Contact No.
Email:
www.neust.edu.ph

Abstract

A real-time biometrics has emerged as a powerful technology for instant and reliable identity verification in our digital age. By leveraging unique physiological or behavioral traits, real-time biometric systems provide a seamless and secure means of authentication. This study explores the concept of real-time biometrics, its benefits, challenges, and implications. The technology's ability to mitigate identity theft and fraud while offering convenience and user experience enhancements is highlighted. Privacy concerns, technological limitations, and potential biases within biometric algorithms are also addressed. The study concludes by emphasizing the need for continual research and development to ensure the accuracy, inclusivity, and responsible implementation of real-time biometrics in various domains.

Table of Contents

CHAPTER 1 5

The Problem and its Background 5

Introduction 5

Related Literature 6

Conceptual Framework 11

Scope and Delimitation 13

Significance of the Study 13

CHAPTER II 16

Research Methodology 16

Research Design 16

Research Locale 17

Research Instrument 18

Data Gathering Procedure 19

Requirements Analysis 19

Statistical Treatment of Data 20

CHAPTER III 21

Results and Discussion 21

System Requirements 21

Designing Stage 23

Development Stage 27

Testing and Debugging 31

Releasing 33

Project Evaluation 33

Functionality 33

Usability 35

Reliability 36

Performance 37

Supportability 38

Maintainability 39

CHAPTER IV 41

Summary, Conclusions and Recommendations 41

Summary41

Conclusions41

Recommendations42

References43

Appendix A: Reference Library45

Appendix B: Data Gathering Instrument46

Appendix C: System Requirments51

Appendix D: Installation52

Appendix E: User Manual53

Appendix F: Estimated Cost of Deployment63

Appendix G: Project Work Photos64

CHAPTER 1
The Problem and its Background

Introduction

In today's fast-paced and interconnected world, efficient and accurate attendance management is vital for organizations of all sizes. Traditional methods of attendance tracking, such as manual sign-in sheets or swipe cards, are prone to errors, time-consuming, and lack reliability (Teachmint, 2023.). Biometrics attendance systems offer a cutting- edge solution by leveraging unique physiological or behavioral traits of individuals for instant and precise attendance verification.

Biometrics attendance systems utilize biometric identifiers such as fingerprints and facial features to authenticate individuals in real-time. This advanced technology captures and analyzes the biometric data of individuals as they check in or out, providing immediate and accurate attendance records. The speed and accuracy of real-time biometrics enable organizations to streamline their attendance management processes and make informed decisions based on reliable data.

One of the key advantages of a biometrics attendance system is its ability to eliminate time theft and buddy punching. Biometric traits are highly unique to individuals, making it virtually impossible for employees to cheat the system by proxy attendance. This level of security ensures that attendance records are accurate, and organizations can effectively manage workforce attendance, scheduling, and payroll.

Biometrics attendance systems represent a significant advancement in attendance management. By leveraging unique physiological or behavioral traits, these systems provide instant and accurate attendance verification,

eliminating time theft and improving overall efficiency. As organizations strive for more reliable and streamlined attendance tracking, real-time biometrics attendance systems offer a transformative solution.

Related Literature

Biometrics Attendance, a rapidly evolving field, encompasses the application of advanced technologies to capture, analyse, and utilize biometric data in real-time. This literature review aims to explore the advancements, challenges, and implications associated with real-time biometrics, shedding light on its potential benefits and limitations.

Current Biometrics Adoption and Trends

Currently, biometrics are employed in a wide variety of domains. According to a 2018 report by German and Barber from the Center of Identity, University of Texas at Austin, the top three sectors which embrace biometric methods are financial services, technology, and government. This is followed by the workplace, recreation, and healthcare and with the least usage in the education domain. (German and Barber, 2018)

Biometrics Application

For most organizations, data and computer protection has become crucial, particularly in recent years, with "hackers" growing in number and becoming more skilled in accessing and changing personal details. Hackers understand and can use a range of devices to hack into networks and servers, including sniffers; they crack passwords and rootkits, among other things, that can be found easily on the Internet. Safety has also proved been a daunting challenge, in terms of providing more comprehensive

protection, for cities and higher authorities, beneficial monitoring organizations and airport security (Meng et al., 2014).

