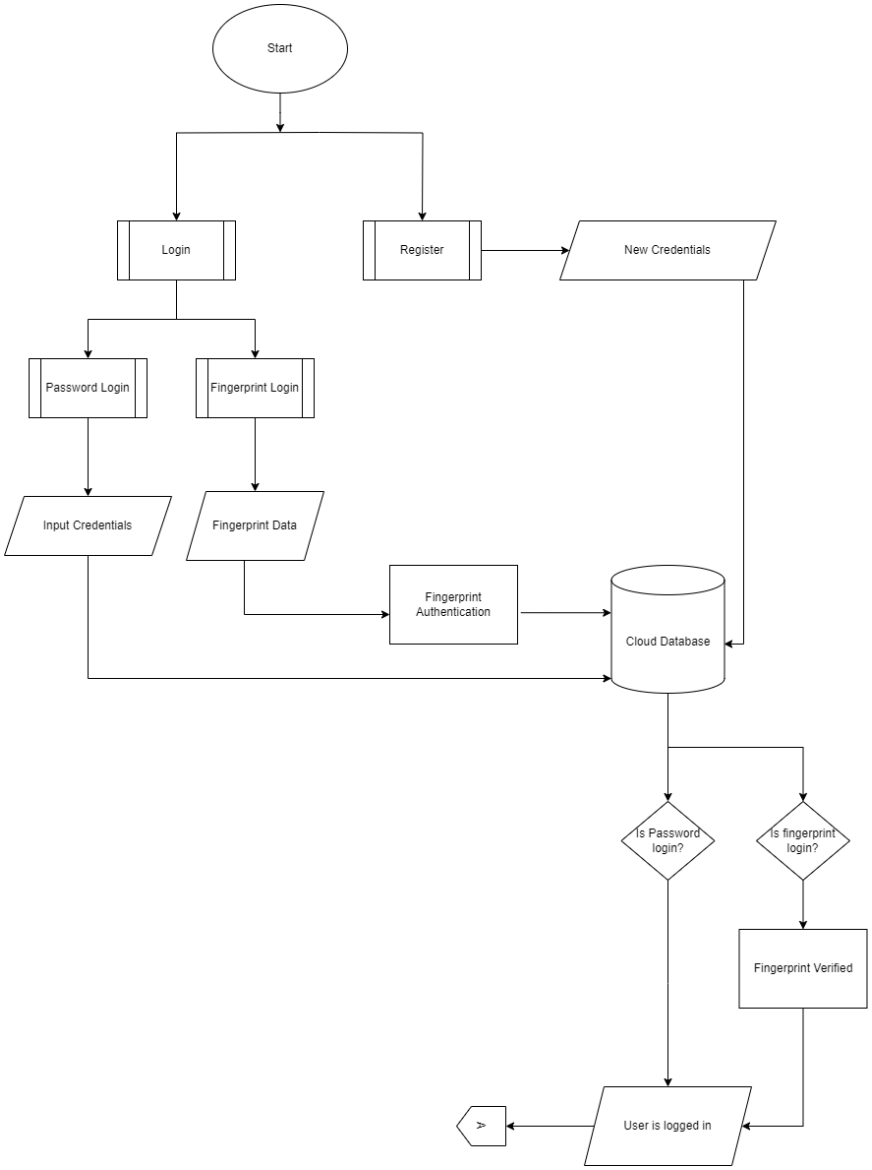


Diagram 2 Block Diagram: User Authentication

In the user authentication process, the initiation begins with accessing the web application. Upon selecting the “register” option within the web application, the user’s credentials are required and are transmitted to a cloud-based database. This database serves as a centralized repository for storing user information securely. Upon successful registration, the user is effectively logged into the system.

Subsequently, when the user opts to "login" to the web application, the user has two options: a password login or a fingerprint login. When the user wants to login using password login the user will then enter his/her credentials then proceeds to login after that they are immediately logged into the web application. When the user wants to login using fingerprint login, he/she will then click a “Scan” button on the login page and then proceeds to authenticate their fingerprint. After authentication when the fingerprint data is validated on the database the user will then be able to login to the web application. This section will only be explaining how the user is authenticated on the login page considering there are two login options.

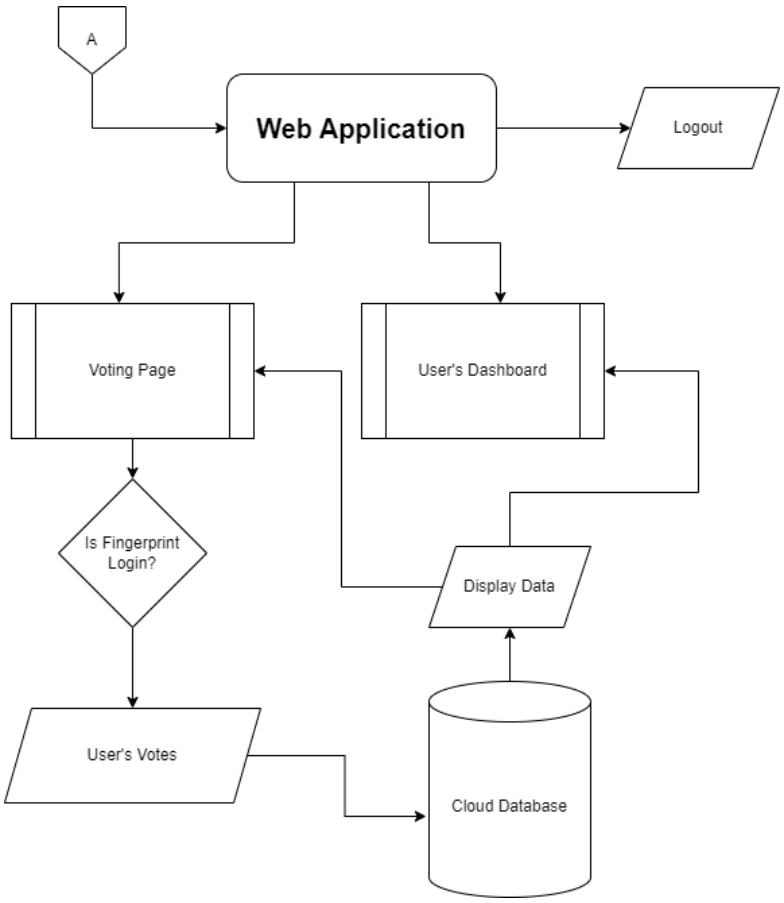


Diagram 3: Block Diagram: User Interface

Upon logging in successfully, users gain access to a comprehensive experience, including the Voting Portal, and User's Dashboard. The Voting Portal serves as the main interface, providing a list of election candidates and the option to cast votes. Before the user can vote on the list, a prompt before the list will ask the users to use a fingerprint login. This process seamlessly integrates with the Cloud Database, securely storing each user's voting choices for election process integrity. Moving to the User Dashboard, users find a personalized space displaying personal information and a detailed voting history, offering transparency into civic engagement. Users also find there live voting session in which there is a progress bar that counts votes. Users also find who is winning in each position of the election. The interaction on the User's Dashboard ensures real-time updates, providing

accurate and timely information. Finally, the Logout Functionality ensures a secure conclusion to user interactions with the system.

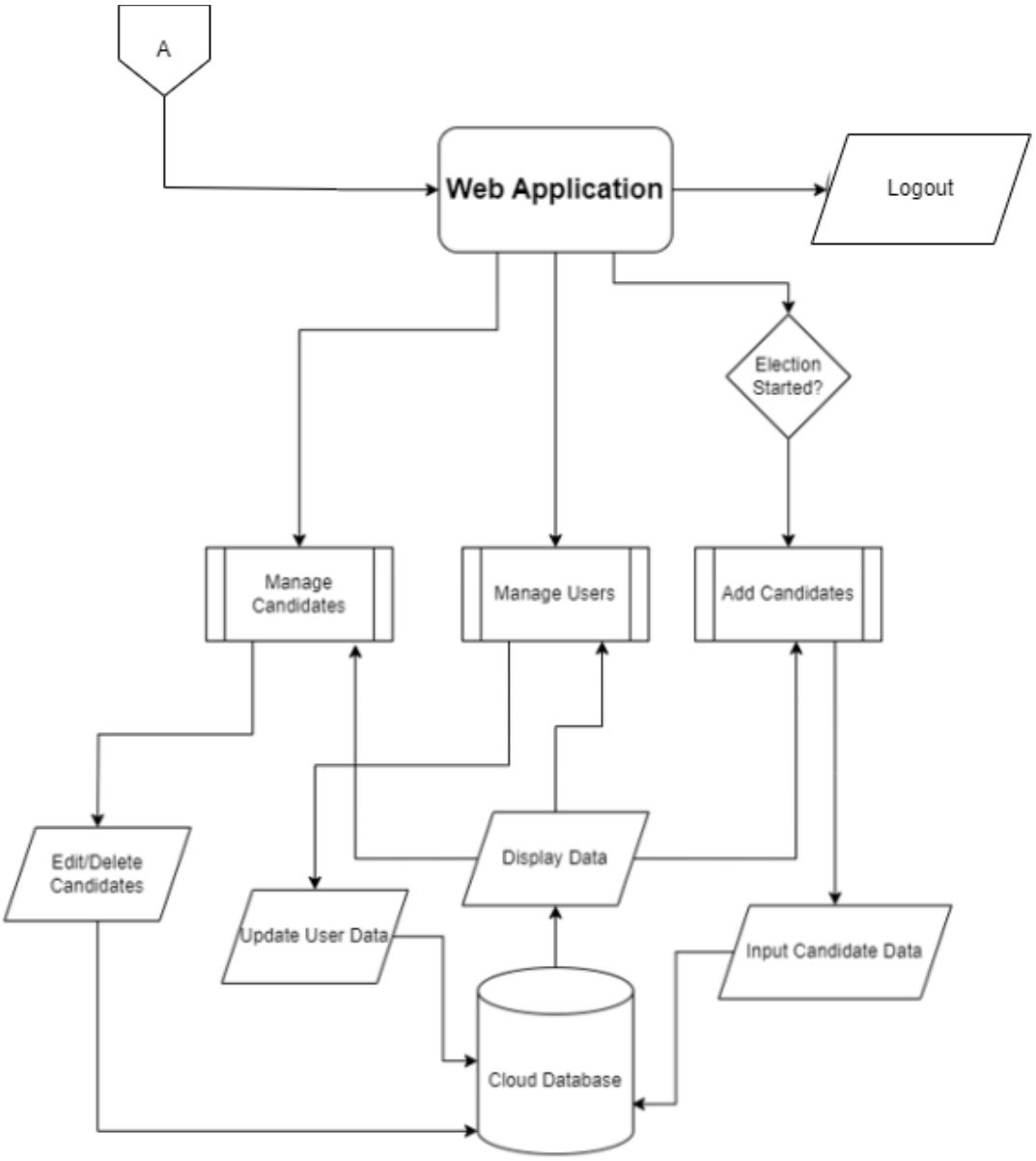


Diagram 4: Block Diagram: Admin Interface

Upon successful login, administrators gain access to a robust suite of tools designed to streamline the election management process. The Manage Candidate page acts as the central hub for administering candidate information, offering a user-friendly platform for

input and management. This ensures a smooth voting experience by efficiently handling the data of candidates running for election. The Manage Users Page empowers administrators with comprehensive oversight of the user base, featuring a detailed list with the ability to update, upload fingerprint or delete individual data as needed. The Add Candidate Page is only allowed when the election is finished or there is no election yet, hence, administrators are able to add candidates with all of their information needed for election. To provide a holistic view of the electoral process, the Dashboard delivers valuable insights into voter participation. It displays key statistics such as the number of voters, non-voters, and a breakdown of votes for each candidate. Finally, the Logout function ensures a secure conclusion to the administrative session, maintaining the integrity of the system. This comprehensive suite of administrative tools underscores a commitment to transparency, user management efficiency, and the seamless facilitation of the election process.

2.2 PROJECT MANAGEMENT

2.2.1 Materials and Resources

Table 1: Materials and Resources

Material/Resource	**Quantity**	**Cost**
Raspberry Pi 4 Model B 4GB RAM Starter Kit	1	₱6989.00
ZFM60 BAK V1.4 Fingerprint Module	1	₱2500.00
7 Inch LCD HDMI Capacitive Touch Screen Display	1	₱2000.00
Building Materials for Kiosk Setup	1	₱2000.00
USB to Serial CP2102 TTL UART	1	₱139.00
Total Cost		₱13,489.00

The Raspberry Pi 4 Model B 4GB RAM Starter Kit offers a comprehensive set of essential components for enthusiasts and developers embarking on diverse projects. Included in the kit are the Raspberry Pi 4 Model B 4GB RAM, the official Raspberry Pi USB-C Power Supply, Micro HDMI to Standard HDMI 1m Cables, a Pi 4 Case with an integrated fan for efficient cooling, a Class 10 microSD Card in varying capacities (16GB, 32GB, or 64GB), and a set of heatsinks.

The Raspberry Pi 4, at the heart of the kit, stands out as a versatile single-board computer. It seamlessly integrates with the Raspberry Pi 8MP Camera module for facial recognition applications. With its built-in WiFi connectivity, the Raspberry Pi 4 facilitates easy access to web applications through standard web browsers.

For enhanced user interaction, a 7 Inch LCD HDMI Capacitive Touchscreen Display is used. This display empowers users to visualize and interact with web applications directly on the touchscreen.

Miscellaneous costs are the additional expenses to be incurred for building the kiosk setup of the project that will provide portability and framework of the project.

2.2.2 Gantt Chart

Figure 2.2.2 Gantt Chart

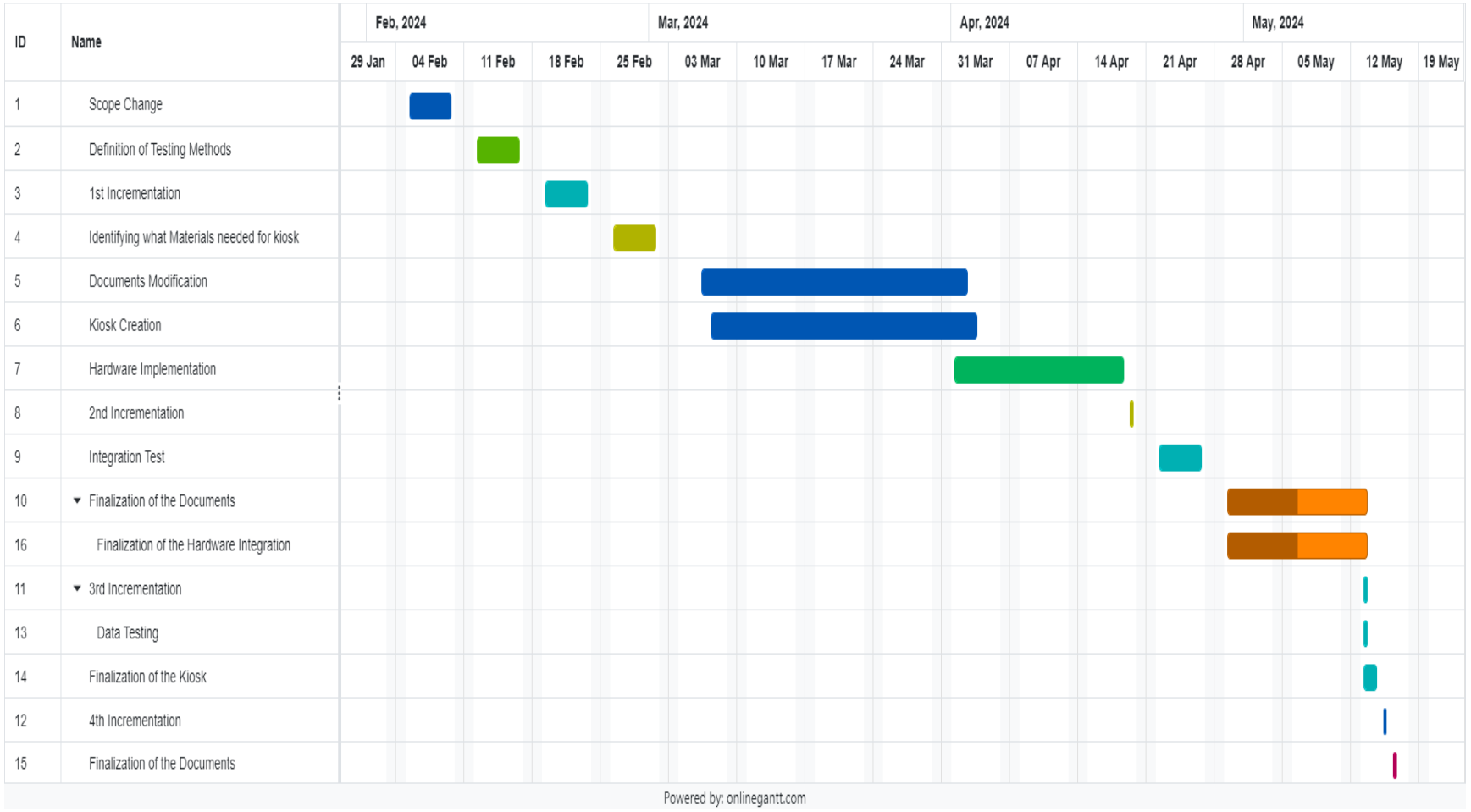


Figure 7: Gantt Chart

2.2 PROTOTYPE DESIGN

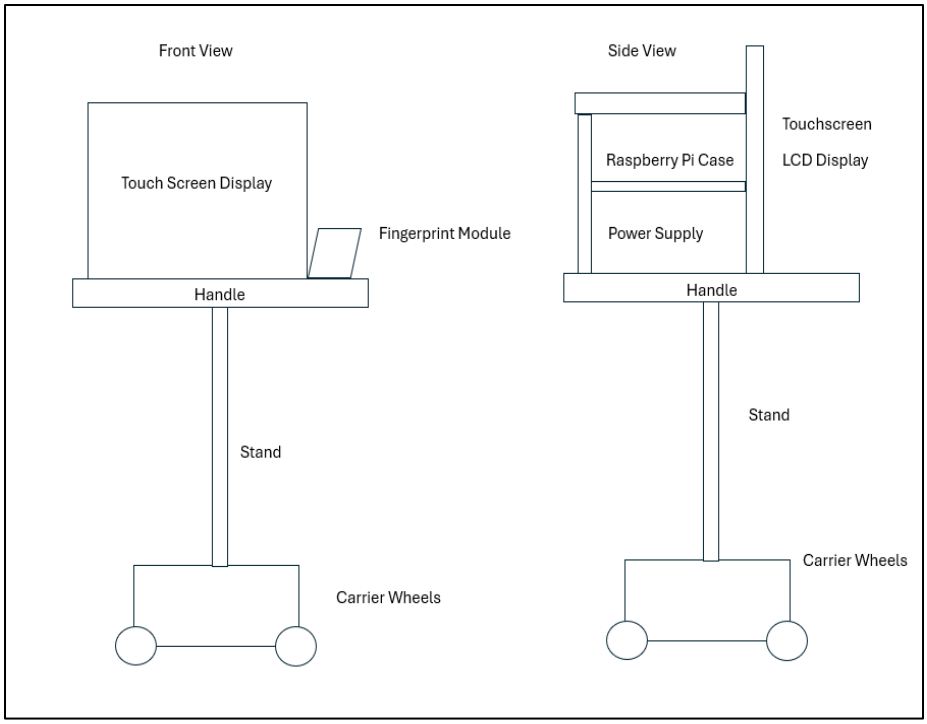


Figure 8: Kiosk Prototype Design

Figure 9: Actual Prototype Design

The WildVote Kiosk is meticulously crafted to offer a seamless and versatile voting solution. Its design features a robust base equipped with caster wheels, ensuring not only stability but also effortless portability. The inclusion of a stand adds further support,

creating a sturdy foundation for the kiosk. A thoughtfully designed handle shelf strategically holds the main components, providing an organized and secure space for the touchscreen LCD display, the powerful Raspberry Pi system, and the reliable power supply. The Fingerprint Module is positioned beside the LCD display, ensuring easy fingerprint scanning.

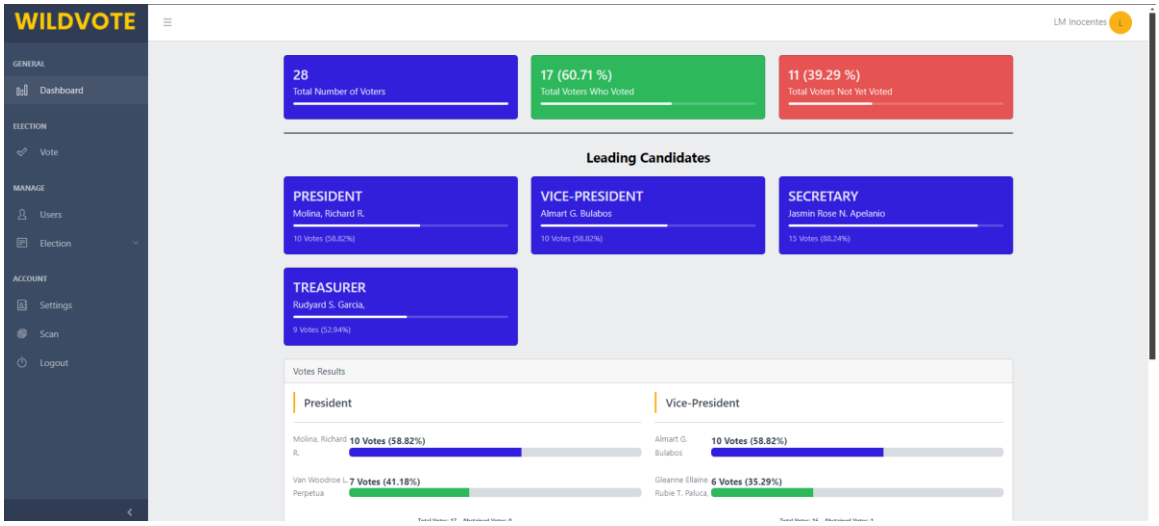


Figure 10: Web App Prototype Design: Admin Dashboard

The Web application is designed using an Angular framework with a backend that runs using Node.js. Once you access the web app as you can see here the Dashboard consists of a Total Number of Votes, Who Voted, and a Not Yet Voted and leading candidates and the vote counts of each candidate. The Dashboard shown on the figure here is the Admin Dashboard though even if a user/admin is not logged in, the dashboard is accessible for everyone. Database used on the dashboard is the Real-time database of Firebase.

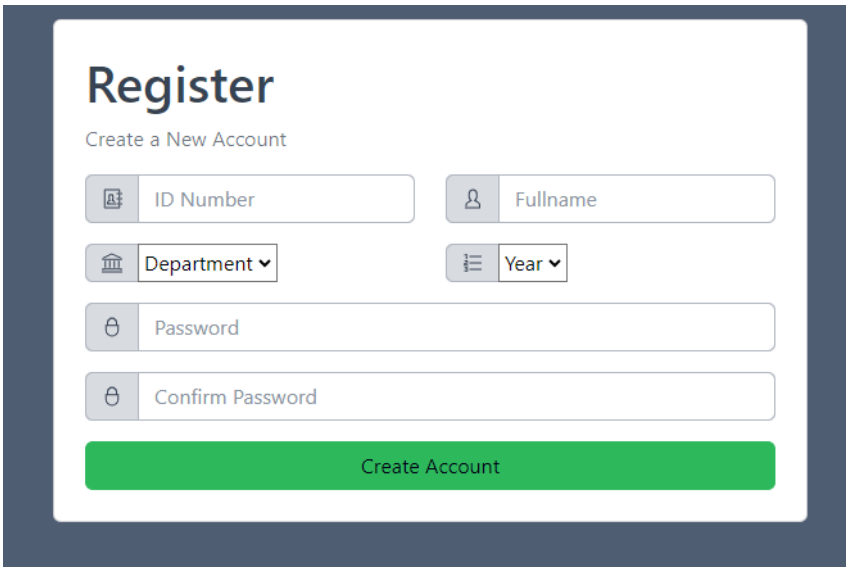


Figure 11Web App Prototype Design: Registration

The Registration Page here consists of an ID number, Full Name, Password, and Confirm Password fields with two drop-down menus for Department and Year. In this page users must fill all the required information to register an account for them to log in into the application.