The applications of biometrics can be divided into the following three main groups:

- Commercial applications: Such as e-commerce, Internet, access, ATMs, credit cards, physical access control, cellular phones and medical records management
- Government applications: Such as national ID cards, correctional facilities, driver's licenses, social security, border control and passport control
- Forensic applications: Such as corpse identification, criminal investigations, terrorist identification, parenthood determination and missing children

Biometrics in workplace

Traditionally, commercial applications have used data authentication (e.g., PINs and passwords), government applications have used tangible token-based systems (e.g., ID cards) and forensic applications have relied on human and biometrics experts to match biometric features.

Biometric systems are being increasingly deployed in large-scale civilian applications. The Schiphol Privium scheme at the Amsterdam airport, for example, employs iris-scan cards to speed up the passport and visa control procedures (Jain et al., 2011). Passengers enrolled in this scheme insert their card at the gate and look into a camera; the camera acquires the image of the traveler's eye and processes it to locate the iris and compute the Iris Code; the computed Iris Code is compared with the data residing in the card to complete user verification (Jain et al., 2011). A similar scheme is also being

used to verify the identity of Schiphol airport employees working in high-security areas. Thus, biometric systems can be used to enhance user convenience while improving security

Biometrics in Education

Biometric "is the science of analyzing physical or behavioral characteristics specific to each individual to authenticate their identity." In a few words, it measures the human body. This technology can measure physiological and behavioral traits . A combination of characteristics can also be made as a multimodal biometric, which improves measurement confidence. Such combinations could be face and fingerprint, face and iris, etc. The main benefit of biometric technology is that it collects unique human characteristics for each person (Thales. 2020)

Like virtually all sectors of the economy, education underwent drastic changes following the outbreak of COVID-19. In-person teaching virtually disappeared, with online learning taking its place across the world. As schools, universities and colleges continue to put the health and welfare of students at the forefront, a blended learning approach is expected to remain. Biometrics, could enable the education sector to meet the increasingly complex needs of students amidst this ongoing transformation.(Int J Interact Des Manuf. 2021)

Biometric person recognition systems share many issues and challenges with other pattern recognition applications like video surveillance, speech technologies, human–computer interaction, data analytics applications, behavioral modeling, or recommender systems. Identity Management Systems (IMS) are platforms where a permission device gives access to a specific service. These are used in education to provide access to a given product or service or for electronic registration. Passwords are very unsafe and sometimes created to be easy to remember. Biometrics are used in this area for security reasons, as it can grant access to a given system to only authorized persons, identified by their physical

or behavioral characteristics (Šošević, U., Milenković, I., Milovanović, M., & Minović, M. 2013). Fingerprint cards are already used in schools for students that acquire free meals in coffee shops (Gold, S. 2010). Indeed, the use of fingerprints is a common practice from elementary school to universities/research centers.

Nita and Mihailescu (Nita, S., & Mihailescu, M. 2018). proposed a secure e-learning system based on biometric authentication and homomorphic encryption exploiting cloud computing. Additionally, this proposal predicts if he/she would pass a final exam based on past data of the user's behavior (using biometrics data).

Identity Management

In the mode of verification, the system approves an individual's identity by comparing the captured biometric features with the individual's biometric template stored in the framework database. In this system, a person who aims to be positively identified claims a factor – generally by means of an individual distinguishing proof number (PIN) or a user name – then the framework system conducts a one-to-one comparison to decide whether the claim is true or not. This mode aims to answer the question "is this person whom he/she claims to be".

Security

In the mode of identification, the individual's identity is recognized by looking through template of all the users in the database for a match. Hence a system conducts a one -to- many comparisons to establish an individual's identity. The identification mode classifies and identifies some unknown identity. It aims to answer questions such as "who is this person". Distinguishing proof is a basic part in negative acknowledgment applications where the framework builds up whether the individual is who

she denies being. The motivation behind negative acknowledgment is to keep an individual from utilizing numerous identities. Identification may also be utilized as a part of positive acknowledgment for convenience (where the induvial is not required to prove an identity). While the traditional methods of personal recognition such as passwords and tokens work for positive recognition, only biometrics can be used for negative recognition (SALIL, P., SHARATH, P, and ANIL, K. 2003)