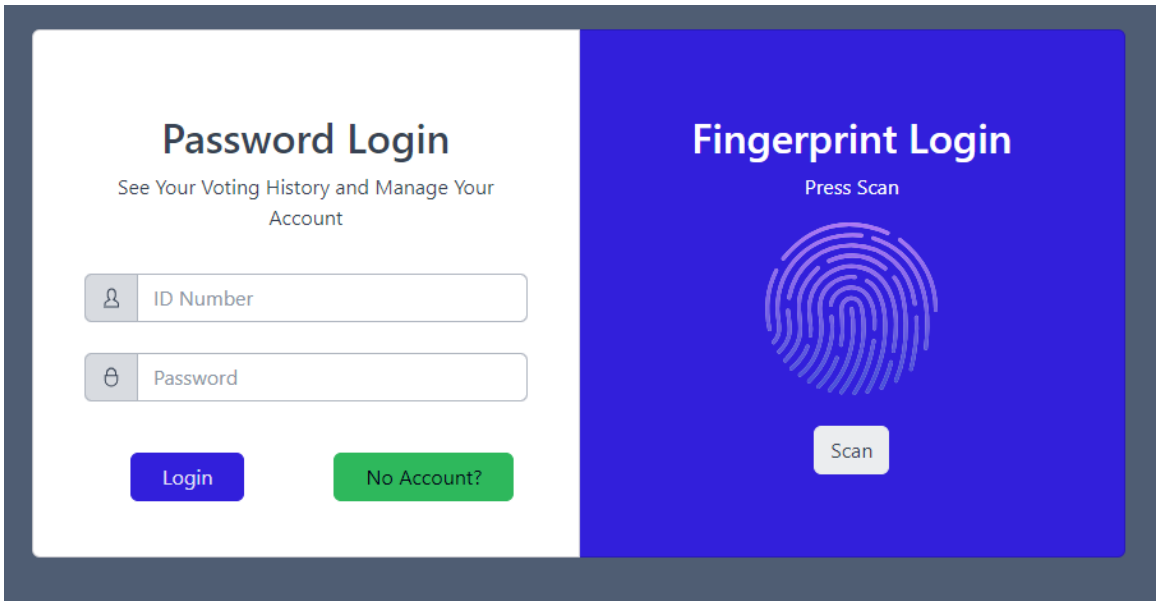


Figure 12: Web App Prototype Design: Password Login and Fingerprint Login

The Login Page here consists of two ways which is Password Login and Fingerprint Login. In the Password Login users are required to input the registered ID number and their password and then press login to proceed into the application. In the Fingerprint Login, users will click the scan button and can proceed to login using their fingerprint. Once the fingerprint is authenticated a login button will show and users can click the button to proceed into the application.

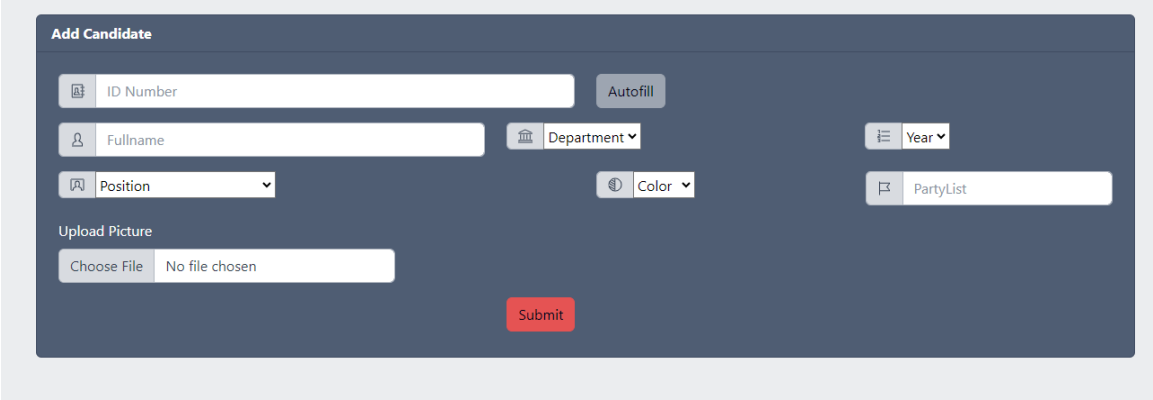


Figure 13: Web App Prototype Design: Add Candidate

In this page, Administrators can add candidates by collecting information of the candidates of their ID Number, Full Name, Position, Department, Color, Year, Party List, and a Picture to be Uploaded. Once the administrator clicks submit, they have successfully added that specific candidate.

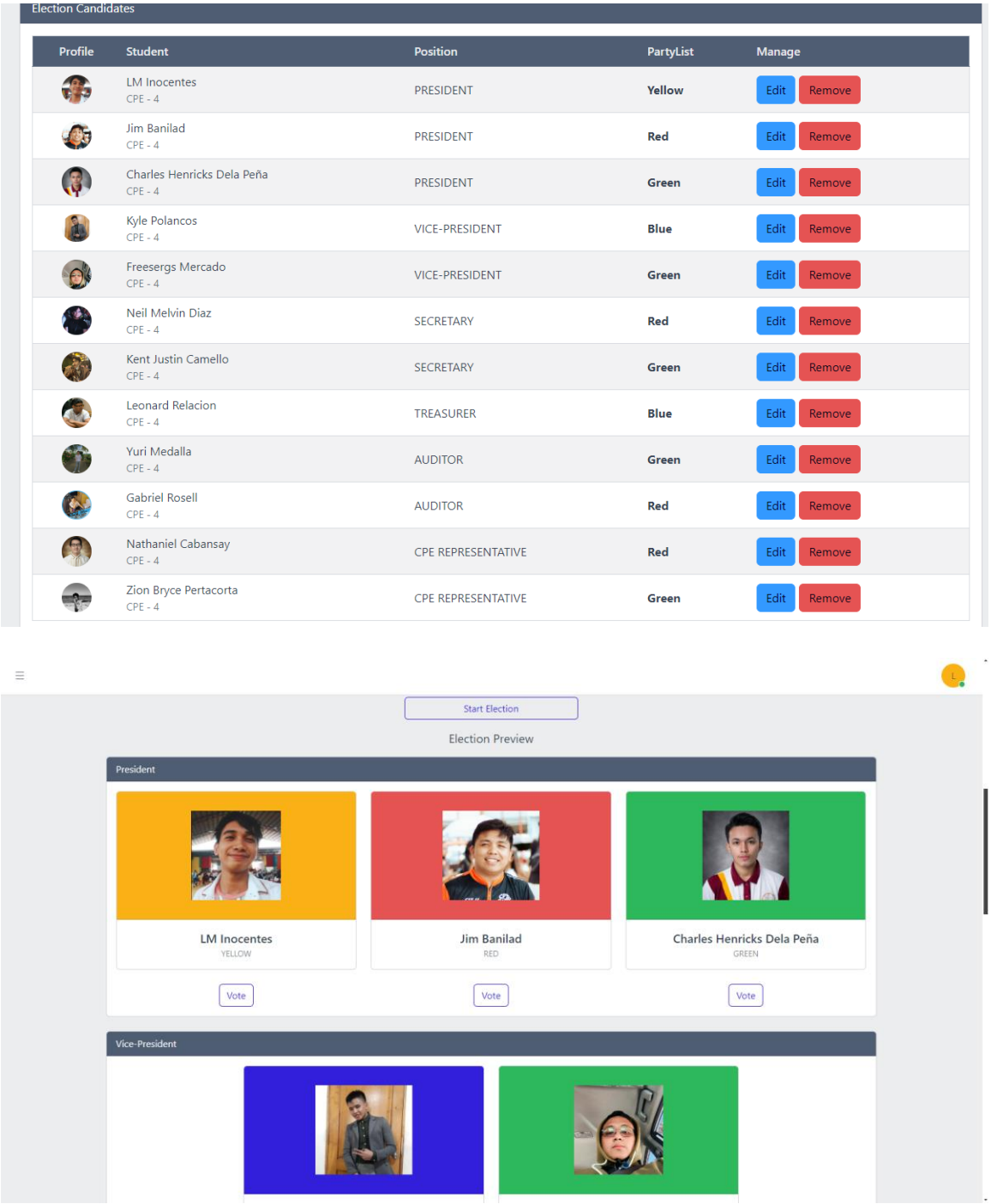


Figure 14: Web App Prototype Design: Manage Candidate

In the Manage Candidate section, administrators are shown with all the lists of the candidates running in the election. Administrators can know what their names are, the position they are running for, and their party list. Administrators are also able to edit or delete a candidate and start or end an election. They are also shown with an election preview where it shows the preview of the voting page for users.

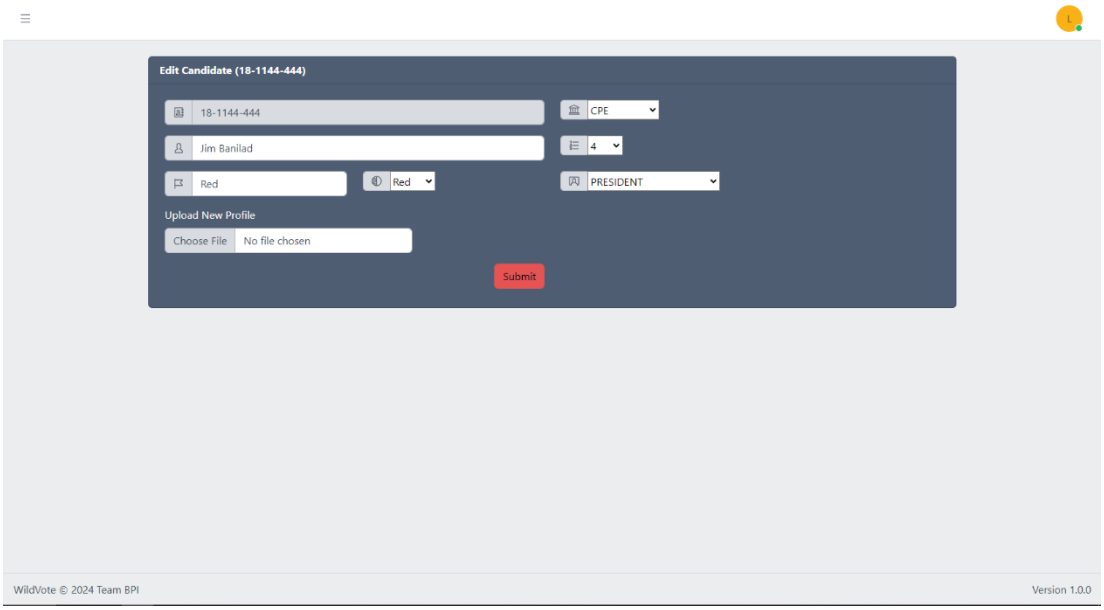


Figure 15: Web App Prototype Design: Edit Candidate

In this Edit Candidate section, administrators are shown with the candidates ID number, Full Name, Color, Party List, Department, Year Level, Position and Uploading their Pictures. Administrators can edit the candidates Full Name, Party List, Color, Department, Year Level, Position and their Reupload their Pictures.

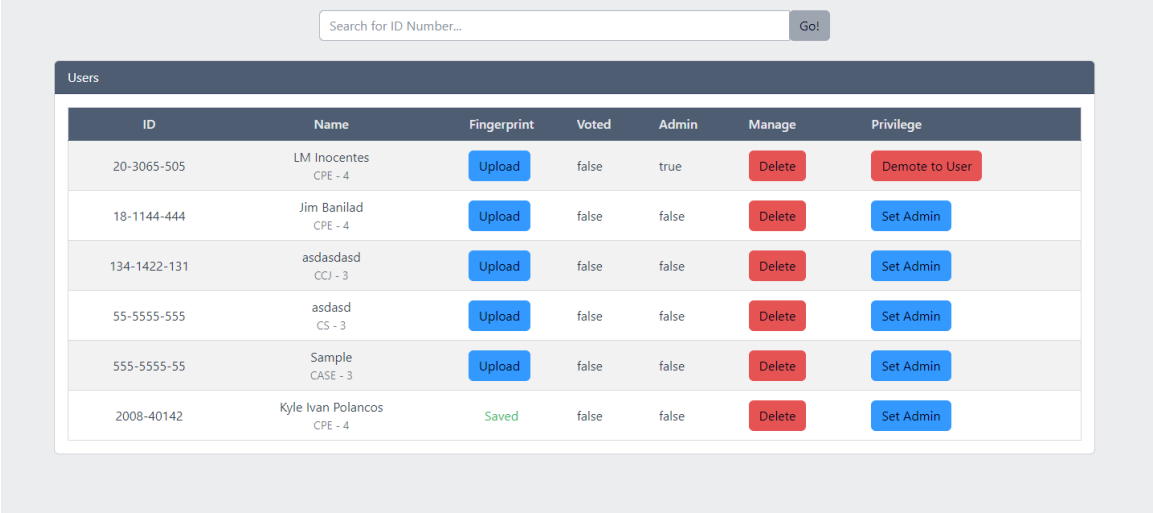


Figure 16: Web App Prototype Design: Manage Users

In the Manage Users section, administrators are shown with all the users registered in the system with their ID, Name, Fingerprint Upload, Voted, Admin, manage by deleting, and a Privilege to promoting into an admin or demoting into a user. In the Fingerprint Upload each of those buttons is a specific upload button for when a user wants to scan their fingerprint and save it into the system.

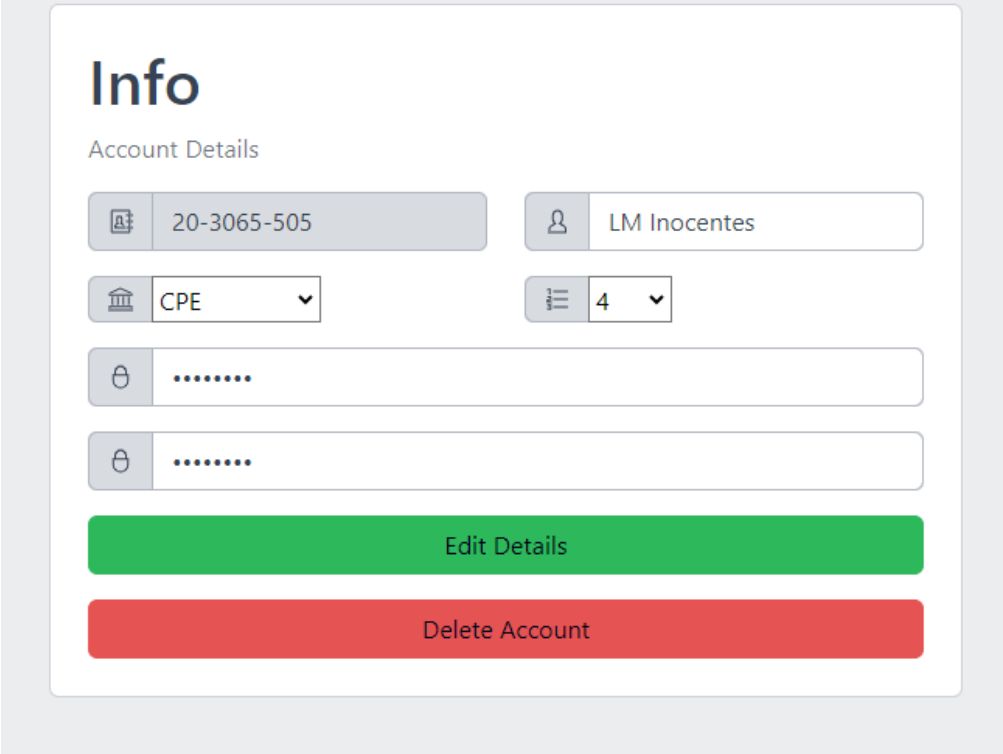


Figure 17: Web App Prototype Design: Account Settings

In the Account Settings section, all voters/students and admin alike are shown with fields of their Full Name, Department, Year Level, and their Password. In this section all users in the system can edit their Full Name, Department, Year Level, and their very own Password. Once they are done, they can simply press Edit Details and it will update in the system. Unfortunately, in this page of the web application, voters/students and admin alike are not able to edit/update their fingerprints.

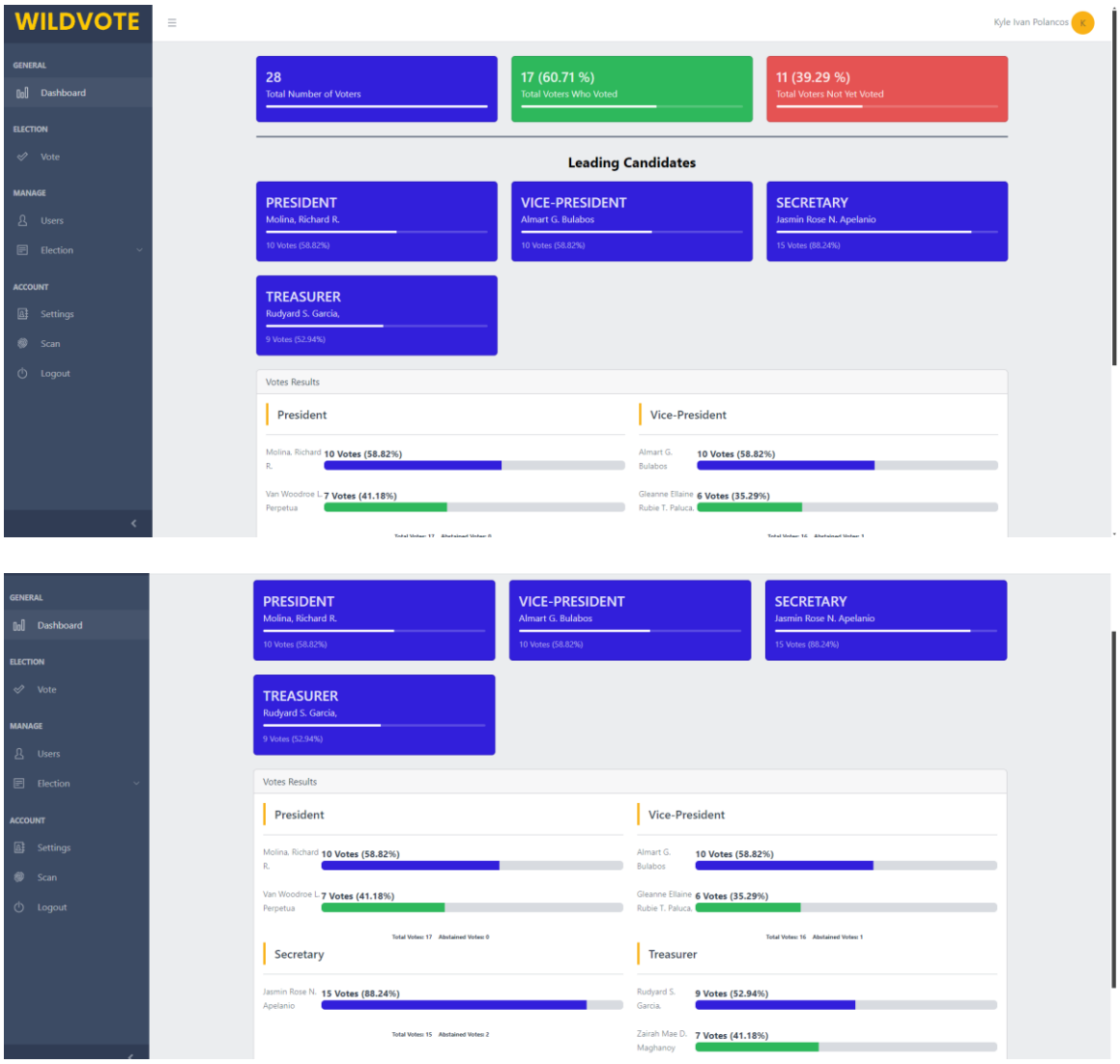


Figure 18: Web App Prototype Design: Dashboard

In the Dashboard, the researchers provided all the necessary details on a voting experience to have. Here in the dashboard, we have all the total of number of voters, total number of voters who have voted, and total number of voters who have not voted. Below are the leading candidates, here it shows which candidate is leading in each position of the election. Below the leading candidates is the Votes Results, in each position here it shows both candidates on how much votes they have and below it is the total number of votes and abstained votes.

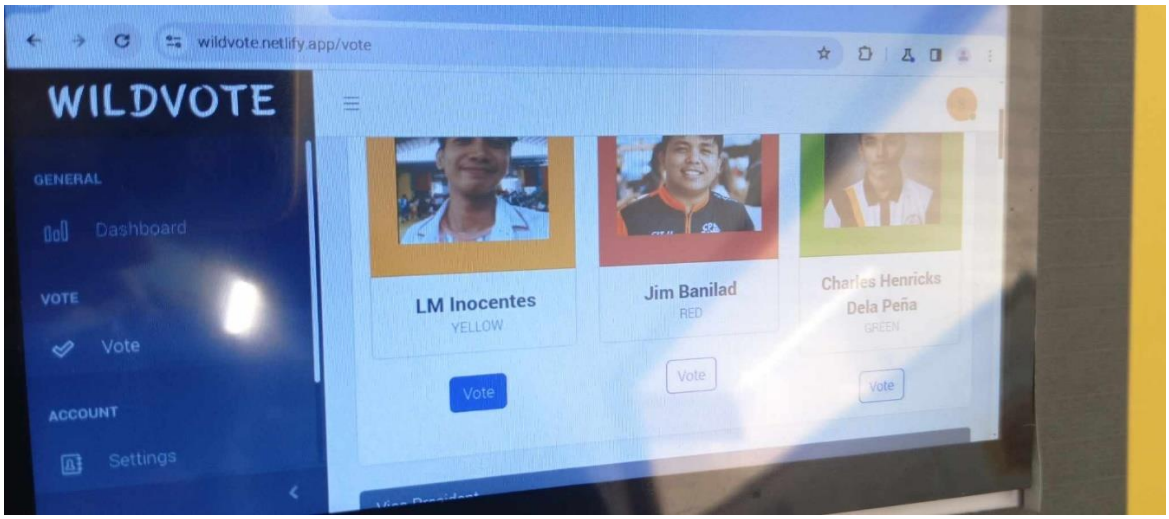


Figure 19: Web App Prototype Design: Voting Page

The Voting Page shows all of the candidates a user can vote for each position. In here they can either vote for their candidate or not, because the users have the right to vote or not. After they have selected their votes on the page, they will now submit their votes and will not be able to vote again. An additional note on this page, this page will not be able to get access to if you did not log in through the kiosk as we have set it for the users to log in using the fingerprint login on the login page.

2.3 CIRCUIT DESIGN

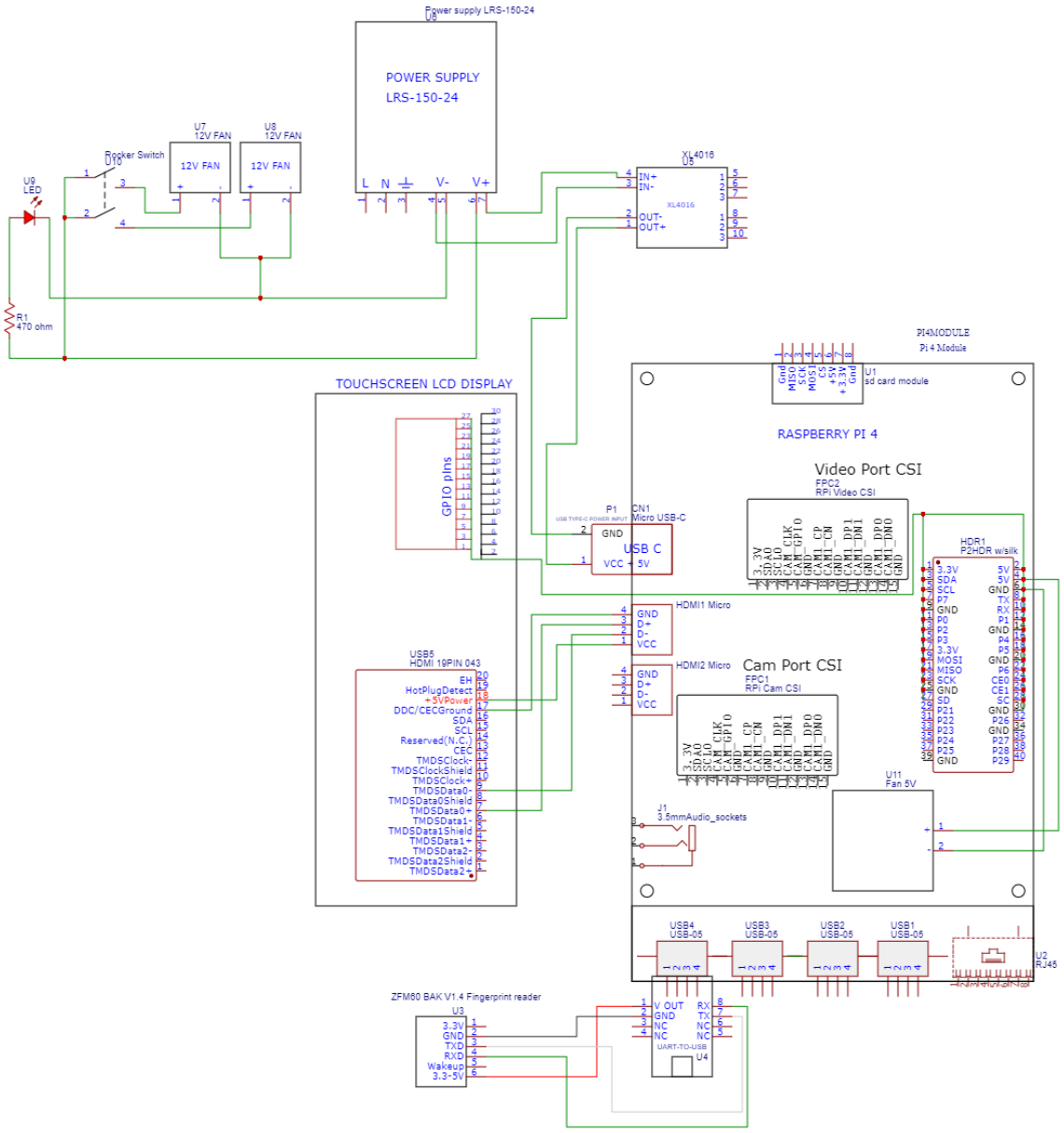
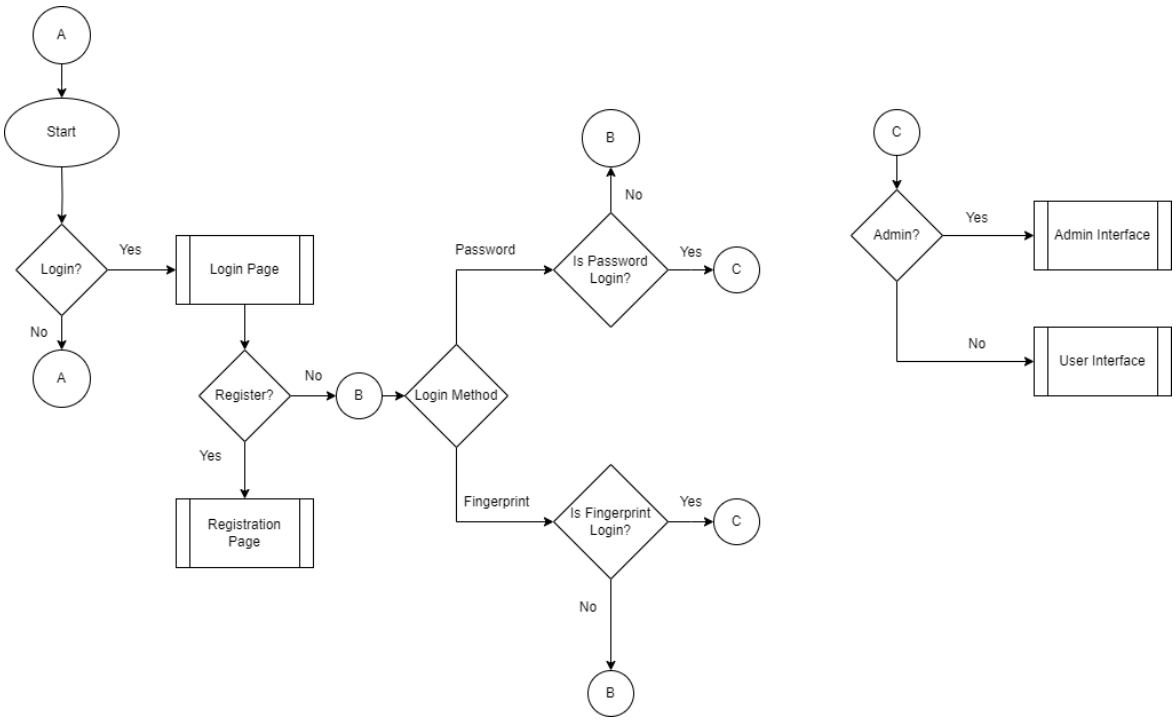


Diagram 5: WildVote Circuit Design

The 7-inch LCD touchscreen display establishes connectivity with the Raspberry Pi through GPIO pins, serving a dual purpose by receiving power through this connection. In addition, an HDMI to micro-HDMI cable facilitates data display, linking the LCD screen with the Raspberry Pi 4. This cable ensures seamless communication and display of content between the two components. Meanwhile, the ZFM60 BAK V1.4 Fingerprint Reader is

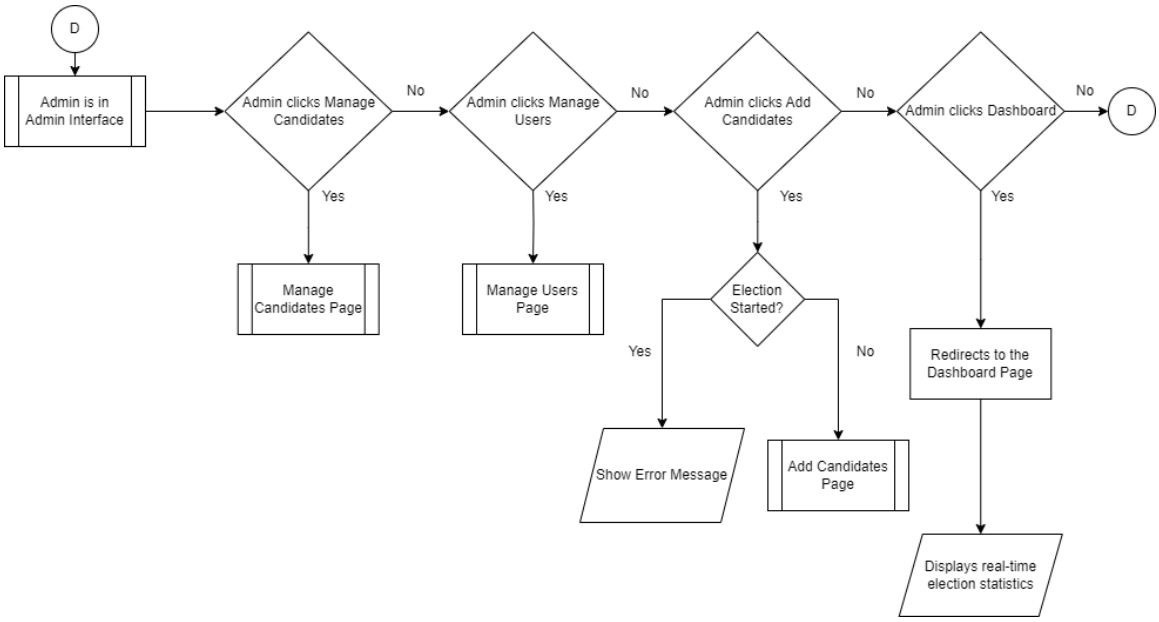
connected to a UART USB Cable to stabilize the module's connection to the Raspberry Pi 4. The researchers wanted to use that cable because we wanted to keep the Raspberry Pi 4 in its casing. The power required for the Raspberry Pi 4 to turn on is only 5V and 3A, so what the researchers did here is connect to a 12V power supply and pass it through a step-down buck converter with efficient adjustments of 5V and 3A to supply the Raspberry Pi 4 with power through its correct voltage and ampere. This setup ensures the safety and efficiency of the power supply. As for the back side of our kiosk, we have here two fans connected, both positively connected to the Rocker Switch, and the Rocker Switch is connected to the positive side of the 12V power supply; the two negative or ground wires of the fans are connected directly to the negative side of the power supply. Lastly, an LED is connected to a 470 ohms resistor to minimize the voltage the LED uses. The LED also checks whether power is supplied through all the wiring.

PROGRAM FLOWCHART



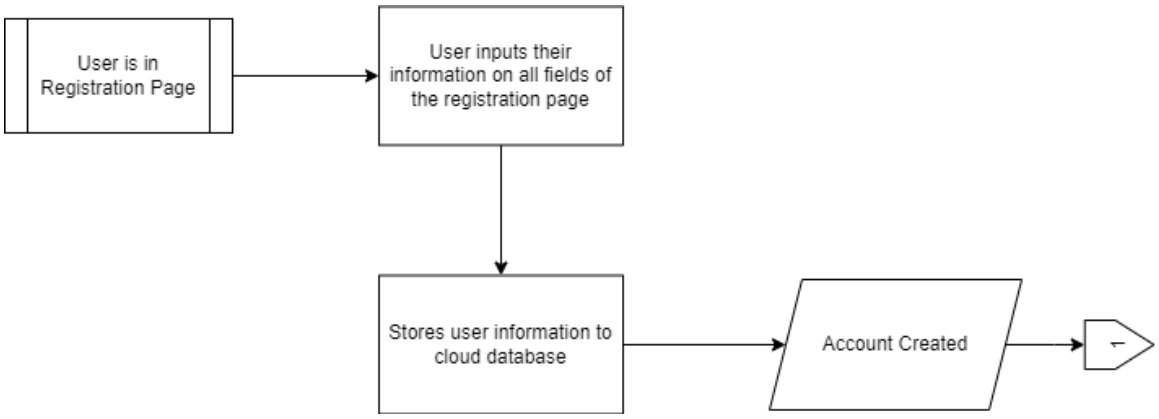
Flowchart 1:Web Application Flowchart

In the Web Application Flowchart, everything here shows as to how it starts and how a user or administrator goes to the Login Page, Registration Page, Admin Interface, and User Interface on the Web Application. It starts with opening the web application and the user or admin clicks the Login button on the Navigation Pane in the Dashboard Page and proceeds to the Login Page. On the Login Page, there is button called “No Account?” so we are just going to refer to this as “Register?”. If the user or admin wants to click the Register button, it will redirect them to the Registration Page. If not, then the user or admin will just proceed to the Login Methods shown on the Login Page whether it is a Password Login or a Fingerprint Login. Once they have attempted to login, the system checks whether the account or fingerprint is an admin or not. If it is an admin it will proceed to the Admin Interface and if it is a user, it will go to the User Interface.



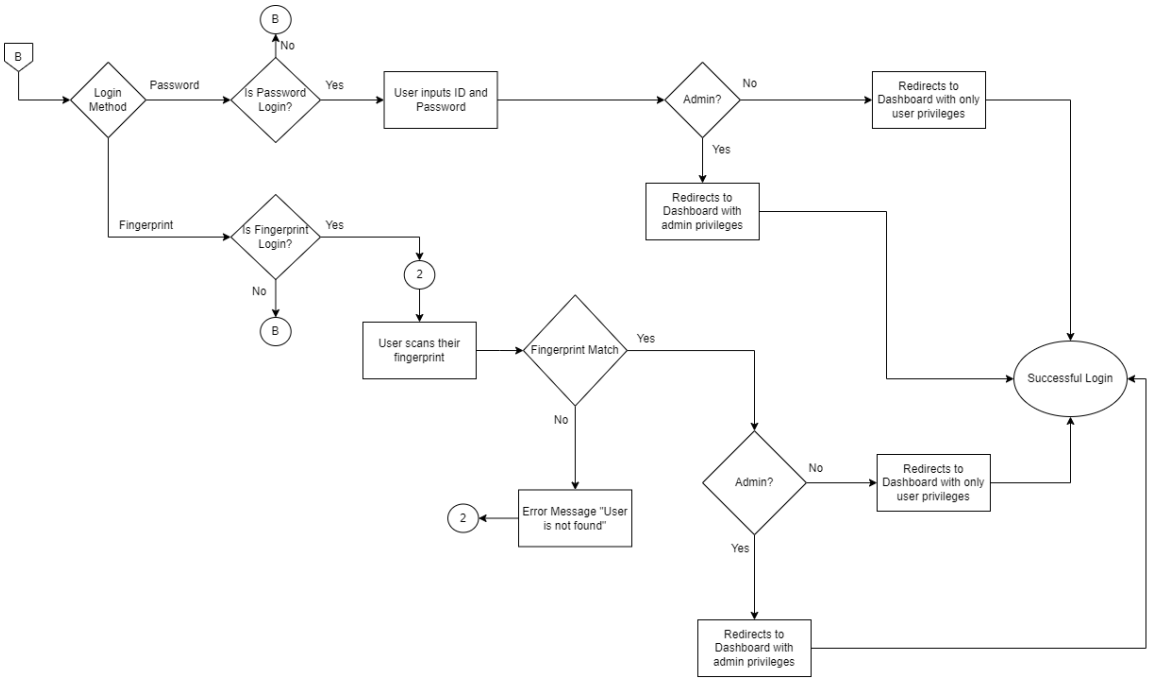
Flowchart 2: Admin Interface Flowchart

In the Admin Interface, if the user selects the "Manage Candidates", it will redirect them to the Manage Candidates Page. If the user selects "Manage Users", it will redirect them to the Manage Users Page. If the user selects "Add Candidates", it has a condition if the election has started or not. If yes, it will show an error message that there is still an election ongoing. If not, then it will redirect them to the Add Candidates Page. If user selects "Dashboard" it will redirect them to the Dashboard Page and then the dashboard displays all the real-time election statistics.



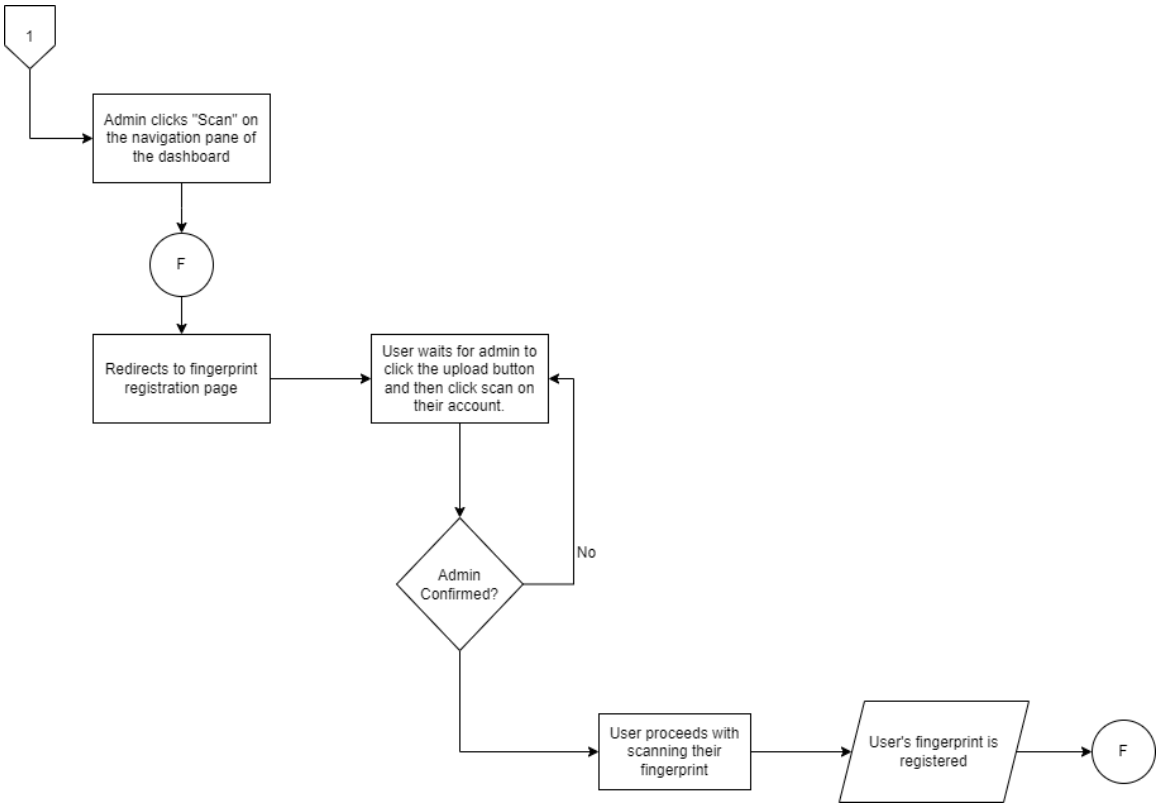
Flowchart 3: Registration Flowchart

For the registration, first users are on the registration page, after that they input all their information on all the fields of the registration page. After inputting their information, the cloud database immediately stores their information then the Account is Created.



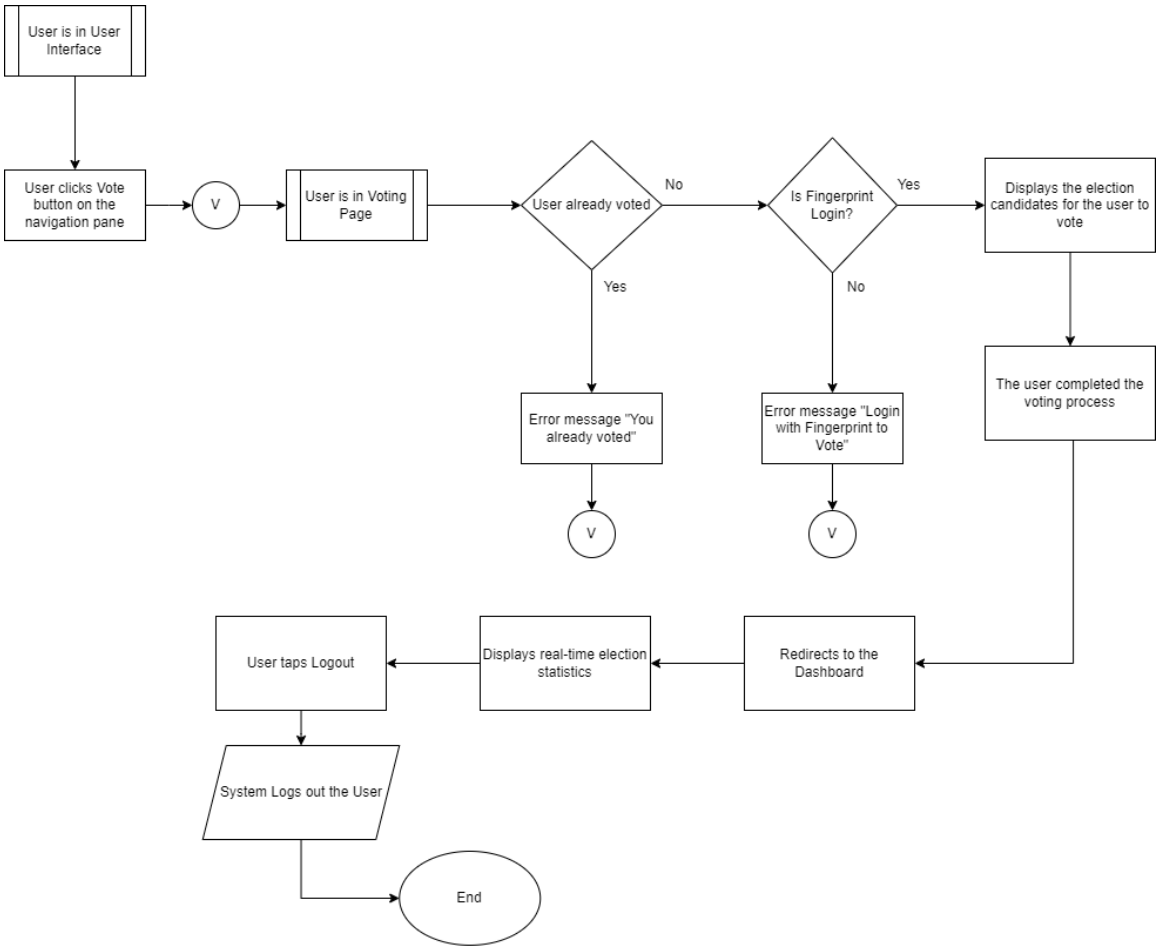
Flowchart 4: Login Flowchart

The Login Page has two options password login and fingerprint login. Password login is only accessed through a PC or a mobile device. In this section of logging in, the user inputs their ID and password and submits it, after that if it's an admin it will redirect them to the dashboard will admin privileges, however, if it's only a user it will redirect them to the dashboard with only user's privileges then a successful login is done. Fingerprint login is only accessed through our kiosk. In this section of logging in, the user scans their fingerprint first then the system identifies whether the fingerprint has a match or not. If the fingerprint match is a success, the algorithm of logging in is same on password login whether if you are an admin or a user, however if the match is invalid it will show an error message that no such user is found.



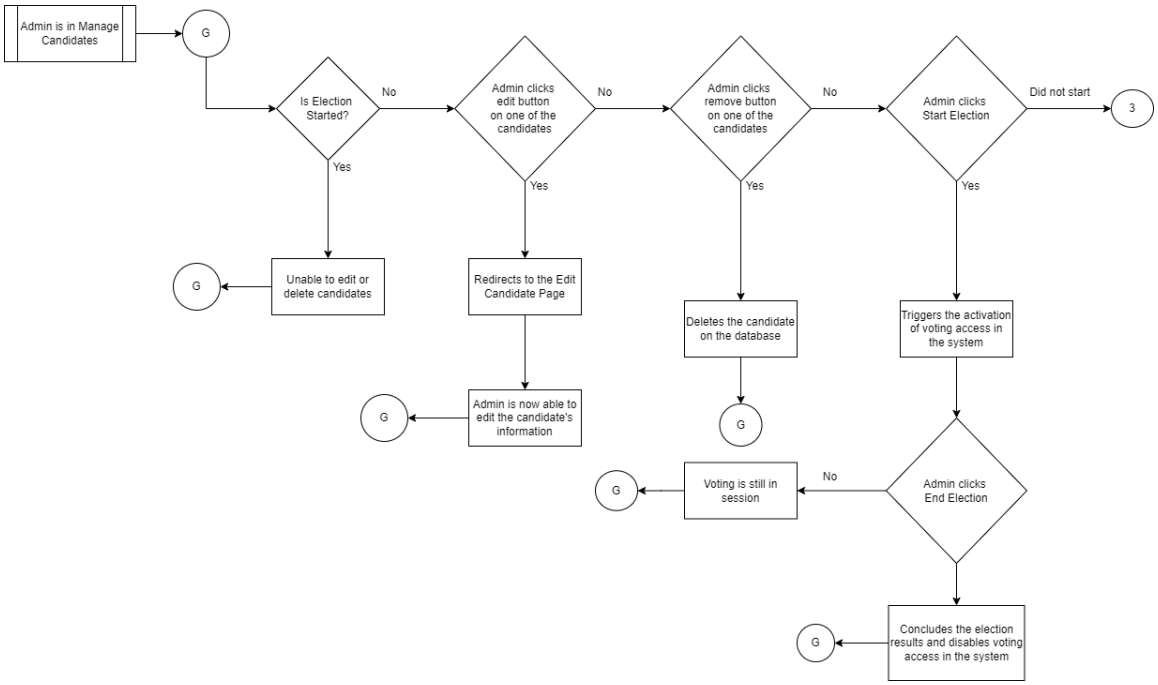
Flowchart 5: Fingerprint Registration Flowchart

For the fingerprint registration, once an account has been registered by the user, an administrator will click on the “Scan” button on the navigation pane of the web application. It will then redirect them to the fingerprint registration page. Users will then wait for the confirmation of the admin if they have selected their account for fingerprint registration. When it is confirmed, the user can proceed in scanning their fingerprint. After they have scanned their fingerprint, the system will save it into the database then the fingerprint is registered.



Flowchart 6: Voting Flowchart

In the Voting Portal, if the user has not voted, it will confirm if the logged in user is using fingerprint as login. If the user is using fingerprint login, it will display the election candidates for the user to vote. After the voting process is done, they will be redirected to the dashboard, and it will display their real-time election statistics and their votes. After that user logs out then the system will log the user out and another user will use.



Flowchart 7: Manage Candidates Flowchart

In the Manage Candidate flowchart, a list of existing candidates is displayed. The system checks if an election has started. If so then admin will not be able to click any of edit or delete but can still end an election. If there is no election, admin can edit or delete the candidates. If the admin clicks the edit button it will redirect them to the edit candidate page and allow them to edit a selected candidate. If the admin clicks the delete button, the candidate will then get deleted on the database and it will get removed from the list. For election control, 'Start Election' triggers the activation of voting access, while 'End Election' concludes the election results and disables voting access.

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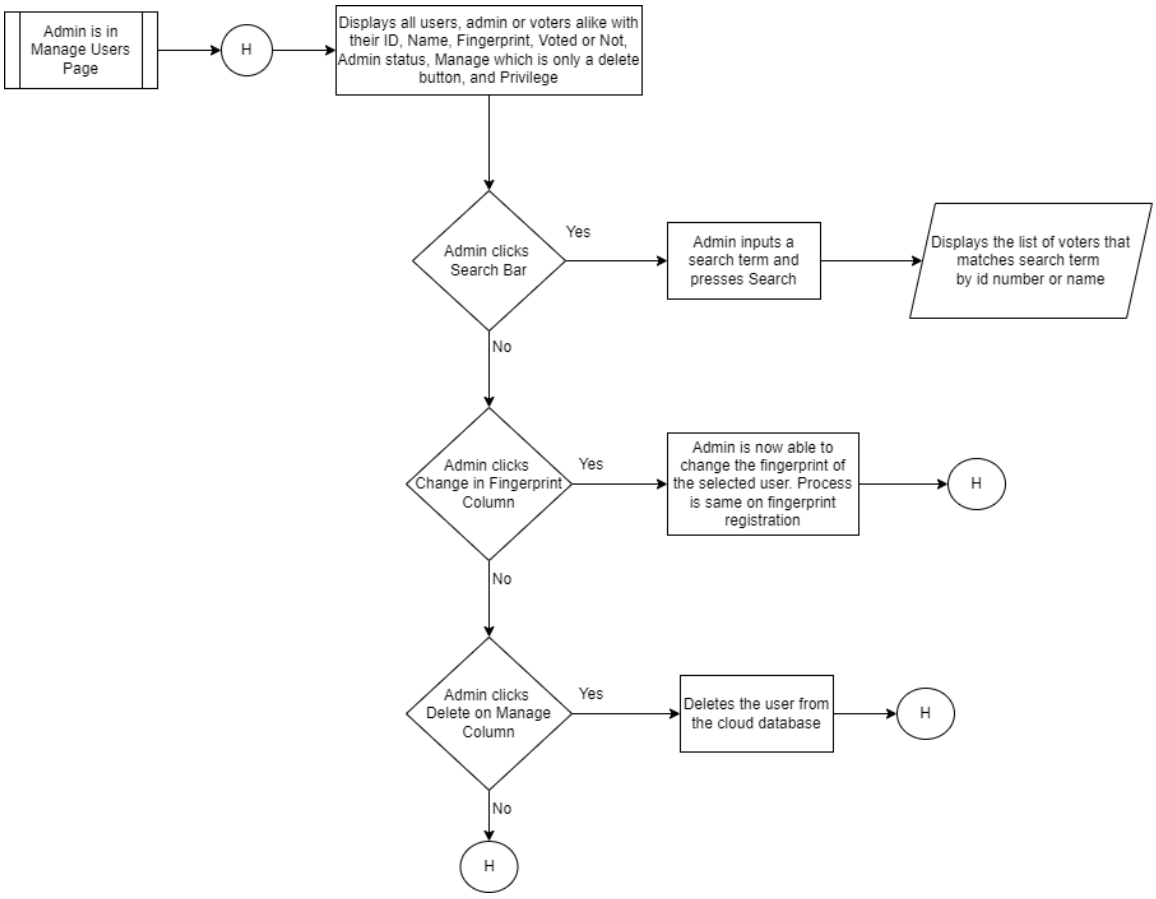

Flowchart 8: Manage Users Flowchart

In the Manage Users Flowchart, it starts with displaying all information of all voters and admins alike with their ID, Name, Fingerprint, Vote Status, Admin Status, Delete, and Privilege. If admin clicks Search Bar, it allows them to input a search term and when Search is pressed, it displays a list of voters that matches the search term by id number or name. If admin clicks Change in Fingerprint Column, they are now able to change the fingerprint of the selected user and the process of changing is the same as the registration process. If admin clicks Delete on the Manage Column, it will automatically deletes the user from the database and will not be shown on the list anymore.

2.4 TESTING AND DATA GATHERING

2.5.1 Unit Testing Strategy

Objective: To ensure that each individual part of the code functions is expected when isolated from the rest of the code.

Feature:

Login Page

Test Cases:

- Open the login page.
- Fill out Login ID and password field with correct credentials.
- Fill out Login ID and password field with incorrect credentials.
- Clicking the scan button on the fingerprint login.
- Clicking the login button on the fingerprint login.

Expectations:

- Page has a Password Login in which it consists of an ID and password fields, and a fingerprint login.
- User logged in.
- Shows error message.
- Shows the Login button.
- Attempts to login the user after the fingerprint is scanned.

Register Page

Test Cases:

- Clicking “No Account?” button on the login component
- After filling up the fields and clicking “Create Account” button.

- Unable to fill up the fields and clicking “Create Account” button.

Expectations:

- Shows the Register Page. Page has an ID, Fullname, Department, Year, Password and Confirm Password Fields.
- Shows a successful registration message.
- Shows error message.

Vote Page

Test Cases:

- Clicking “Vote” button with saved fingerprint.
- Clicking “Vote” button without saved fingerprint.

Expected:

- Shows the candidates for the user to vote.
- Shows a message to user which requires them to scan their fingerprint first.

Manage Users (Admin Side)

Test Cases:

- Clicking “Users” button

Expected:

- Shows a list of users.

Manage Candidates (Admin Side)

Test Cases:

- Clicking the “Manage Candidates” button.

Expected:

- An Admin can see a list of students, able to see a preview of the election, and able to start and end an election.

Add Candidates (Admin Side)

Test Cases:

- Clicking the “Add Candidates” button without an election ongoing.
- Clicking the “Add Candidates” button with an election ongoing.
- Clicking the “Submit” button without filling up the required fields.
- Clicking the “Submit” button with filling up the required fields.

Expected:

- Admin can add candidates.
- Admin is unable to add candidates.
- Shows the error message.
- Successfully adding a candidate.

2.5.2 Network Testing Strategy

Objective: To assess system performance by measuring the time it takes for a page to load under various internet speeds, ensuring responsiveness meets the acceptable criteria of 1-10 seconds.

Test Cases:

- **Internet Speed Variability Tests:**
    - **Description**: Measure the time taken for the Dashboard page to load at different internet speeds.

- **Speeds**: 10 kbps, 20 kbps, 30 kbps, 40 kbps, 50 kbps, 60 kbps, 70 kbps, 80 kbps, 90 kbps, 100 kbps.
- **Expected Result**: Time taken should be within 1-10 seconds.
- **Pass/Fail Criteria**: Pass if the load time is within 1-10 seconds for each speed tested.

2.5.3 End-to-End Testing Strategy

Objective: To ensure that the entire workflow of the system operates correctly from start to finish.

Test Cases:

1. **Registration Test**
    - **Description:**
        1. Users access the website with their working PCs/Laptops/Mobile Phones.
        2. Click the Login button.
        3. Click the "No Account?" button.
        4. Fill up the necessary details.
    - **Expected Result:** User is now registered to the system.
    - **Pass/Fail Criteria:** Pass if the user is successfully registered.
2. **Password Login Test**
    - **Description:**
        1. User fills up the ID and password fields.
        2. Click the Login button in the navigation pane.
    - **Expected Result:** User is now in the dashboard but unable to vote.

- **Pass/Fail Criteria:** Pass if the user is redirected to the dashboard and cannot vote yet.

3. **Fingerprint Login Test**
    - **Description:**
        1. User clicks the Scan button.
        2. Scan their fingerprint.
        3. System authenticates the fingerprint.
        4. User can proceed to vote.
    - **Expected Result:** User is now in the dashboard and able to vote.
    - **Pass/Fail Criteria:** Pass if the user can access the dashboard and vote successfully after fingerprint authentication.
4. **Vote Test**
    - **Description:**
        1. User logs in using the fingerprint login.
        2. User is now in the dashboard.
        3. Proceed to click Vote button in navigation pane.
        4. Proceeds select their desired candidate.
        5. After selecting, proceeds to click the vote button.
    - **Expected Result:** User has successfully voted and is able to see his/her votes.
    - **Pass/Fail Criteria:** Pass if the user has successfully voted and able to see his/her votes.
5. **Real-time statistics Test**

- **Description:**
    1. Admin logs in using the password login.
    2. Admin is now on the dashboard.
- **Expected Result:** Admin can now see the real-time statistics per position on how many votes for each candidate.
- **Pass/Fail Criteria:** Pass if the admin can see the real-time statistics.

6. **Manage Users Test**
    - **Description:**
        1. Admin logs in using the password login.
        2. Admin is now on the dashboard.
        3. Proceeds to click the Users on the Navigation Pane.
    - **Expected Result:** Admin can now confirm an upload of a fingerprint for each new users, see if users have voted or not, see if users are an admin or not, can delete a user, and can promote to admin or demote to a user.
    - **Pass/Fail Criteria:** Everything mentioned on the expected result is considered a pass otherwise a failure mark.
7. **Adding a Fingerprint Test**
    - **Description:**
        1. Admin logs in using password login.
        2. Admin is now on the dashboard.
        3. User clicks the Scan button on the navigation pane.
        4. User waits for the confirmation on the admin side.
        5. Admin clicks the Upload button.

6. User is now able to scan their fingerprint two times.
7. Once done, user clicks confirm.

- **Expected Result:** User has now added their fingerprint on the system.
- **Pass/Fail Criteria:** Pass if adding a fingerprint is a success.

8. Manage Candidates Test

- **Description:**
  1. Admin logs in using password login.
  2. Admin is now on the dashboard.
  3. Proceeds to click Election on the Navigation Pane
  4. A drop-down menu shows.
  5. Proceeds to click the Manage Candidates on the drop-down menu.
- **Expected Result:** Admin is now able to edit or remove each candidate. Admin is also able to see an election preview and start or end an election.
- **Pass/Fail Criteria:** Pass if admin is able to edit candidates, able to see an election preview, able to start or end an election.

9. Add Candidates Test

- **Description:**
  1. Admin logs in using password login
  2. Admin is now on the dashboard
  3. Proceeds to click Election on the Navigation Pane
  4. A drop-down menu shows
  5. Proceeds to click Add Candidate if there is no election.

- **Expected Result:** Admin is now able to input an ID number, full name, Position, Department, and other fields for a candidate to be added.
- **Pass/Fail Criteria:** Pass if Admin is able to add candidate/s.

10. Account Settings Test

- **Description:**
    1. Admin or user proceeds to login with either a password login or fingerprint login
    2. Admin or user is now on the dashboard.
    3. Proceeds to click the Settings button on the navigation pane.
- **Expected Result:** Admin or user can now edit their Full Name, Department, Year Level, and Password.
- **Pass/Fail Criteria:** Pass if admin or user can edit their details.

2.5.4 Performance Testing Strategy

Objective: In this testing strategy, the researcher's goal is to know the average performance time of our system on both hardware and software. In this section, the researchers would test the Fingerprint Scanning During Registration and Fingerprint Scanning During Login for Voting using Recommended Speed. The researchers would also like to test the Web Application Performance During Mock Election.

Fingerprint Scanning During Registration using Recommend Speed

Objective: Measure the time taken for fingerprint scanning during the registration process.

Methodology:

- Perform 10 registration attempts.

- For each attempt, record the time taken for both the first and second fingerprint readings.
- Calculate the average time taken for both the first and second readings across all attempts.

Fingerprint Scanning During Login for Voting using Recommended Speed

Objective: Measure the time taken for fingerprint scanning during the login process.

Methodology:

- Perform 10 login attempts.
- For each attempt, record the time taken for the fingerprint reading.
- Calculate the average login time across all attempts.

Web Application Performance During Mock Election

Objective: Measure the performance of the web application during a mock election with varying user loads.

Methodology:

- Test the web application with user loads of 5, 10, and 15 users.
- For each user load, measure and record the time taken to perform the following tasks:
  - Load the dashboard.
  - Navigate to the vote page.
  - Submit a ballot.
- Conduct multiple trials for each user load to ensure accuracy and consistency.
- Calculate the average time for each task at each user load level.

User Acceptance Testing

Objective: Validate the software application meets the end0user's needs and requirements, and to identify any remaining issues before the final release. It provides the final quality check from the perspective of actual users in a realistic environment.

Methodology:

- The researchers will establish a booth on the Executive Office Lobby of CIT-U.
- Invite atleast 30 respondents. Respondents will approach the researchers if they are willing and interested to participate.
- Each respondent will have to participate on the registration and the voting process of the actual prototype.
- After the demonstration, the respondents are required to fulfil the user acceptance questionnaire.
- Processing and analysis of data will be done by descriptive statistics.

Questionnaire Questions:

1. How familiar are you with using digital systems for voting?
    a. Very Familiar
    b. Somewhat Familiar
    c. Not Familiar
2. How easy was the registration process?
    a. Very Easy
    b. Easy
    c. Neutral
    d. Difficult

    e. Very difficult

3. How satisfied are you with the fingerprint authentication process?
    a. Very Satisfied
    b. Satisfied
    c. Neutral
    d. Dissatisfied
    e. Very Dissatisfied
4. Did you encounter any issues during registration or authentication? If yes, please describe.
    a. Yes
    b. No
        i. Please indicate the issues during registration. Type "N/A" if none
5. How easy was it to cast your vote using the touchscreen?
    a. Very Easy
    b. Easy
    c. Neutral
    d. Difficult
    e. Very difficult
6. How satisfied are you with the overall voting process?
    a. Very Satisfied
    b. Satisfied
    c. Neutral
    d. Dissatisfied

    e. Very Dissatisfied

7. Did you encounter any issues while casting your vote? If yes, please describe.
    a. Yes
    b. No
        i. Please indicate the issues during casting of Vote. Type "N/A" if none
8. How accurate and up-to-date were the real-time vote counts and candidate standings?
    a. Very accurate
    b. Accurate
    c. Neutral
    d. Inaccurate
    e. Very Inaccurate
9. How would you rate the system’s performance and responsiveness in your experience?
    a. Very Responsive
    b. Responsive
    c. Neutral
    d. Slow
    e. Very Slow
10. Did you experience any delays or issues with real-time updates? If yes, please describe.
    a. Yes

b. No

i. If yes, please indicate here. Type "N/A" if no issues

11. How satisfied are you with the overall experience of using the Web-Connected Smart Voting System?

a. Very Satisfied

b. Satisfied

c. Neutral

d. Dissatisfied

e. Very Dissatisfied

12. Do you have any suggestions for improving the system?

a. Yes

b. No

i. Please input here your suggestion/remarks. Type "N/A" if none

13. Did you vote last May 10, 2024 (40th CITU SSG Elections)

a. Yes

b. No

14. Please choose your most favorable reason why some technologians DID NOT cast their votes.

a. Students may not be aware of the election schedule, candidates, or how to vote.

b. Some students might feel disconnected from student government or believe that the election outcomes will not impact their lives or that the candidates are not addressing issues relevant to them.
c. Academic pressures, work commitments, or extracurricular activities may leave students with little time to vote
d. A complicated or unclear voting procedure can discourage participation.
e. A lack of transparency in the election process or doubts about the fairness of the election.
f. Peer pressure or influence from friends and classmates who are not voting can affect individual decisions
g. Negative experiences in previous elections, such as long lines, technical difficulties, or perceived unfairness, can discourage future participation.
h. Exposure to negative campaigning or smear tactics can result in voter cynicism and apathy.

CHAPTER 3

DATA PRESENTATION AND ANALYSIS

For this chapter, the data presentation and analysis phase unfold, incorporating comprehensive tests conducted on both software and hardware components. Both software and hardware underwent meticulous Unit Testing, Network Testing, and End-to-End Testing in which the researchers opted for each test yielding a “Pass” status, it also went in a Performance Testing which the researchers opted each test on knowing the average time, this would affirm the robustness and functionality of the software and hardware components.

Table 2: Unit Testing Results

Feature	**Description**	**Expected Result**	**Pass/Fail**	**Actual Result(if failed)**
Login Page	Open the login page	Page has a Password Login in which it consists of an ID and password fields, and a fingerprint login.	Pass	
Login Page	Fill out login ID and password field with correct credentials	User logged in.	Pass	
Login Page	Fill out Login ID and password field with incorrect credentials	Shows error message.	Pass	
Login Page	Clicking the scan button on the fingerprint login	Shows the Login button.	Pass	
Login Page	Clicking the login button on the fingerprint login	Attempts to login the user after the fingerprint is scanned.	Pass	
Register Page	Clicking the “No Account?” button	Shows the Register Page. Page has an ID,	Pass	

	on the login component	Fullname, Department, Year, Password and Confirm Password Fields.		
Register Page	After filling up the fields and clicking "Create Account" button	Shows a successful registration message.	Pass	
Register Page	Unable to fill up fields and clicking "Create Account" button	Shows error message.	Pass	
Vote Page	Clicking "Vote" button with saved fingerprint.	Shows the candidates for the user to vote.	Pass	
Vote Page	Clicking "Vote" button without saved fingerprint	Shows a message to user which requires them to scan their fingerprint first.	Pass	
Manage Users Page (Admin Side)	Clicking "Users" button	Shows a list of users.	Pass	
Manage Candidates Page (Admin Side)	Clicking the "Manage Candidates" button	Admin can see a list of students with their perspective position. Admin is also able to see a preview of the election. Admin is also able to start or end the election.	Pass	
Add Candidate Page (Admin Side)	Clicking the "Add Candidates" button without an election ongoing	Admin can add candidates	Pass	
Add Candidate Page (Admin Side)	Clicking the "Add Candidates" button with an election ongoing	Admin is unable to add candidates.	Pass	
Add Candidate Page (Admin Side)	Clicking the "Submit" button without filling up the required fields.	Shows the error message.	Pass	
Add Candidate (Admin Side)	Clicking the "Submit" button	Successful adding of a candidate.	Pass	

	with filling up the required fields.			

Unit testing process was not just thorough, but also meticulously precise, ensuring that every aspect of our application was verified. The researchers began with the Login Page, meticulously confirming that all necessary fields, including ID, password, and fingerprint login options, were correctly displayed upon opening the page. Successful login was granted to users with valid credentials, while those with invalid credentials received precise and appropriate error messages. The fingerprint login function also worked flawlessly, revealing the login button upon clicking the scan button and attempting a user login after a successful fingerprint scan. Continuing to the Register Page, the researchers tested the navigation to this page by clicking the 'No Account?' button, which displayed all required fields such as ID, full name, department, year, password, and confirm password. We verified the registration process by filling out these fields and clicking the 'Create Account' button, resulting in a successful registration message. Conversely, attempting to create an account without completing the necessary fields correctly triggered an error message, showcasing the robustness of our validation system. On the Vote Page, tests revealed that clicking the 'Vote' button with a saved fingerprint displayed the list of candidates for voting. When attempting to vote without a saved fingerprint, the system correctly prompted users to scan their fingerprint first, ensuring a secure voting process. On the Manage Users Page (Admin Side), the researchers verified that clicking the 'Users' button displayed a comprehensive list of users, a crucial functionality for user management. Similarly, on the Manage Candidates Page (Admin Side), the researchers ensured that

admins could view a list of candidates, start or end elections, and preview the election setup, all of which are vital for the smooth operation of the voting system.

The researchers tested several scenarios for the Add Candidate Page (Admin Side). Admins could add candidates when no election was ongoing but were appropriately restricted from adding candidates during an ongoing election. Additionally, the system displayed error messages correctly when the "Submit" button was clicked without filling in the required fields, and candidates were successfully added when all fields were completed correctly.

Overall, the unit testing results indicate that our system's features function as designed. Each test case passed, validating that the login, registration, voting, and administrative management functionalities are robust and that error-handling mechanisms are effectively implemented. This thorough testing ensures a reliable and user-friendly experience for both end-users and administrators.

3.2 Network Testing Results

Table 3: Network Testing Results

Page	**Internet Speed**	**Time Taken to Load the Page (seconds)**	**Result (Pass/Fail)**
Dashboard	10 kbps	50 seconds	Fail
Dashboard	20 kbps	30 seconds	Fail
Dashboard	30 kbps	28.91 seconds	Fail
Dashboard	40 kbps	7.31 seconds	Pass
Dashboard	50 kbps	5.38 seconds	Pass
Dashboard	60 kbps	5.30 seconds	Pass
Dashboard	70 kbps	4.71 seconds	Pass
Dashboard	80 kbps	3.62 seconds	Pass
Dashboard	90 kbps	3.53 seconds	Pass
Dashboard	100 kbps	3 seconds	Pass

In the network testing results, it shows here that the time taken from 10 kbps – 30 kbps is not acceptable to the acceptance range time of 1 – 10 seconds, therefore in this range of speeds are not acceptable to run the program. However, 40 – 50 kbps shows lesser range of the acceptance range of 1 – 10 seconds, therefore these are the range of speeds that the system would require to operate in a smooth and user-friendly manner.

3.3 End-to-End Testing Results

Table 4: End-to-End Testing Results

Feature	**Description**	**Expected Result**	**Pass/Fail**	**Actual Result (if failed)**
Registration	1. Users access the website with their working PC/Laptops/Mobile Phones 2. Proceeds to click the Login button 3. Proceeds to click the "No Account?" button 4. Fills up the necessary details	User is now registered to the system	Pass	
Password Login	1. User fills up the id and password fields 2. Proceeds to click the Login button in the navigation pane	User is now in the dashboard but unable to vote	Pass	
Fingerprint Login	1. User clicks the Scan button 2. Proceeds to scan their fingerprint 3. System authenticates it 4. Once authenticated, users can now click the login button on the fingerprint login	User is now in the dashboard able to vote	Pass	
Vote	1. User logs in using the fingerprint login 2. User is now in the dashboard	User has successfully voted and is	Pass	

	3. Proceeds to click the Vote button in navigation pane 4. Proceeds select their desired candidate 5. After selecting, proceeds to click the vote button	able to see his/her votes		
Real-time statistics	1. Admin logs in using the password login 2. Admin is now on the dashboard	Admin can now see the real-time statistics per position on how many votes for each candidate	Pass	
Manage Users	1. Admin logs in using the password login 2. Admin is now on the dashboard 3. Proceeds to click the Users on the Navigation Pane	Admin can now confirm an upload of a fingerprint for each new users, see if users have voted or not, see if users is an admin or not, can delete a user, and can promote to admin or demote to a user.	Pass	
Adding a Fingerprint	1. User logs in using Password Login 2. User is now in the dashboard 3. User click the Scan button on the navigation pane 4. User waits for the confirmation on the admin side for adding/uploading 5. Admin clicks the Upload button	User has now added their fingerprint on the system.	Pass	

	6. User is now able to scan their fingerprint two times 7. Once done, user clicks confirm			
Manage Candidates	1. Admin logs in using password login 2. Admin is now on the dashboard 3. Proceeds to click Election on the Navigation Pane 4. A drop-down menu shows 5. Proceeds to click the Manage Candidates on the drop-down menu	Admin is now able to edit or remove each candidate. Admin is also able to see an election preview and start or end an election.	Pass	
Add Candidates	1. Admin logs in using password login 2. Admin is now on the dashboard 3. Proceeds to click Election on the Navigation Pane 4. A drop-down menu shows 5. Proceeds to click Add Candidate if there is no election.	Admin is now able to input an ID number, full name, Position, Department, Year, Color, Party List and can upload a picture of a candidate to be added.	Pass	
Account Settings	1. Admin or user proceeds to login with either a password login or fingerprint login 2. Admin or user is now on the dashboard 3. Proceeds to click the Settings button on the navigation pane	Admin or user can now edit their Full Name, Department, Year Level, and Password	Pass	

The results of the voting system's end-to-end testing were largely positive. All the characteristics we examined excelled, showing that the system is solid and dependable. The researchers tested fingerprint login, which is an essential feature. This function enables

users to access the system using their fingerprints, a more secure and convenient option than traditional password-based logins. The fingerprint login function has been tested and proven to function correctly, allowing voters to use it confidently. Another important aspect we evaluated, the real-time statistics feature, demonstrated its effectiveness. This functionality enables administrators to monitor the real-time count of votes received by each candidate. The practical testing demonstrates its usefulness and practicality, giving administrators confidence in its dependability for overseeing election outcomes. End-to-end testing results for our voting system show great promise. All tested features succeeded, proving the system is ready for deployment. This system will provide voters with a safe and dependable platform for voting.

3.4 Performance Testing Results

Fingerprint Scanning During Registration using Recommend Speed

Table 5: Fingerprint Scanning During Registration

Attempts	1st Reading (Seconds)	2nd Reading (Seconds)
1	3.93 seconds	2.70 seconds
2	3.55 seconds	2.75 seconds
3	3.56 seconds	3.65 seconds
4	2.78 seconds	2.46 seconds
5	4.05 seconds	2.36 seconds
6	3.37 seconds	2.45 seconds
7	3.90 seconds	2.20 seconds
8	3.03 seconds	2.16 seconds
9	4.13 seconds	2.81 seconds
10	2.66 seconds	1.59 seconds

In the first reading of the fingerprint scanning in registration, the average performance time it took to scan a fingerprint was 3.5 seconds, in the second reading it took 2.51 seconds to scan a fingerprint. The fingerprint module works fine in an average time to scan of 3.5 seconds and 2.51 seconds in the registration process.

Fingerprint Scanning During Login for Voting using Recommend Speed

Table 6: Fingerprint Scanning During Login

Attempts	Reading (Seconds)
1	2.47 seconds
2	3.80 seconds
3	2.72 seconds
4	2.60 seconds
5	2.51 seconds
6	2.80 seconds
7	2.94 seconds
8	4.27 seconds
9	2.86 seconds
10	2.34 seconds

In the fingerprint scanning during login only one reading was tested as it only takes one attempt to identify a fingerprint and it took an average time of 3.13 seconds to scan and identify a fingerprint for them to login into the web application using the fingerprint module on our kiosk.

Web Application Testing Performance During Mock Election

Table 7: Web Application Testing Performance

Number of Users	5	10	15
Dashboard	2.50 seconds	3 seconds	3.20 seconds
Navigate Vote Page	1.80 seconds	2.10 seconds	2.50 seconds
Ballot Submission	2.30 seconds	2.40 seconds	2.55 seconds

The results of the web application testing were done in a mock election in groups 5, 10, and 15. In the groups of 5 the average time it took on the dashboard to load was 2.50 seconds, for the navigate vote page it took 1.80 seconds, and as for the ballot submission it took 2.30 seconds. In the groups of 10 the average time it took on the dashboard to load was 3 seconds, for the navigate vote page it took 2.10 seconds, and the ballot submission was 2.40 seconds. In the groups of 15 the average time it took on the dashboard to load

was 3.20 seconds shockingly it increased little by little, the navigate vote page took 2.50 seconds which is only a slight increase, and as for ballot submission it took 2.55 seconds which of course the more groups of 5 it only increases milliseconds of it to submit. All these means in a recommended speed of the web application, a group of 5, 10, 15 simultaneously opening the dashboard, navigating the vote page, and submitting ballots has no problems with the operation of the system.

3.5. User Acceptance Testing Results

3.5.1 User's Questionnaire

In this section, the researchers will present the data collected from the on-site user acceptance testing conducted through a demonstration and user acceptance questionnaire immediately following the respondents' observation and experience of the voting process. The researchers will systematically divide by sections to address each question posed in the questionnaire. The sections are present to group question that has mutual choices. The researchers allocate 3 sections following a brief discussion of results.

Section 1: Question 1

Question # 1: How familiar are you with using digital systems for voting?

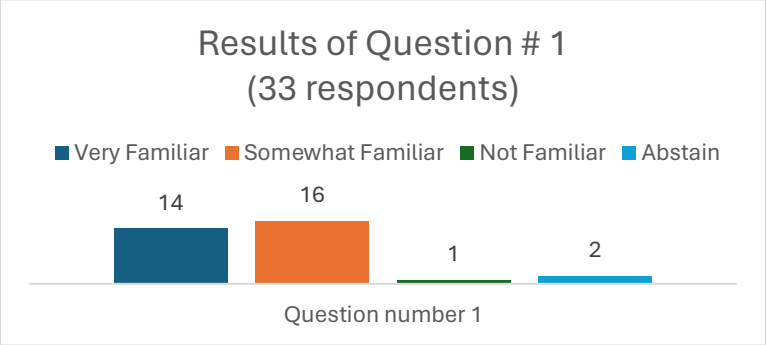

Figure 20: Results of Question # 1

The researchers analyze this data by considering Very Familiar and Somewhat Familiar as a positive response for the system. Both garnered the majority votes even though that's

what happen, researchers should also include to mention the only 1 respond for: Now familiar".

Section 2: Question 2 & 5

Question # 2 : How easy was the registration process?

Question # 5: How easy was it to cast your vote using the touchscreen?

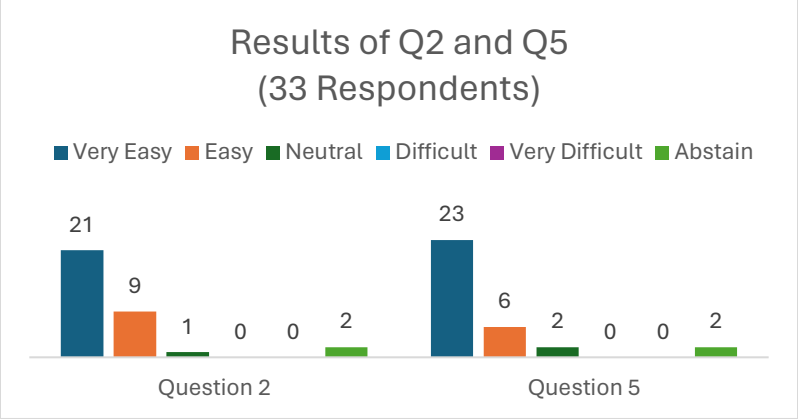

Figure 21: Results of Q2 and Q5

The researchers included this section with two specific questions because it offers mutual choices and allows for a more sustainable presentation of both results simultaneously. Based on the diffusion of innovation theory, the randomly selected respondents are categorized as early adopters due to their demographics. As millennials, they are likely to adopt new technologies in the digital age. According to the data, researchers can infer that the respondents found both registration and using WildVote's touchscreen to be convenient.

Section 3: Question 3, 6, & 11

Question # 3 : How satisfied are you with the fingerprint authentication process?

Question # 6: How satisfied are you with the overall voting process?

Question # 11: How satisfied are you with the overall experience of using the Web-Connected Smart Voting System?

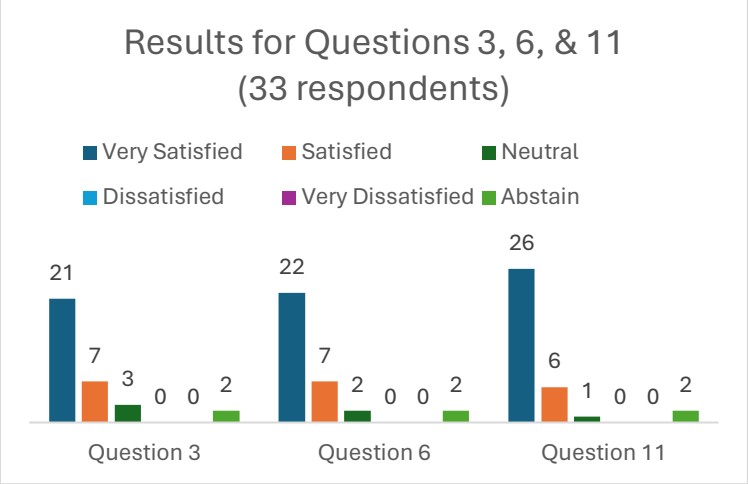

Figure 22: Results for Questions 3, 6, 11

The respondents of the WildVote smart voting system expressed satisfaction with the fingerprint authentication, the overall voting process, and their overall experience.

Section 4: Performance and Accuracy

Question # 8 How accurate and up-to-date were the real-time vote counts and candidate standings?

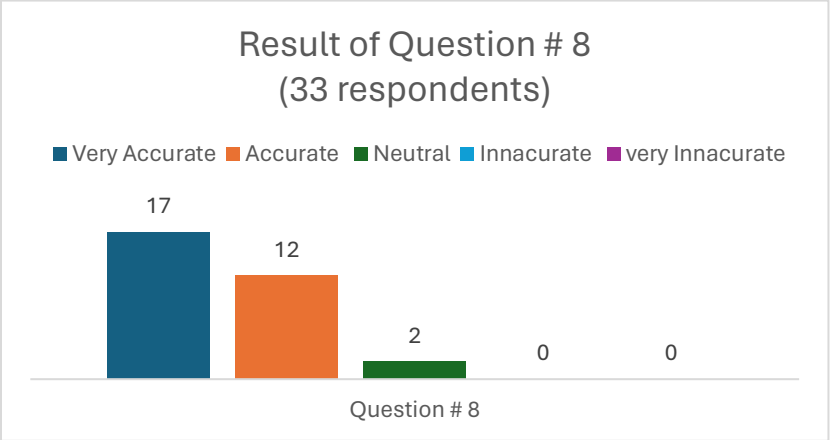

Figure 23: Accuracy Data

Question # 9: How would you rate the system's performance and responsiveness in your experience?

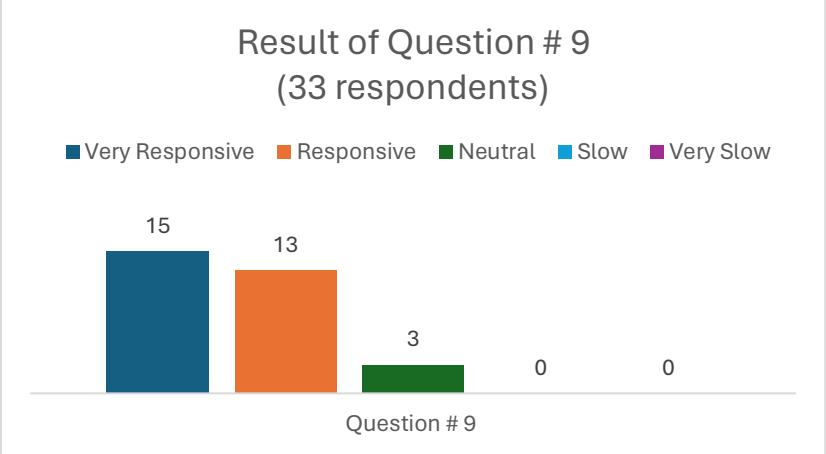

Figure 24: Performance Data

The analysis of the responses to Questions #8 and #9 indicates a high level of satisfaction with the WildVote smart voting system. For the accuracy and currency of the real-time vote counts and candidate standings, a significant majority of respondents (29 out of 31) rated the system positively, with 17 stating it was "Very Accurate" and 12 as "Accurate."

Only 2 respondents were neutral, and none rated it negatively, highlighting the system's reliability in delivering real-time data. Similarly, the performance and responsiveness of the system were well-received, with 28 out of 31 respondents providing positive feedback—15 rated it "Very Responsive" and 13 "Responsive." Only 3 respondents were neutral, indicating that the system's performance meets users' expectations effectively. Overall, these responses reflect a strong endorsement of the WildVote system's functionality and user experience.

Section 5: Review of Issues

Question # 4: Did you encounter any issues during registration or authentication? If yes, please describe.

Question # 7: Did you encounter any issues while casting your vote? If yes, please describe.

Question # 10: Did you experience any delays or issues with real-time updates? If yes, please describe.

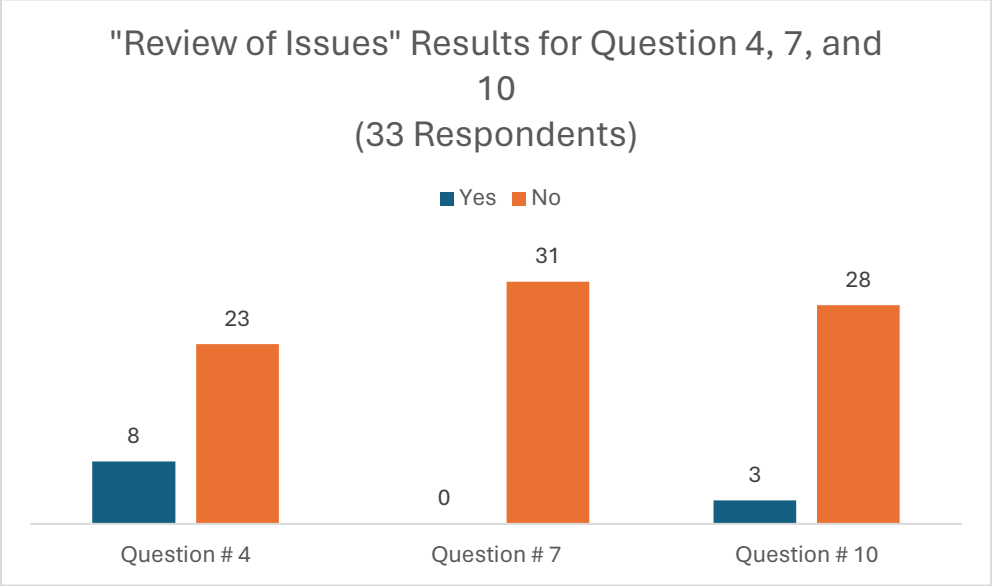

Figure 25: Review of Issues

The analysis of the next section reveals a generally positive user experience with the WildVote smart voting system. Most respondents did not encounter issues during registration or authentication, indicating a largely trouble-free initial setup. The voting process itself was notably smooth, with no respondents reporting any problems, highlighting the system's efficiency and reliability during this critical phase. While a few respondents experienced delays or issues with real-time updates, the majority found the updates to be timely and accurate. These findings suggest that the WildVote system performs well in facilitating a seamless voting experience, with only minor areas needing improvement in the registration and real-time update processes.

Section 6: Collection of Insights

This is the section where the researchers will enumerate and classify and record the frequency of what grievance does the response belong.

Question: "If yes, please indicate here. Type "N/A" if no issues"

Table 8: Table of Grievances

Question Number	Verbatim Response
4	N/A
	The CIT-U wifi is bit laggy
	Fingerprint issues at first
	ni static ako kamot hehe
	Wifi Connection

	Authentication problem on the profile details, like when I check in the settings, it is not my credentials being shown.
7	N/A
10	N/A
	Delays due to wifi connection

Grievance Classification

Table 9: Frequency of Grievances

Question Number	Classification	Frequency
4	N/A	**26**
	Internet Connectivity Related	**2**
	Hardware Component	**2**
	Functionality Related	
	Software Functionality Related	**1**
7	N/A	**31**
10	N/A	**30**
	Internet Connectivity Related	**1**

Section 7: Data for the Student participation on Elections

Question 13: Did you vote last May 10, 2024 (40th CITU SSG Elections)?

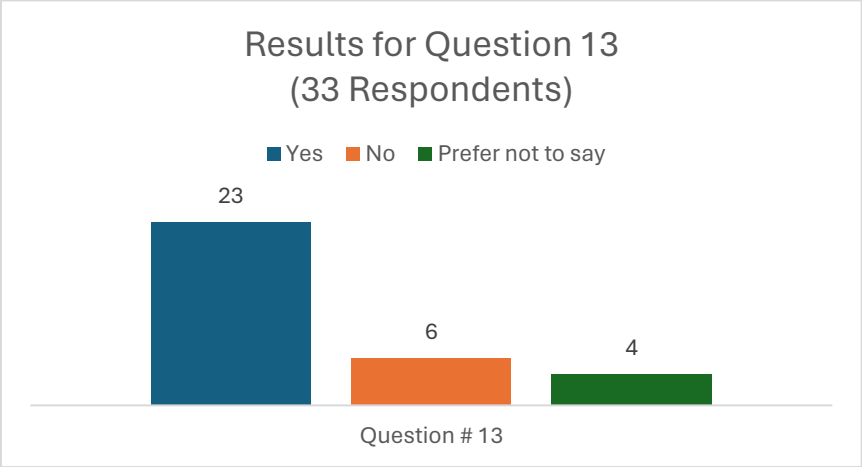

Figure 26: Results for Q13

The majority of the respondents (23) confirmed that they voted, indicating a high level of engagement with the electoral process. Six respondents did not vote, and four preferred not to disclose their participation. This data suggests that the WildVote system was primarily used by individuals who were actively involved in the election, reflecting its effectiveness in reaching and engaging its intended user base.

Question 14: Please choose your most favorable reason why some technologians DID NOT cast their votes.

Legend:

a. Students may not be aware of the election schedule, candidates, or how to vote.

b. Some students might feel disconnected from student government or believe that the election outcomes will not impact their lives or that the candidates are not addressing issues relevant to them.

c. Academic pressures, work commitments, or extracurricular activities may leave students with little time to vote

d. A complicated or unclear voting procedure can discourage participation.

e. A lack of transparency in the election process or doubts about the fairness of the election.

f. Peer pressure or influence from friends and classmates who are not voting can affect individual decisions

g. Negative experiences in previous elections, such as long lines, technical difficulties, or perceived unfairness, can discourage future participation.

h. Exposure to negative campaigning or smear tactics can result in voter cynicism and apathy.

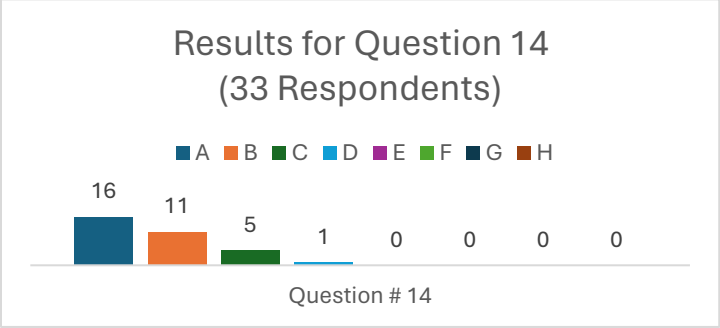

Figure 27: Results for Q14

The analysis of responses to Question #14, which asked respondents to select the most favorable reason why some technologians did not cast their votes, highlights several key factors. The most cited reason, chosen by 16 respondents, was that students may not be aware of the election schedule, candidates, or how to vote, indicating a significant communication gap. The second most common reason, selected by 11 respondents, was that some students might feel disconnected from student government or believe that the election outcomes will not impact their lives or that the candidates are not addressing issues relevant to them. Academic pressures, work commitments, or extracurricular activities were cited by 5 respondents as reasons for not voting, reflecting the competing demands

on students' time. Only one respondent felt that a complicated or unclear voting procedure was a deterrent. The remaining reasons, such as lack of transparency, peer pressure, negative past experiences, or exposure to negative campaigning, were not selected by any respondents. This data suggests that improving awareness and engagement strategies could significantly increase voter participation.

Section 8: Comments and Suggestions

Question 12: Do you have any suggestions for improving the system?

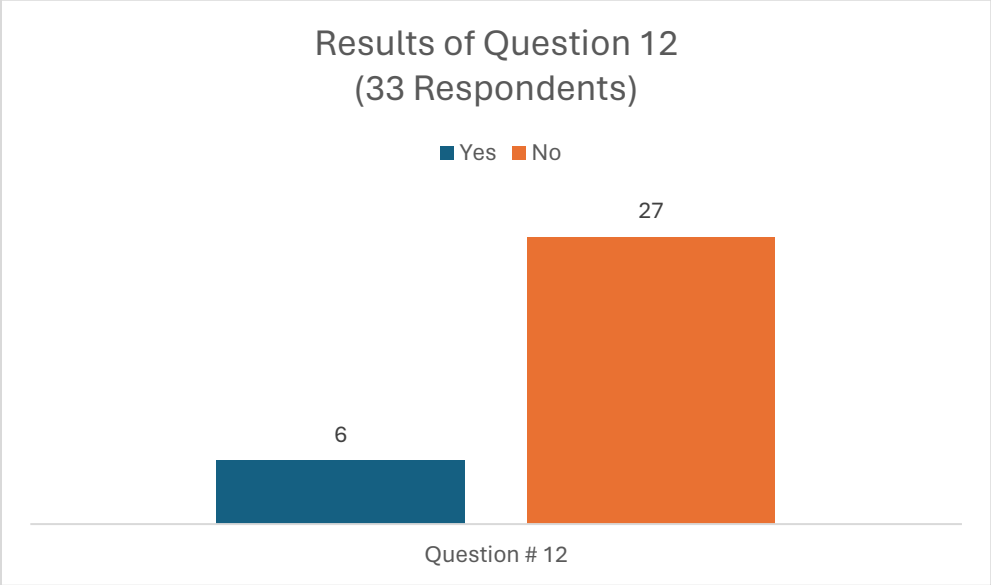

Figure 28: Results for Q12

Question 13: Please input here your suggestion/remarks. Type "N/A" if none

Table 10: Table of Suggestions and Comments

Question Number	Verbatim Response
13	*N/A*
	i suggest to have an own wifi nalng po sa system
	Fingerprint issues at first
	About abstaining votes, I hope we can unclick our accidental votes.
	The fingerprint registration flow
	Further reduce the latency
	Better LED and faster servers and internet for the program

CHAPTER 4

CONCLUSION AND RECOMMENDATION

4.1 Conclusion

In conclusion, the WildVote: Technologian Smart Voting System represents a significant advancement in the field of voting technology, addressing the pressing need for efficient, secure, and transparent electoral processes. By leveraging biometric authentication technology, specifically fingerprint data for verification, the system has demonstrated its ability to streamline validation processes and enhance the security and efficiency of student elections at CIT-U.

The unit testing phase emerged as a pivotal aspect of the study, shedding light on the robustness and functionality of the WildVote system's software and hardware components. Each meticulously conducted test, from login page functionality to fingerprint authentication, yielded a resounding "Pass" status, affirming the system's reliability and performance. These findings underscore the system's readiness for real-world implementation and its ability to deliver a seamless and secure voting experience for all users.

The user acceptance testing results underscored the system's user-friendly interface and high level of satisfaction among both voters and administrators, highlighting its potential to improve accessibility and confidence in the electoral process. Additionally, the robust performance observed during unit testing further validates the reliability and functionality of the WildVote system, ensuring a seamless and secure voting experience for all users.

4.2 Recommendation

Reflecting on the researchers' experience with the WildVote fingerprint voting system, several key recommendations for future researchers and developers in this field are proposed. Firstly, expanding the range of biometric authentication options beyond fingerprints can greatly enhance user flexibility and security. For instance, integrating retina scanning technology alongside fingerprint recognition and exploring other modalities like iris recognition can provide users with a diverse array of highly secure biometric identifiers. This approach not only adds layers of authentication but also accommodates varying user preferences and accessibility needs, thus advancing biometric technology within voting systems. Secondly, scaling up the number of kiosks is pivotal for improving voting efficiency, necessitating a robust system architecture capable of handling increased loads and concurrent connections. Implementing load balancing techniques across multiple instances of the web application and backend services will be instrumental in maintaining performance and availability as the system scales. Thirdly, continuous deployment and upgrades are vital for ensuring security, performance, and functionality. It is recommended to adopt a DevOps approach with automated deployment pipelines and leverage containerization and orchestration tools like Docker and Kubernetes to streamline deployment across diverse environments. Additionally, optimizing cloud service usage and considering serverless computing can enhance cost-effectiveness and performance efficiency.

Moreover, in the area of verifying and record-keeping, blockchain technology presents a promising solution to the challenges of contemporary voting procedures. Blockchain's inherent design excels in applications where multiple users are working on

immutable data, making it ideal for ensuring secure and transparent record-keeping in voting systems. By leveraging blockchain technology, future researchers can implement a robust system that minimizes the risk of false voting and tampering with election records. By combining advanced biometric authentication, scalable system architecture, continuous deployment practices, and blockchain-enabled record-keeping, future voting systems can achieve unprecedented levels of security, efficiency, and transparency, ultimately benefiting both voters and electoral authorities alike. Researchers are encouraged to explore and implement these recommendations to advance the field of secure and efficient electronic voting systems.

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APPENDIX A

TEAM PROFILE

PERSONAL DATA

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Address: 19 F Jaca Street Kinasang-an, Pardo, Cebu City

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EDUCATION

2020 - Present | Cebu Institute of Technology - University | Computer Engineering

2018 - 2020 | Holy Rosary School of Pardo | SHS

2014 - 2018 | Holy Rosary School of Pardo | Secondary Diploma

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EDUCATION

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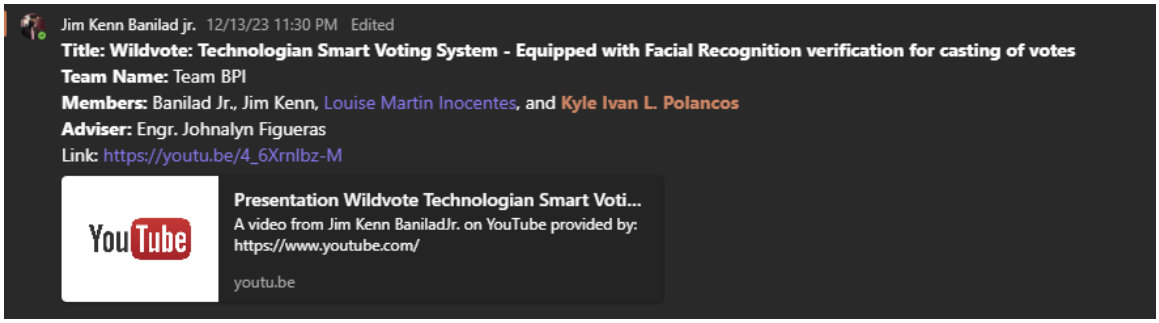
2014 – 2018 | Cebu Institute of Technology – University | Secondary Diploma

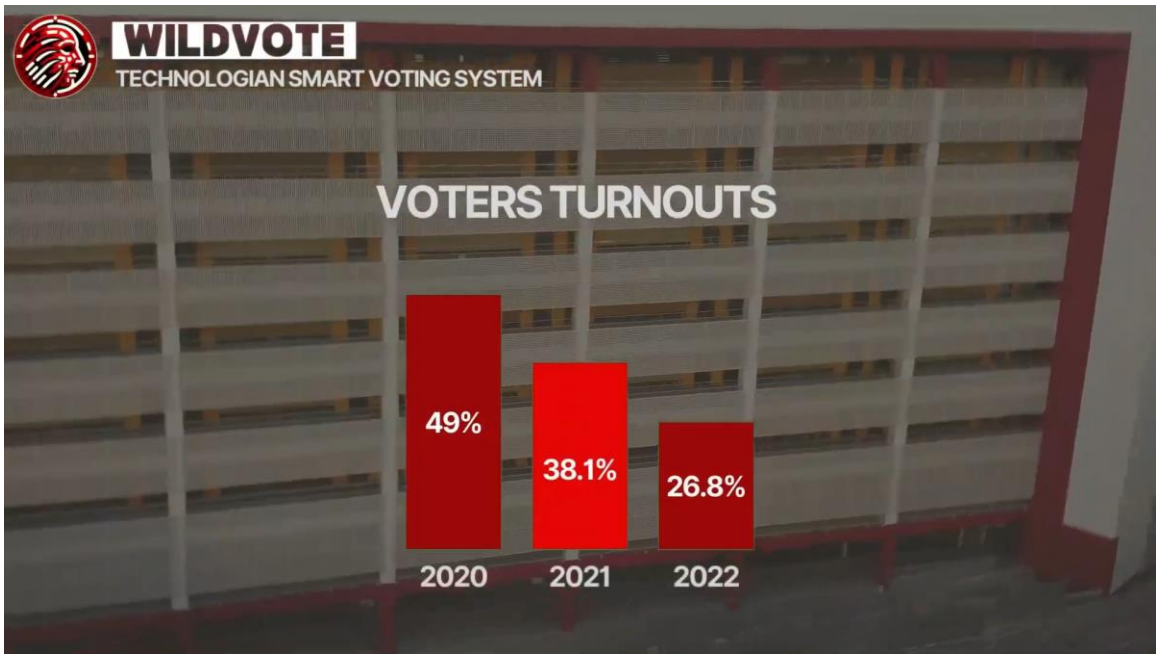
2008 – 2014 | Cebu Institute of Technology – University | Elementary Diploma

APPENDIX B

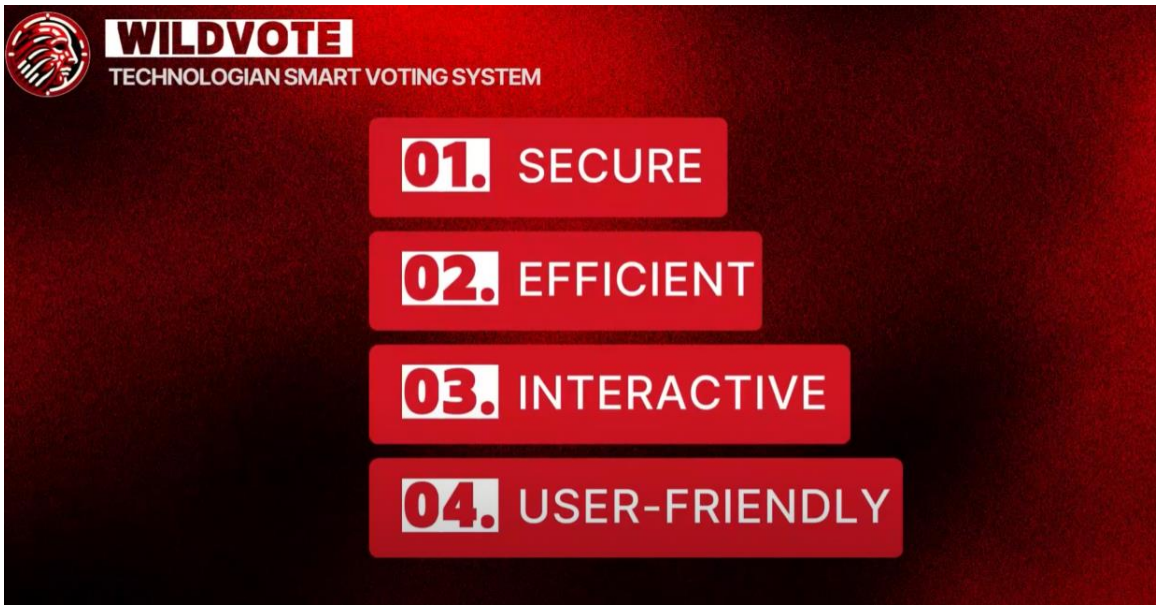
PROJECT DEVELOPMENT DOCUMENTS

Project Proposal

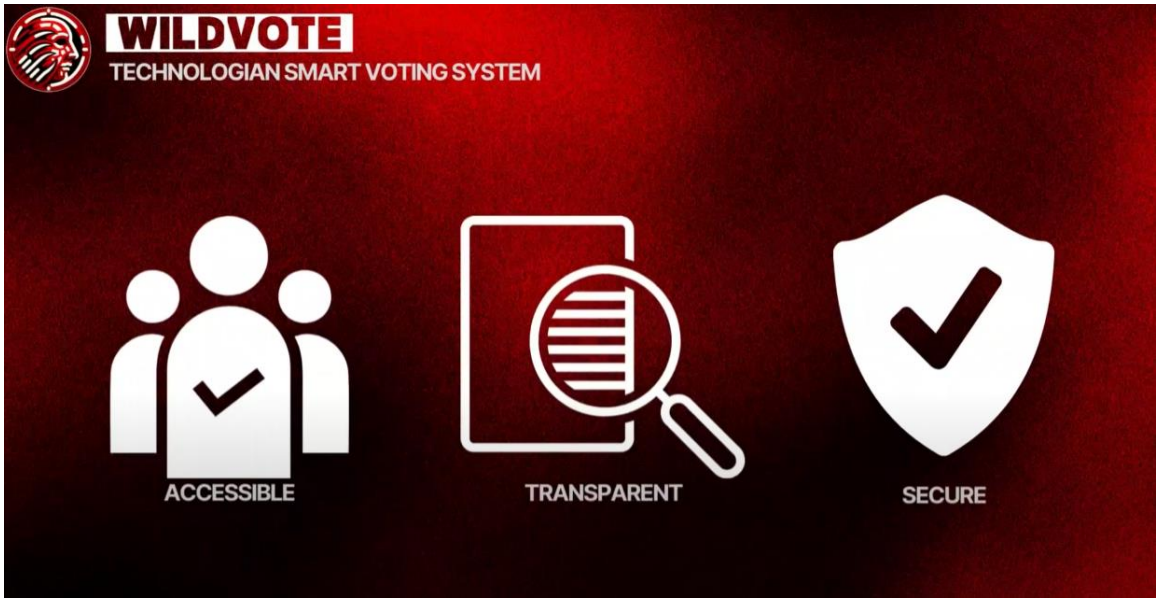




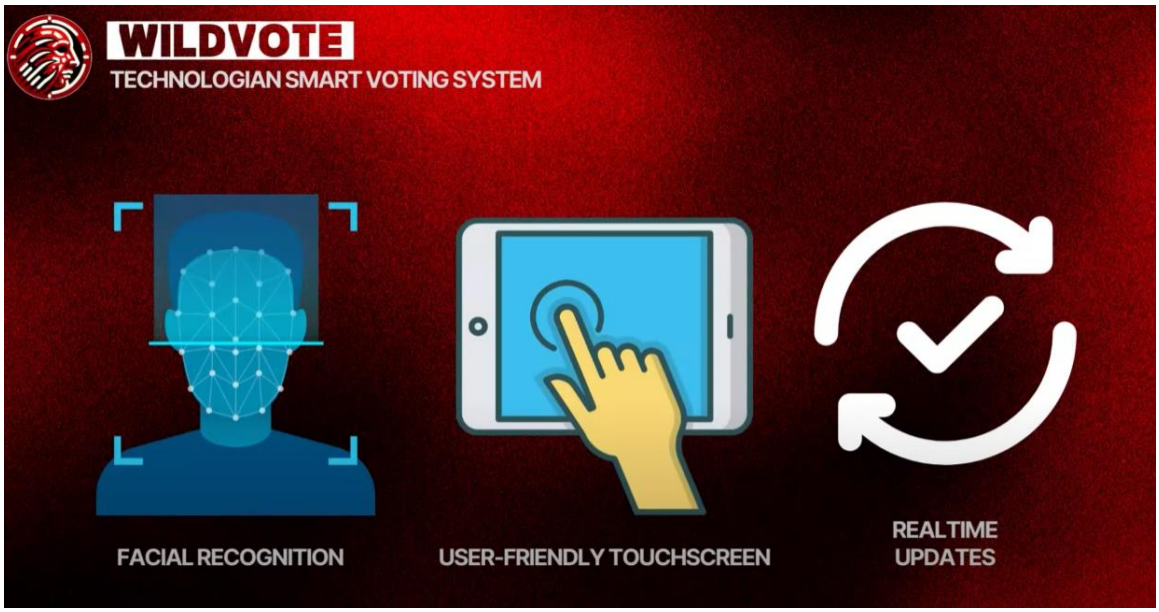

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM

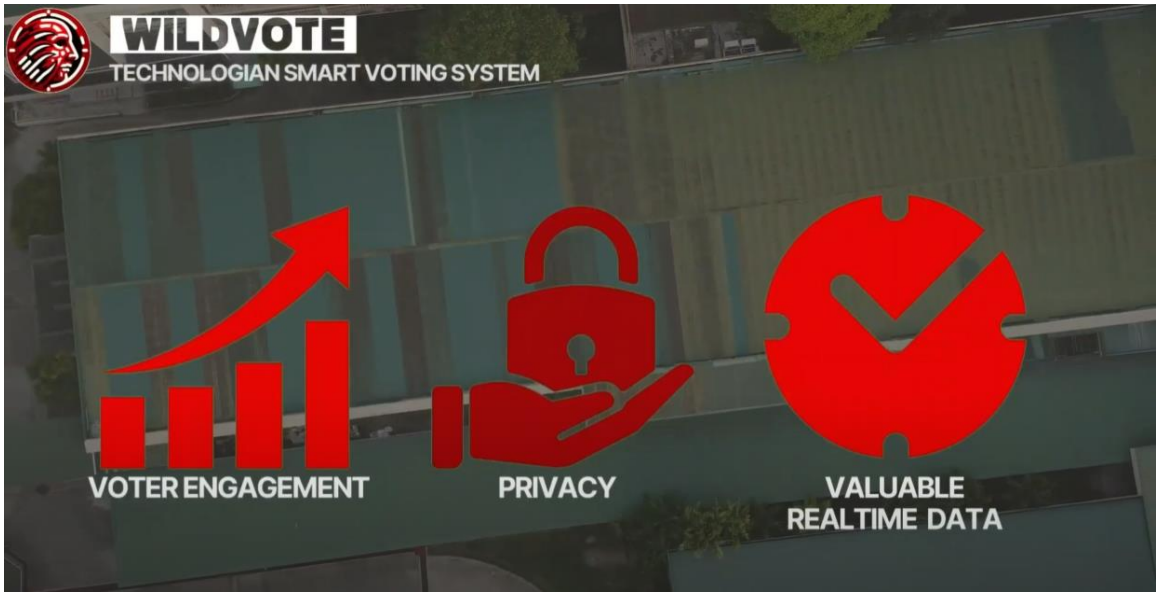

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
01. SECURE
02. EFFICIENT
03. INTERACTIVE
04. USER-FRIENDLY

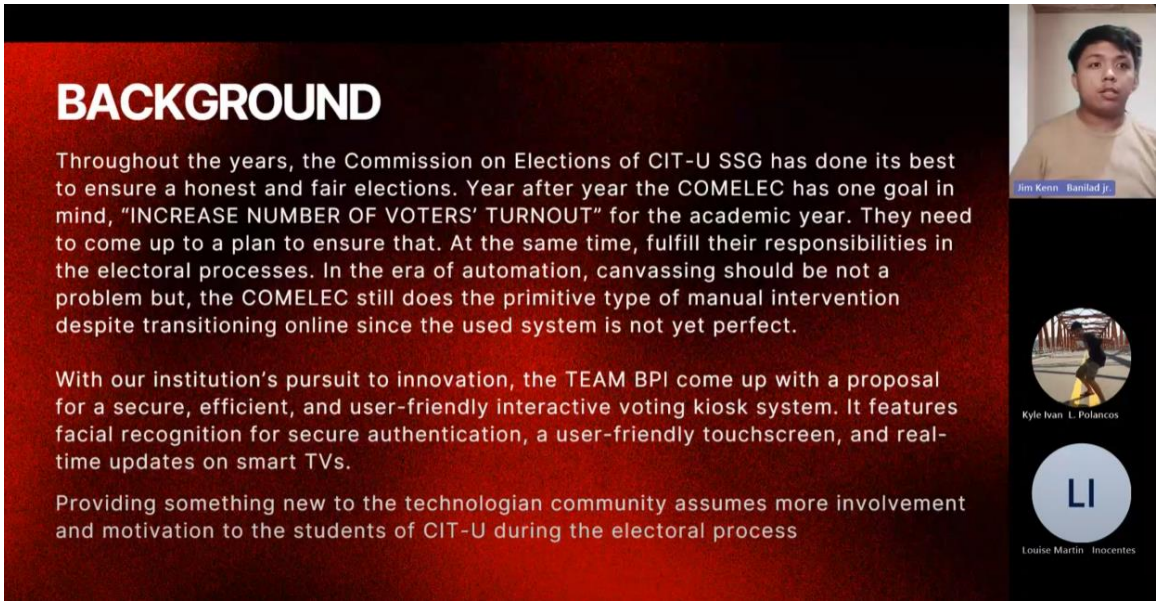

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
BANILAD JR.
JIM KENN
INNOCENTES
LOUISE MARTIN
POLANCOS
KYLE IVAN

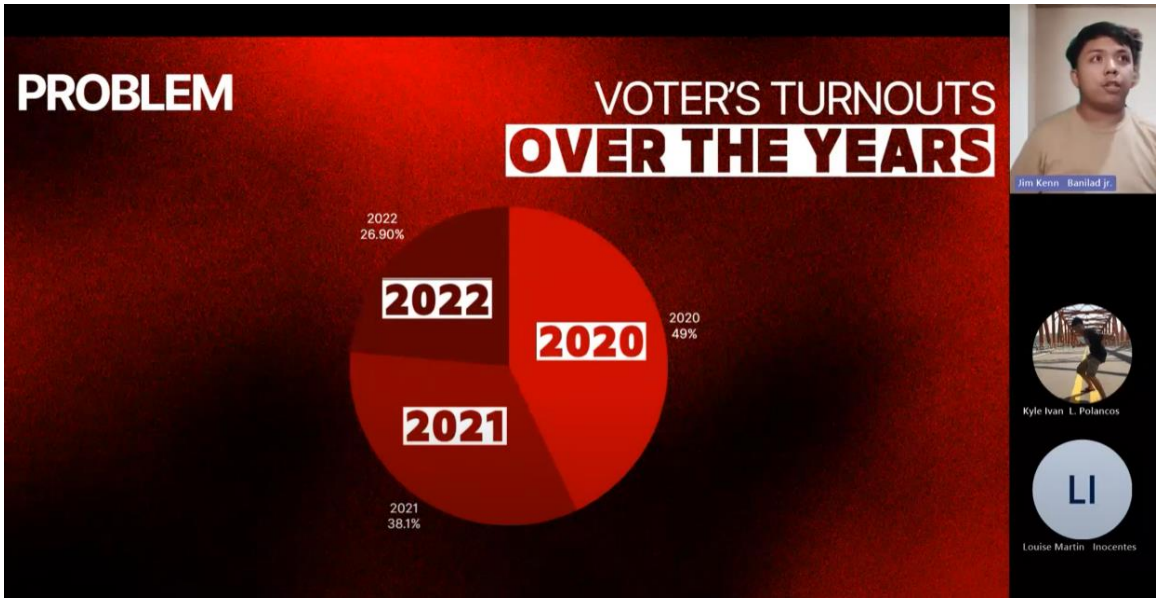

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
ACCESSIBLE
TRANSPARENT
SECURE

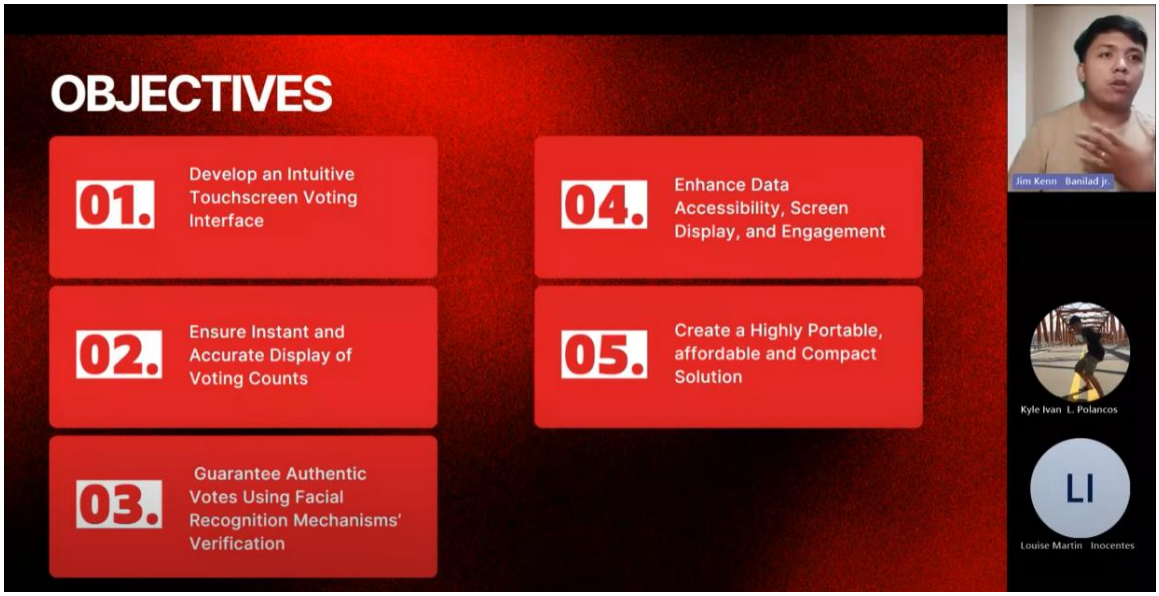

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
LONG QUEUE
PAPER WASTAGE
CONCERN TO TRASPARENCY

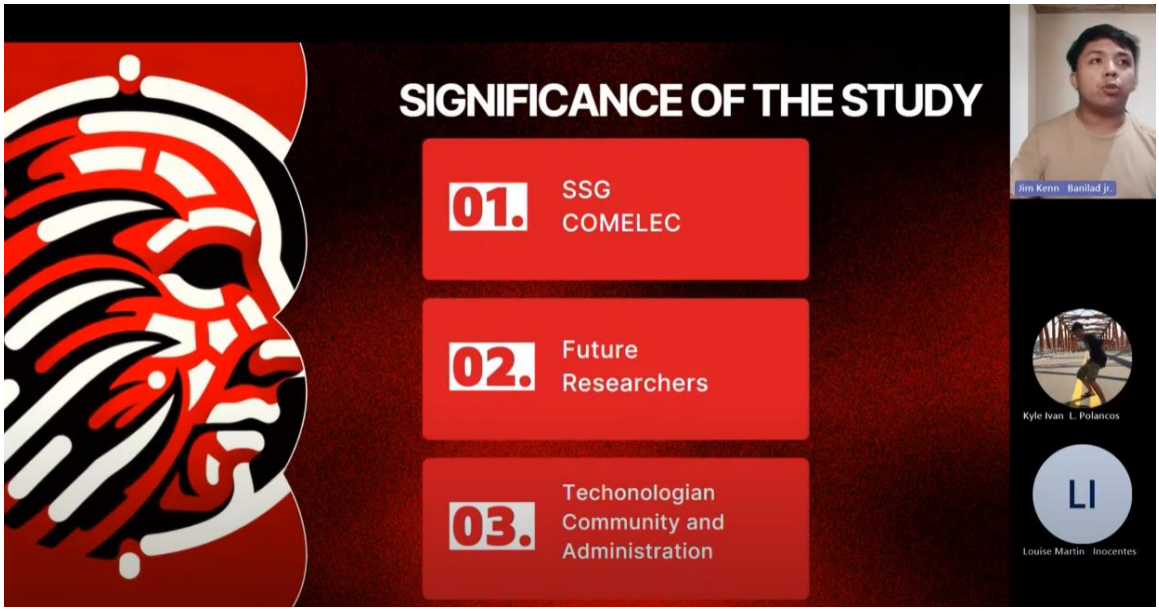

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
FACIAL RECOGNITION
USER-FRIENDLY TOUCHSCREEN
REALTIME
UPDATES

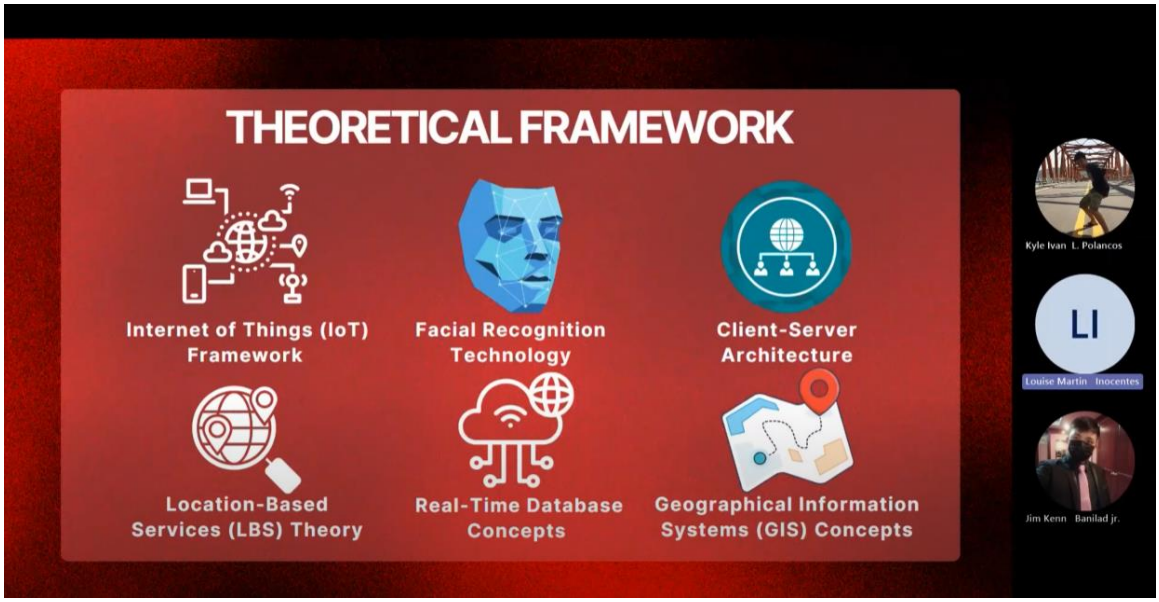

WILDVOTE
TECHNOLOGIAN SMART VOTING SYSTEM
VOTER ENGAGEMENT
PRIVACY
VALUABLE
REALTIME DATA


BACKGROUND
Throughout the years, the Commission on Elections of CIT-U SSG has done its best to ensure a honest and fair elections. Year after year the COMELEC has one goal in mind, "INCREASE NUMBER OF VOTERS' TURNOUT" for the academic year. They need to come up to a plan to ensure that. At the same time, fulfill their responsibilities in the electoral processes. In the era of automation, canvassing should be not a problem but, the COMELEC still does the primitive type of manual intervention despite transitioning online since the used system is not yet perfect.
With our institution's pursuit to innovation, the TEAM BPI come up with a proposal for a secure, efficient, and user-friendly interactive voting kiosk system. It features facial recognition for secure authentication, a user-friendly touchscreen, and real-time updates on smart TVs.
Providing something new to the technologian community assumes more involvement and motivation to the students of CIT-U during the electoral process
Jim Kenn Banilad jr.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes


PROBLEM
VOTER'S TURNOUTS
OVER THE YEARS
2022
26.90%
2022
2020
2020
49%
2021
2021
38.1%
Jim Kenn Banilad jr.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes

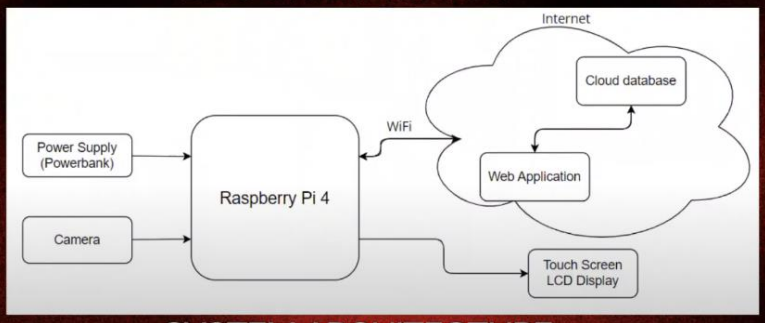

OBJECTIVES
01.
Develop an Intuitive Touchscreen Voting Interface
02.
Ensure Instant and Accurate Display of Voting Counts
03.
Guarantee Authentic Votes Using Facial Recognition Mechanisms' Verification
04.
Enhance Data Accessibility, Screen Display, and Engagement
05.
Create a Highly Portable, affordable and Compact Solution
Jim Kenn Banilad jr.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes


SIGNIFICANCE OF THE STUDY
01. SSG COMELEC
02. Future Researchers
03. Techonologian Community and Administration
Jim Kenn Banilad jr.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes


THEORETICAL FRAMEWORK
Internet of Things (IoT) Framework
Facial Recognition Technology
Client-Server Architecture
Location-Based Services (LBS) Theory
Real-Time Database Concepts
Geographical Information Systems (GIS) Concepts
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes
Jim Kenn Banilad jr.

METHODOLOGY

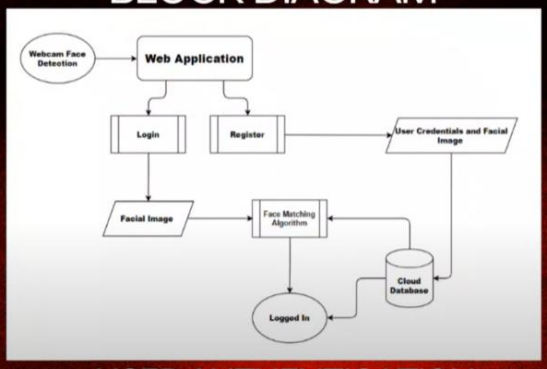
BLOCK DIAGRAM



SYSTEM ARCHITECTURE

METHODOLOGY

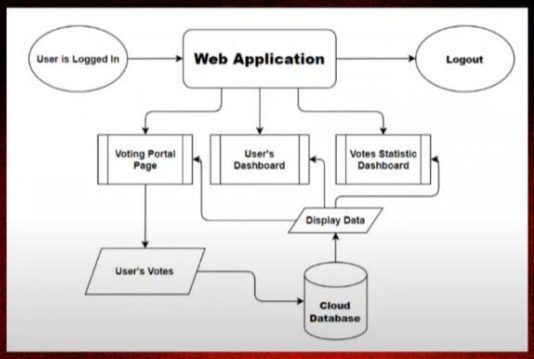
BLOCK DIAGRAM



USER AUTHENTICATION

METHODOLOGY

BLOCK DIAGRAM



USER INTERFACE


Kyle Ivan L. Polancos

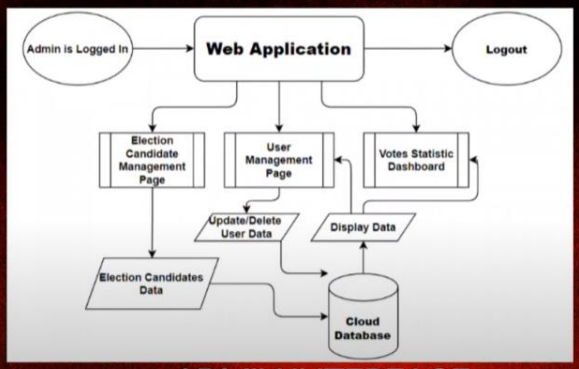
LI

Louise Martin Inocentes


Jim Kenn Banilad jr.

METHODOLOGY

BLOCK DIAGRAM



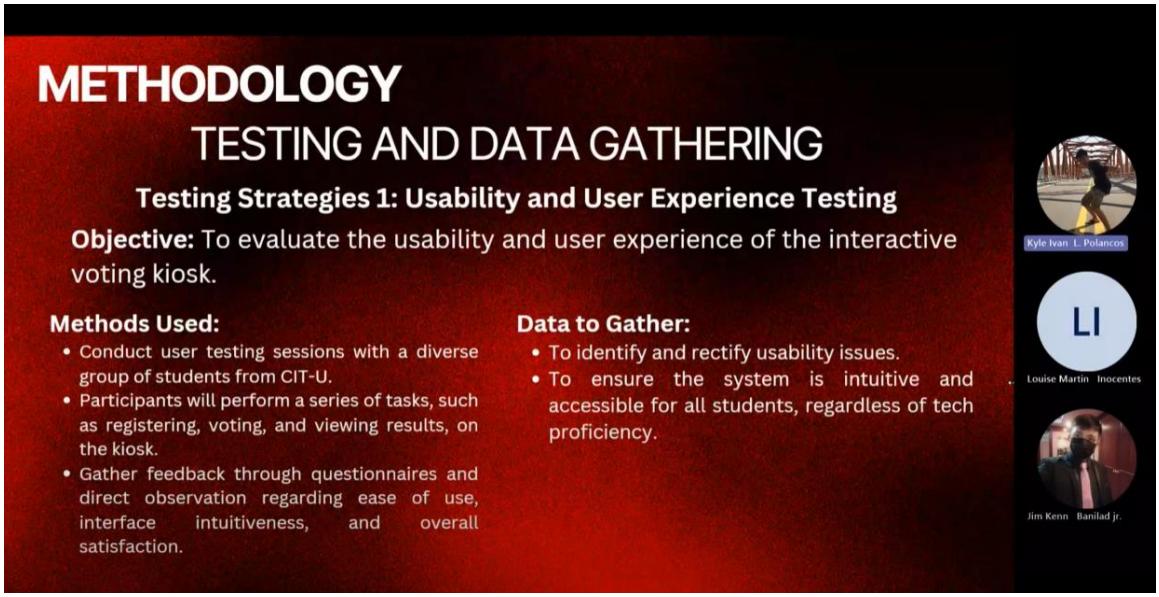
ADMIN INTERFACE

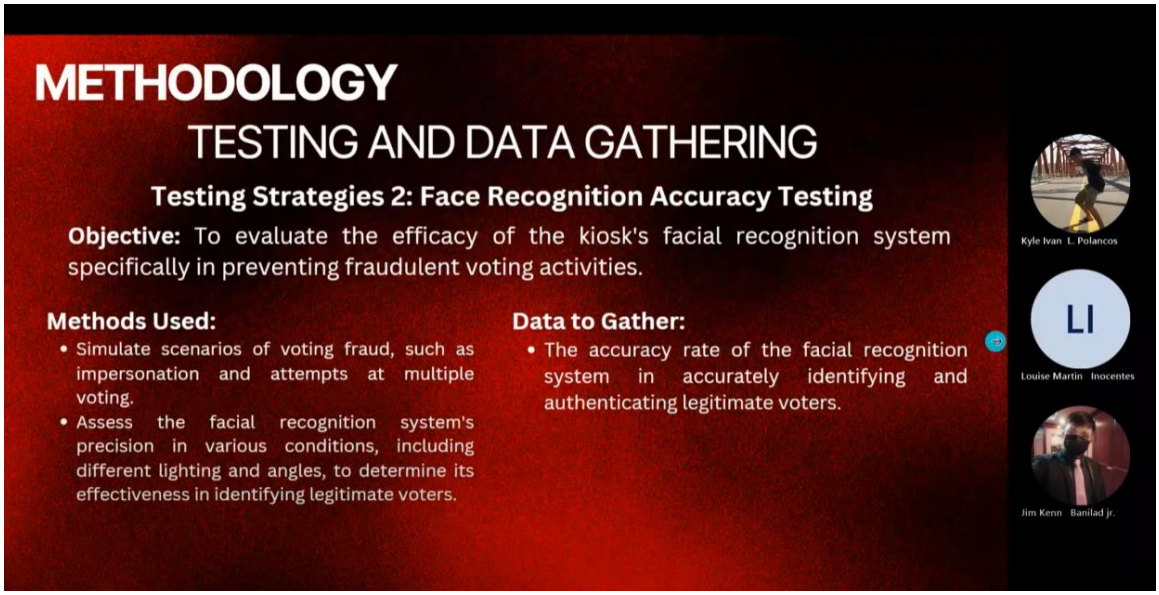

Kyle Ivan L. Polancos

LI

Louise Martin Inocentes


Jim Kenn Banilad jr.


METHODOLOGY
TESTING AND DATA GATHERING
Testing Strategies 1: Usability and User Experience Testing
Objective: To evaluate the usability and user experience of the interactive voting kiosk.
Methods Used:
• Conduct user testing sessions with a diverse group of students from CIT-U.
• Participants will perform a series of tasks, such as registering, voting, and viewing results, on the kiosk.
• Gather feedback through questionnaires and direct observation regarding ease of use, interface intuitiveness, and overall satisfaction.
Data to Gather:
• To identify and rectify usability issues.
• To ensure the system is intuitive and accessible for all students, regardless of tech proficiency.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes
Jim Kenn Banilad jr.


METHODOLOGY
TESTING AND DATA GATHERING
Testing Strategies 2: Face Recognition Accuracy Testing
Objective: To evaluate the efficacy of the kiosk's facial recognition system specifically in preventing fraudulent voting activities.
Methods Used:
• Simulate scenarios of voting fraud, such as impersonation and attempts at multiple voting.
• Assess the facial recognition system's precision in various conditions, including different lighting and angles, to determine its effectiveness in identifying legitimate voters.
Data to Gather:
• The accuracy rate of the facial recognition system in accurately identifying and authenticating legitimate voters.
Kyle Ivan L. Polancos
LI
Louise Martin Inocentes
Jim Kenn Banilad jr.

Approval Sheet

CIT-U College of Engineering
Computer Engineering Department

CpE 481 Approval Sheet

Title of the Project WildVote: Technologian Smart Voting System	**Date Submitted** **March 7, 2023**
Name of Proponents Banilad Jr., Jim Kenn Inocentes, Louise Martin Polancos, Kyle Ivan L.	**Name of Adviser** Mrs. Johnalyn L. Figueras

Brief Description of the Project

The project entails developing an interactive voting kiosk system. Users begin by approaching the registration for the system where the administration will facilitate. The registration aims to capture an individual's fingerprint image using a sensor and then analyzing the distinctive features of the fingerprint, such as ridges, loops, and whorls. A fingerprint recognition feature then verifies the authenticity of the user, ensuring that the individual is a bonafide technologian who is currently enrolled for the school year. The kiosk boasts a touchscreen interface for easy user interaction. To make it more intuitive, the user interface will feature *wild wizard* – a UI wizard for step-by-step instruction of the process of votation. Speaking of storage, all data gather and processed will be stored in the cloud database making it convenient for the administration for up-to-date status. The system kiosk should be compact, lightweight, budget-friendly and also fitted with wheels for mobility. The wildvote app allows the administrators to check in real time vote turnouts and candidate standings. Additionally, the system offers real-time voting statistics updates for voting transparency to the technologian community. The researchers are eyeing to the opportunity to use the smart TVs strategically places in the vicinity since it will be much convenient to display to real-time votes.

Objectives of the Project

- To develop an intuitive touchscreen voting interface that modernizes CIT-U's traditional voting processes.
- To ensure the instant and accurate display of voting counts as they are cast and enhance transparency.
- To ensure authentic votes using fingerprint recognition mechanisms' verification.
- To ensure the system is a highly portable and compact solution, enabling its deployment in various voting locations.

Testing Strategies

- ***Functional Testing:*** evaluates the system's specific functionalities to ensure they work as intended.
- ***Performance Testing:*** gauges the system's efficiency and responsiveness under various conditions.
- ***Network Testing***: ensures the system's robustness and reliability in terms of internet connectivity.
- ***End-to-End Testing***: End-to-end testing simulates a user's complete interaction with the system, from start to finish.

CIT-U College of Engineering
Computer Engineering Department

Agreement

This is to certify that the project entitled *WildVote: Technologian Smart Voting System* has been approved by the CpE 526 Project Proposal Approving Committee. It was agreed that the team needs to implement the major functionalities and will be checked based on incremental milestones. It is also understood that each increment will be given specific percentage as specified in the table below. Failure to have project checking on the dates agreed is considered zero for a particular Increment.

Milestone		Functionalities Included
Increment 1	40%	❖ **WildVote App Core Feature** ➢ User Interface (UI) for Registration ➢ Administrator Controls: ▪ Allows the administrator to add, delete, modify candidates for election ➢ Vote Submission ▪ Mechanism to submit the vote once the user has made their choice.
Increment 2	60%	❖ **Voting Interface & Real-time Updates** ➢ Real-time Voting Statistics: ▪ Display live voting statistics on the kiosk and potentially on strategically placed smart TVs for transparency ➢ Hardware integration ▪ Finger print recognition and verification of voter. ▪ Touchscreen for the user interface ❖ **WildVote App Core Feature** ➢ User Interface (UI) for Registration ➢ Administrator Controls: ▪ Allows the administrator to add, delete, modify candidates for election ➢ Vote Submission ▪ Mechanism to submit the vote once the user has made their choice.
Increment 3	80%	❖ **Mobility, Security & Administrator Controls** ➢ Kiosk Mobility: ▪ Equip the kiosk with wheels for easy transport. ➢ Administrator Controls: ▪ Software for administrators to check real-time vote turnouts and candidate standings. ❖ **Voting Interface & Real-time Updates** ➢ Real-time Voting Statistics: ▪ Display live voting statistics on the kiosk and potentially on strategically placed smart TVs for transparency ➢ Hardware integration ▪ Finger print recognition and verification of voters ❖ **WildVote App Core Feature** ➢ User Interface (UI) for Registration ➢ Administrator Controls: ▪ Allows the administrator to add, delete, modify candidates for election ➢ Vote Submission

		▪ Mechanism to submit the vote once the user has made their choice.
Increment 4	100%	❖ **Network Integration, Finalization & Testing** ➢ Network Integration: ▪ Internet Connectivity: • to ensure a stable connection to the internet ▪ Cloud database Connection: • Integration with a cloud database to securely store and retrieve voting data. This ensures that votes are not only stored locally but also backed up in a secure cloud environment. ❖ **End-to-End System Testing:** ➢ Functional testing ▪ Ensure all functionalities, from ID input to vote submission, work as intended. ➢ Performance Testing ▪ Evaluate the system's responsiveness, especially during peak voting hours, and its capacity to handle multiple users. ➢ Network testing ▪ Test the system's ability to maintain a stable internet connection and its performance under different network conditions. ➢ End-to-end User Simulation ▪ Simulate the complete voting process from a user's perspective, ensuring all components work harmoniously from registration to vote submission. ❖ **Integration with External Displays:** ▪ to display real-time voting statistics on smart TVs placed strategically in the vicinity. This enhances transparency and allows the larger community to stay updated on voting progress.

Grading System

The team also affixes their signature in agreement to the grading system and regulations in the evaluation of the project. The passing percentage is 50%. Students whose percentage will go below 50% will be given a chance through written or practical exam related to their project. The highest grade for those who will take the removal exam is 3.0.

Criterion	Percentage
Milestones/Deliverables	40%
Documentation	20%
Presentation and Defense	40%

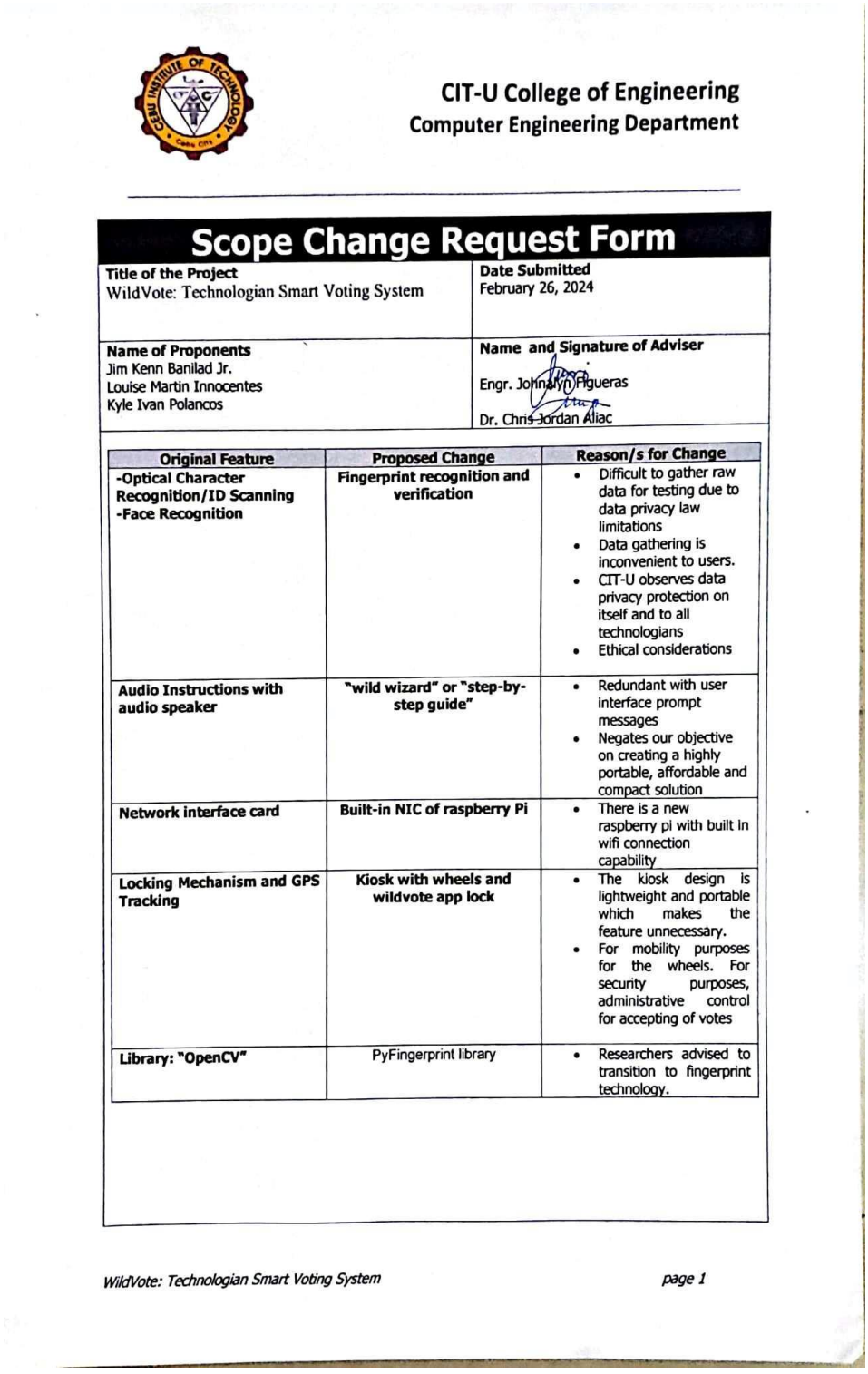
Promptness of Deliverables

The team is advised to observe promptness in submitting deliverables/milestones to ensure completion of the project within the given duration. A delay in submission of one of the deliverables would already affect the final delivery of the project. The team's failure to come during project checking for an increment would mean zero for that particular increment. Delay in document deliverables would mean subtraction of 10 points from the milestone item of Documentation criteria.

Signatories and Proponents

Approval Signature	Proponents
Johnalyn Figueras (Adviser)	Banilad Jr., Jim Kenn
Chris Jordan Aliac (Project Coordinator	Inocentes, Louise Martin
	Polancos, Kyle Ivan L.

Scope Change



CIT-U College of Engineering
Computer Engineering Department

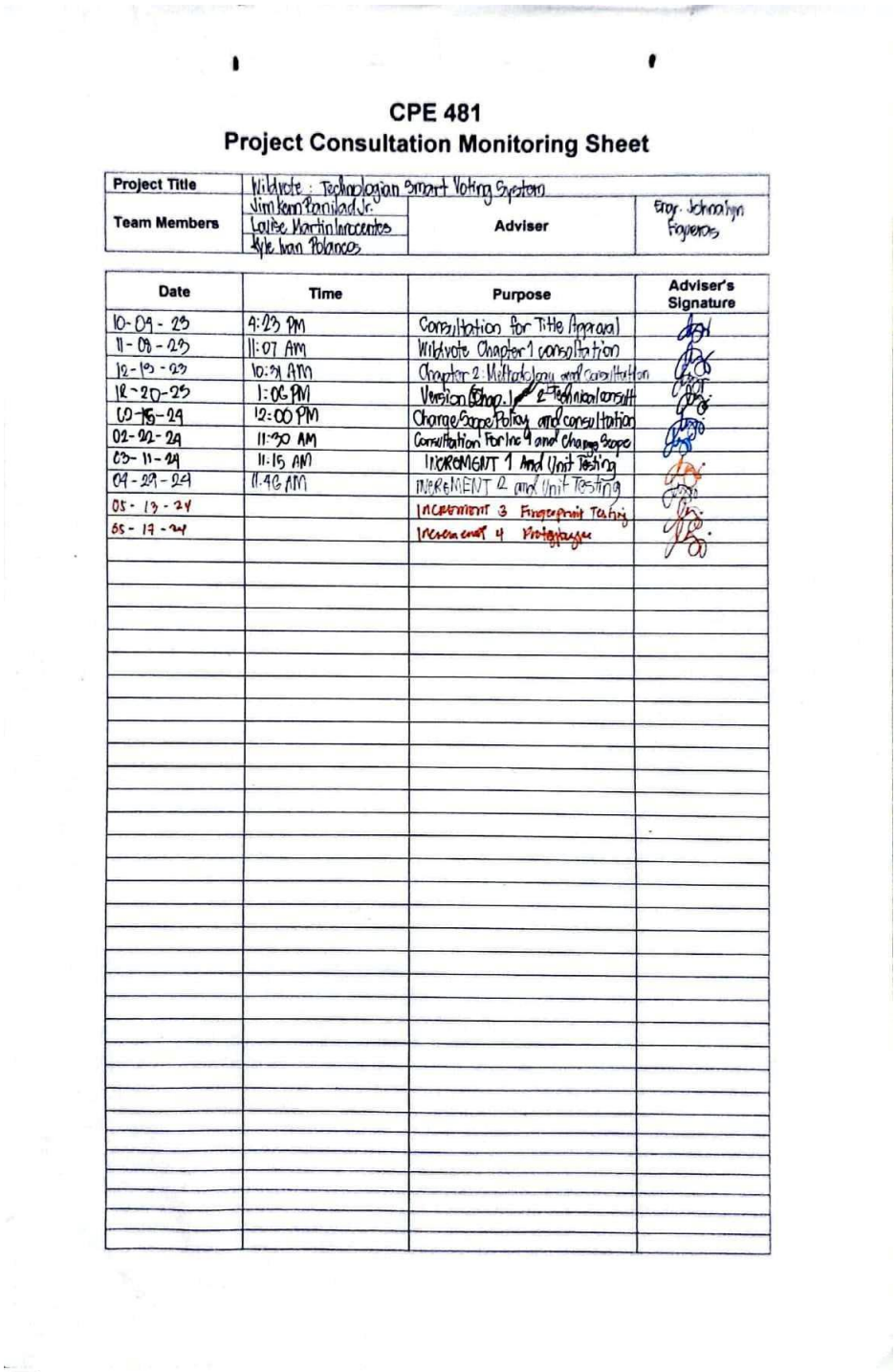
Scope Change Request Form

Title of the Project	Date Submitted
WildVote: Technologian Smart Voting System	February 26, 2024
Name of Proponents Jim Kenn Banilad Jr. Louise Martin Innocentes Kyle Ivan Polancos	**Name and Signature of Adviser** Engr. Johnalyn Figueras Dr. Chris Jordan Aliac

Original Feature	Proposed Change	Reason/s for Change
-Optical Character Recognition/ID Scanning -Face Recognition	Fingerprint recognition and verification	• Difficult to gather raw data for testing due to data privacy law limitations • Data gathering is inconvenient to users. • CIT-U observes data privacy protection on itself and to all technologians • Ethical considerations
Audio Instructions with audio speaker	"wild wizard" or "step-by-step guide"	• Redundant with user interface prompt messages • Negates our objective on creating a highly portable, affordable and compact solution
Network interface card	Built-in NIC of raspberry Pi	• There is a new raspberry pi with built in wifi connection capability
Locking Mechanism and GPS Tracking	Kiosk with wheels and wildvote app lock	• The kiosk design is lightweight and portable which makes the feature unnecessary. • For mobility purposes for the wheels. For security purposes, administrative control for accepting of votes
Library: "OpenCV"	PyFingerprint library	• Researchers advised to transition to fingerprint technology.

WildVote: Technologian Smart Voting System *page 1*

Attendance Monitoring Sheet



CPE 481

Project Consultation Monitoring Sheet

Project Title	WildVote : Technologian Smart Voting System		
Team Members	Jim Kem Panilad Jr. Louise Martin Inocentes Kyle Ivan Polancos	Adviser	Engr. Johnalyn Fajeros

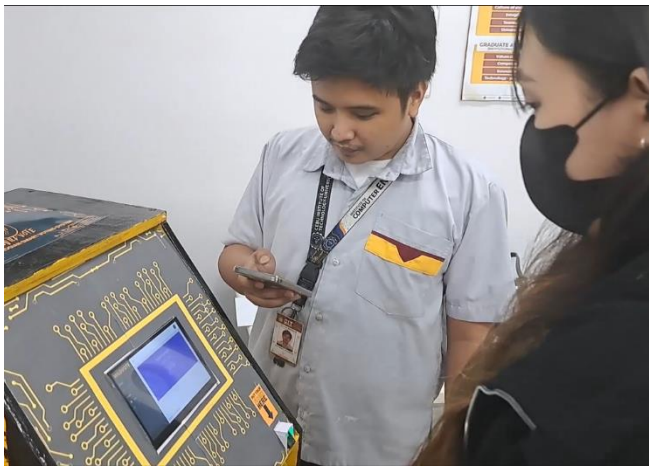
Date	Time	Purpose	Adviser's Signature
10-09-23	4:23 PM	Consultation for Title Approval	
11-08-23	11:07 AM	WildVote Chapter 1 consultation	
12-19-23	10:31 AM	Chapter 2 Methodology and consultation	
1R-20-23	1:06 PM	Version 1 Shop. 2 Technical consult	
01-15-24	12:00 PM	Change Scope Policy and consultation	
02-22-24	11:30 AM	Consultation For Inc 4 and Change Scope	
03-11-24	11:15 AM	INCREMENT 1 And Unit Testing	
04-29-24	11:46 AM	INCREMENT 2 and Unit Testing	
05-13-24		INCREMENT 3 Fingerprint Testing	
05-17-24		Increment 4 Prototyping	

APPENDIX C

PROJECT DESIGN DOCUMENTS

RAW DATA GATHERED

FINGERPRINT DATA GATHERING, AND USER ACCEPTANCE TESTING

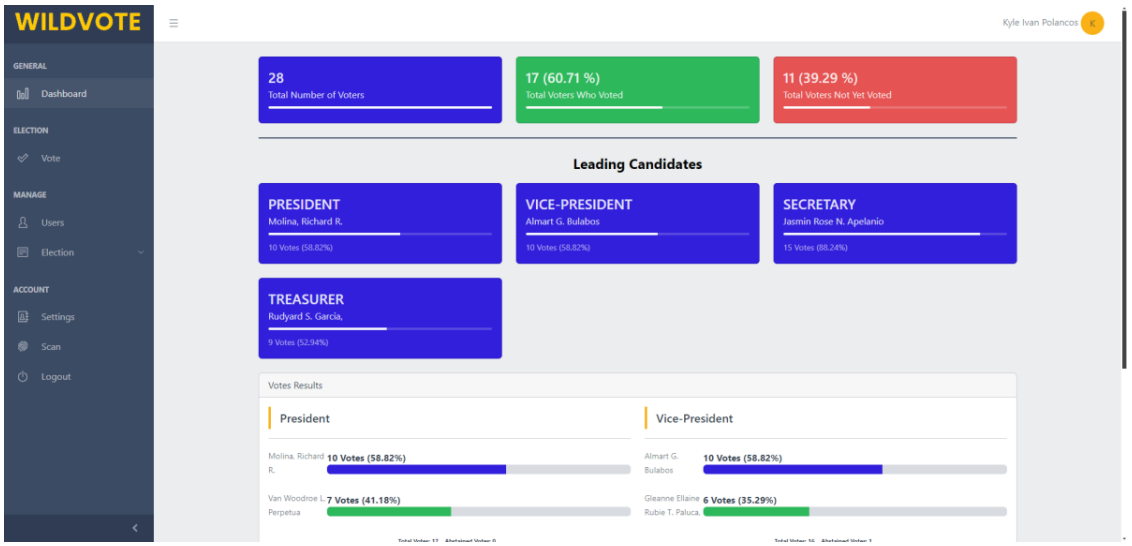


SEQUENTIAL OF OPENING DASHBOARD, VOTE PAGE, AND SUBMITTING THEIR VOTES IN GROUPS OF 5, 10, 15

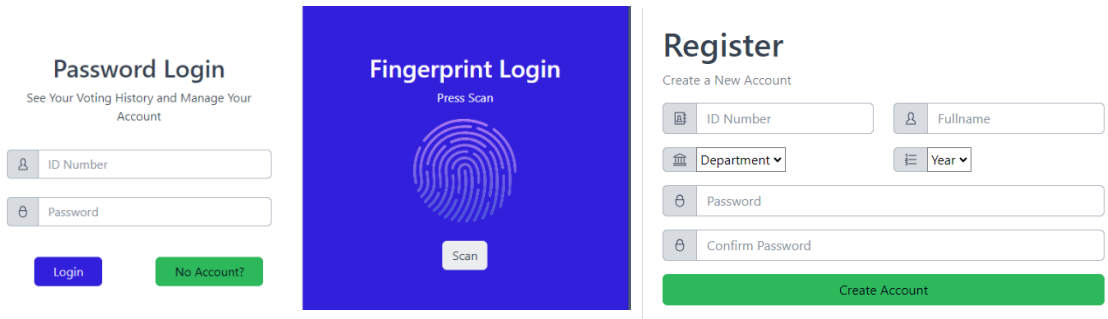
SCREENSHOTS

Web Application

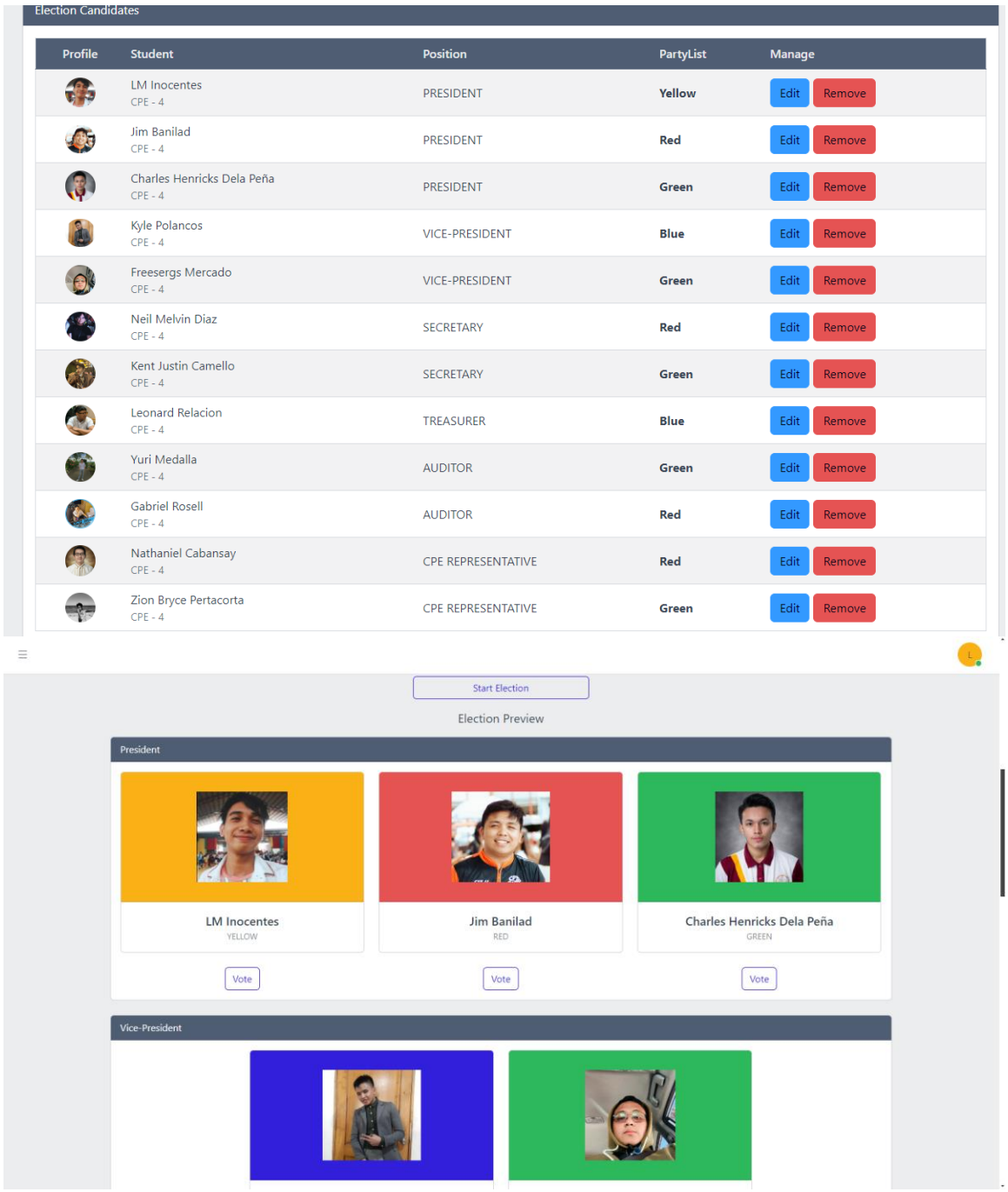
Dashboard



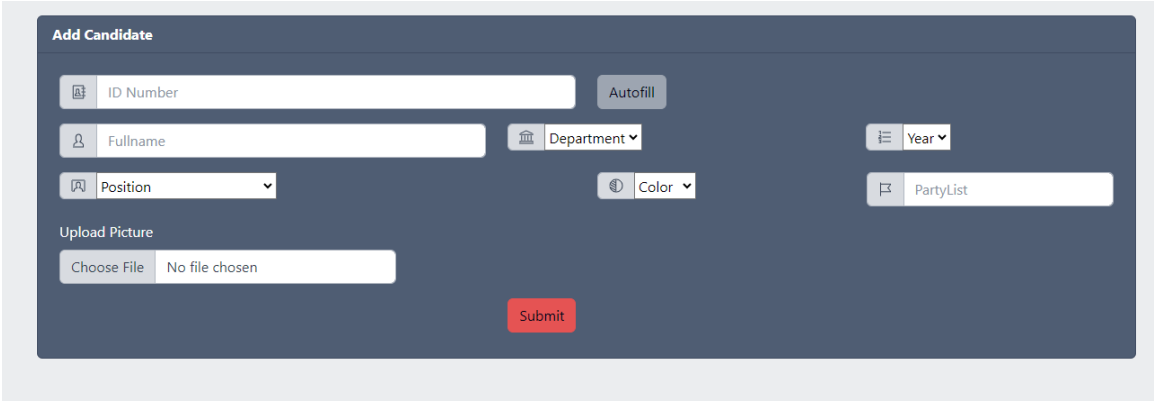
Login & Register



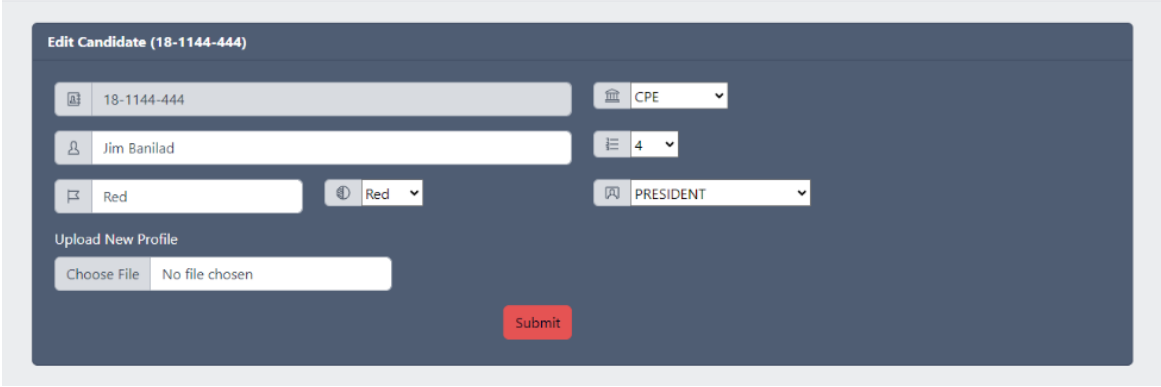
Manage Candidates



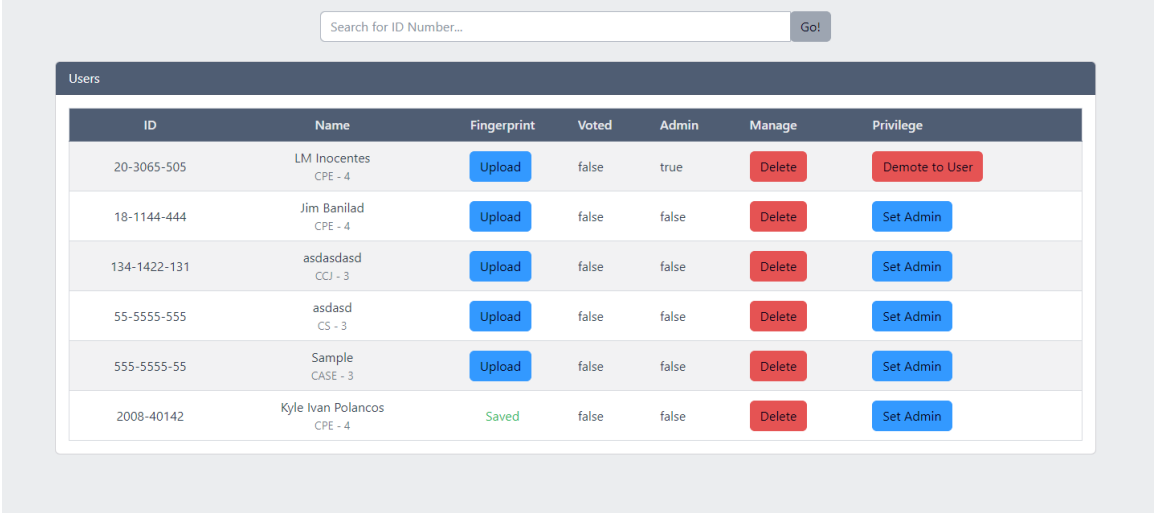
Add Candidate



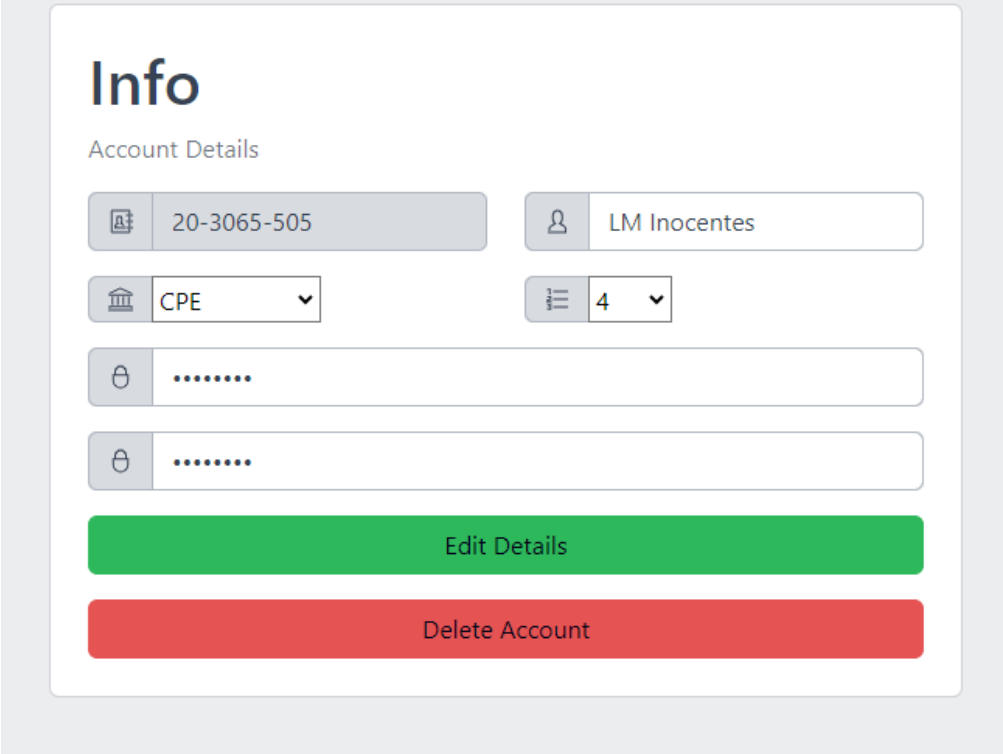
Edit Candidate



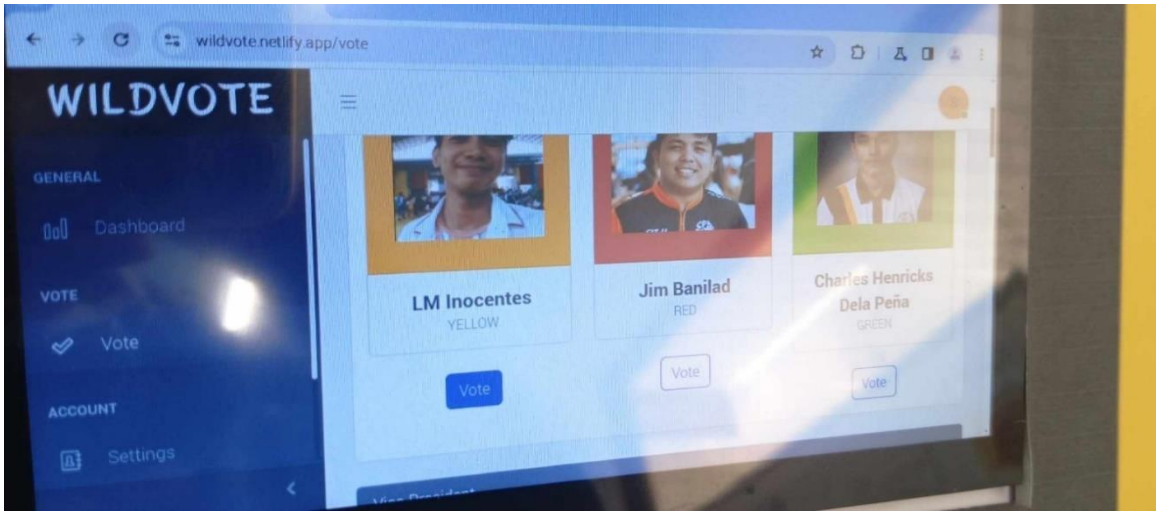
Manage Users



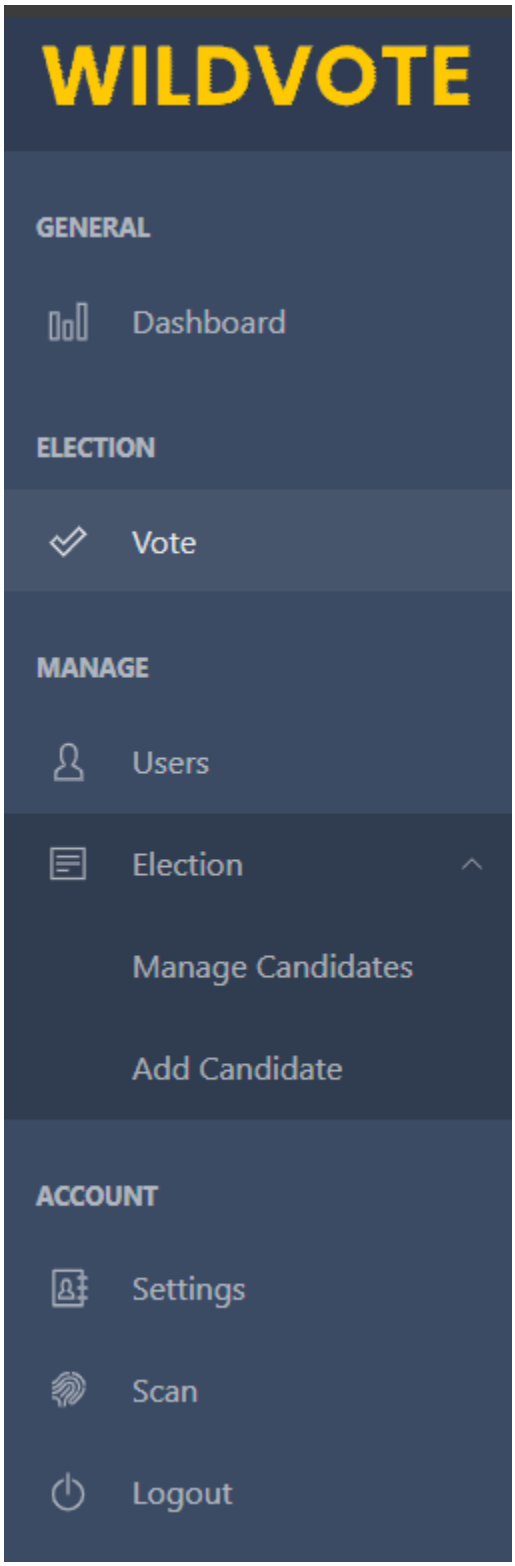
Account Settings



Voting Page

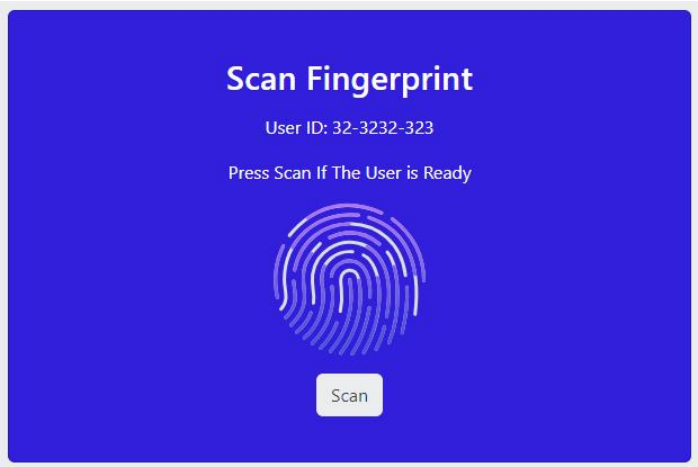


Navigation Bar

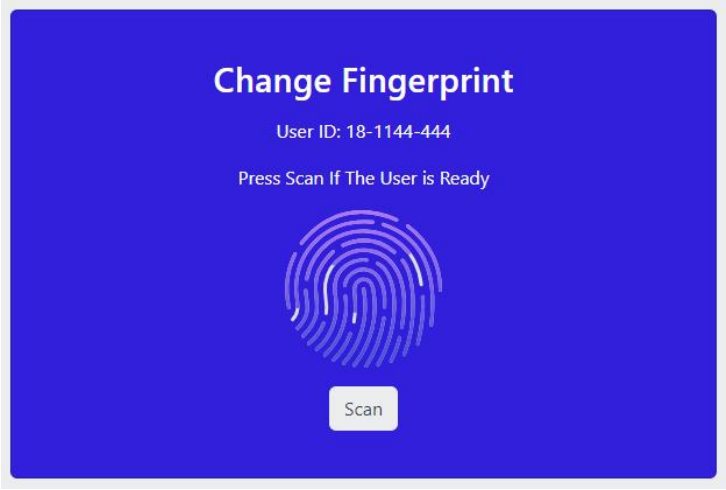


Fingerprint Registration UI (User)

Fingerprint Registration UI (Admin)



Fingerprint Change UI (Admin)



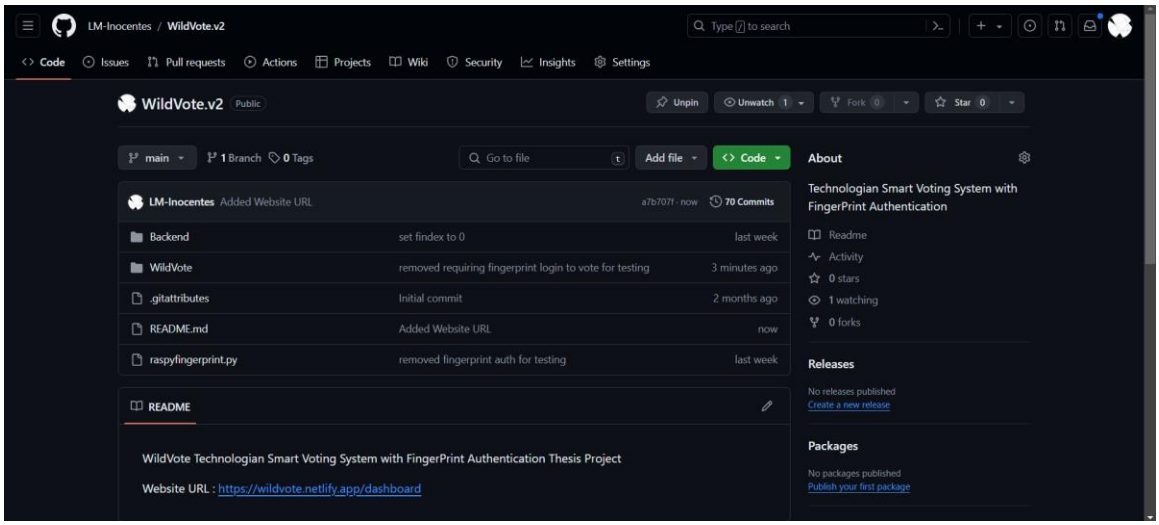
WildVote Kiosk

External View

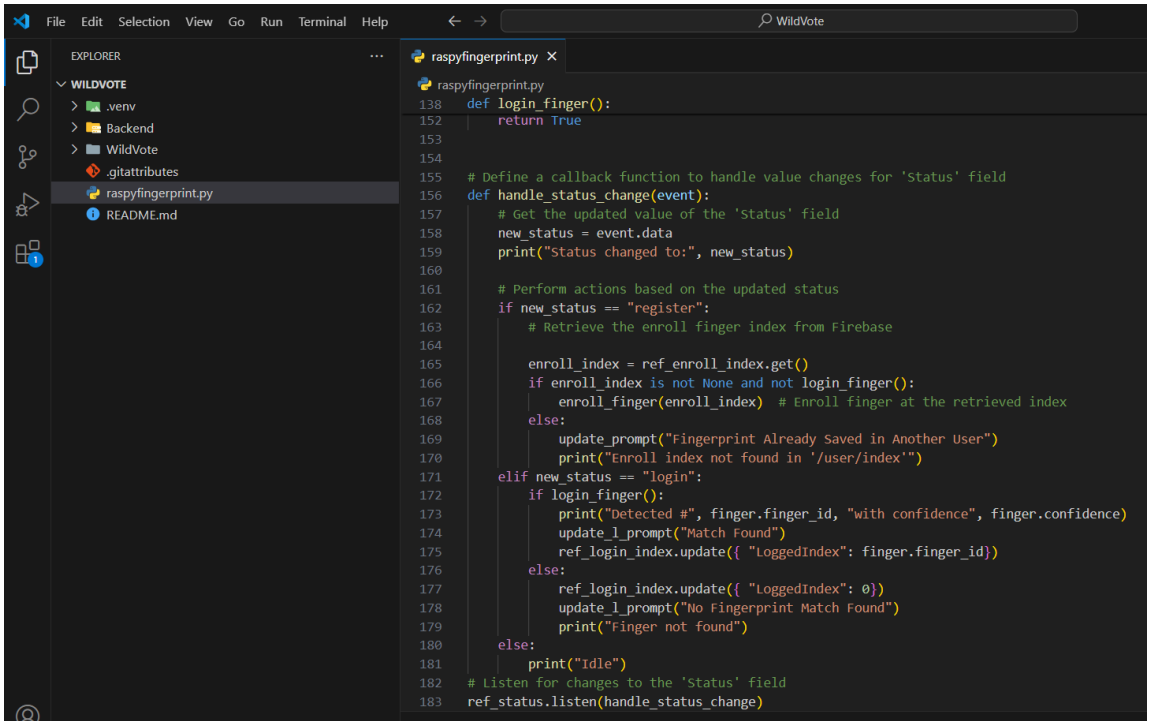
Internal View

CODES

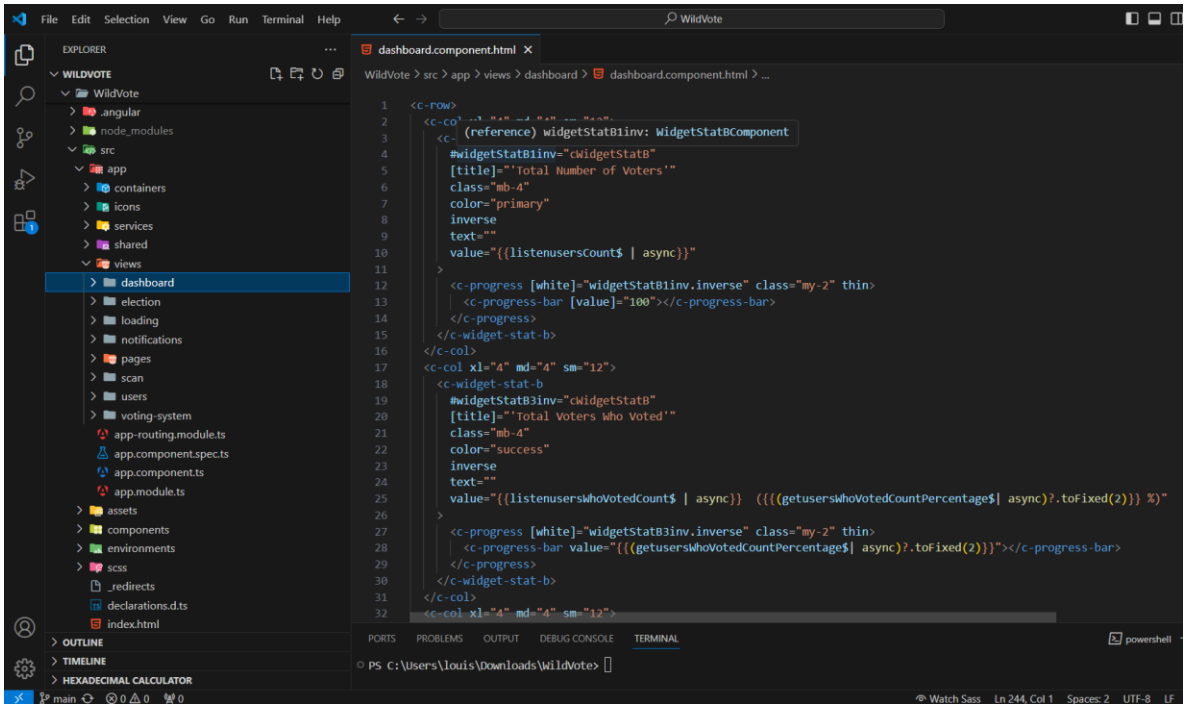
Web Application GitHub Link: https://github.com/LM-Inocentes/WildVote.v2



Fingerprint Registration/Authentication Code



Frontend Folder Structure



Backend Folder Structure