Synthesis

Biometric attendance systems have emerged as a transformative solution in attendance tracking by leveraging unique biological features for identification and verification. Employing modalities such as fingerprint recognition offer unparalleled accuracy and reliability. The real-time monitoring capability ensures prompt attendance data tracking, contributing to efficient organizational management. Enhanced security is a prominent benefit, as biometric traits are difficult to forge, mitigating the risk of unauthorized access and ensuring trustworthy attendance records. While promoting time efficiency and cost savings over the long term, challenges such as privacy concerns, technical limitations, and initial implementation costs must be addressed. Widely applicable across corporate environments, educational institutions, and government services, biometric attendance systems represent a technological advancement that addresses the shortcomings of traditional attendance tracking methods, emphasizing accuracy, efficiency, and heightened security in various sectors.

Conceptual Framework

The diagram below will define the process of how proponents came to the conclusion of discovering solution for the existing problem of the chosen locale. The input explains how proponents gather the information through surveys, interview, and web searching. After that, the process explains how the proponents came to the conclusion of having solution designed through user requirements. And finally, the output reveals the insights for system development intended for Penaranda National High School.

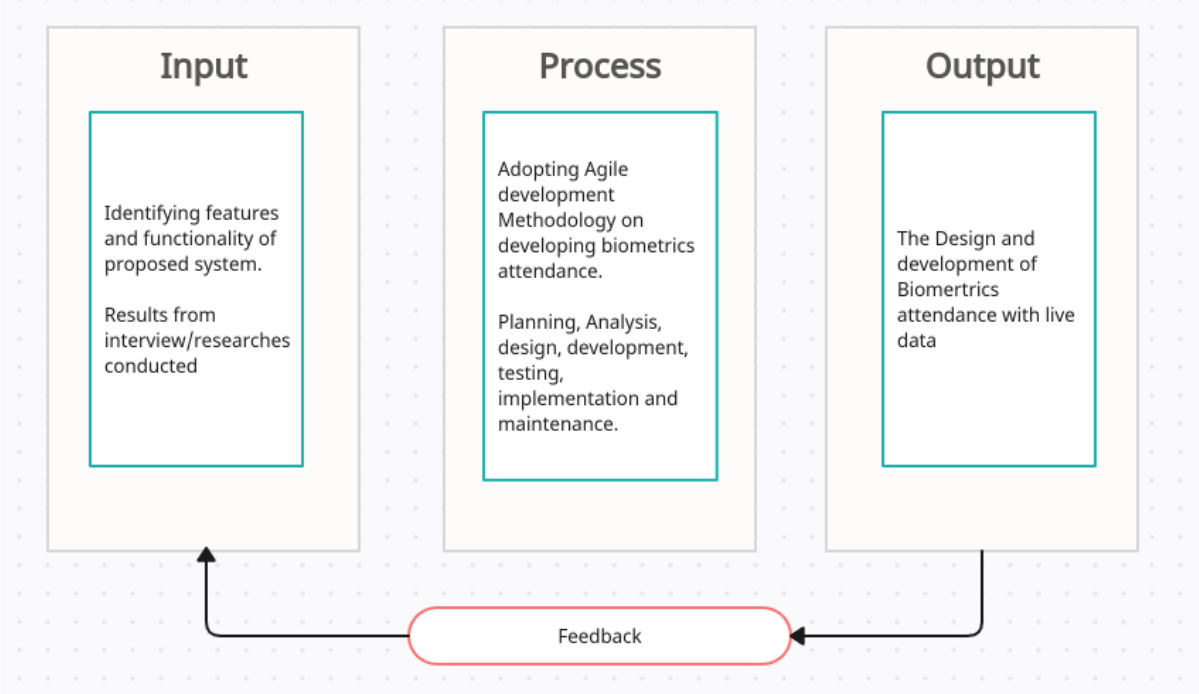


Figure 1 Conceptual Framework

Statement of the problem

The current attendance tracking system faces several challenges that hinder efficiency, accuracy, and data integrity. Firstly, the system's data processing takes an extended period, resulting in significant delays in checking and analyzing attendance records. Secondly, the system encounters difficulties in accurately tracking records when incorrect inputs or instances of missing punch in/punch out occur. This lack of visibility creates challenges in effectively monitoring employee attendance and may lead to discrepancies in calculating work hours.

This redundancy introduces complexities and potential inconsistencies between the two methods, requiring extra effort to reconcile the data. Additionally, a critical concern arises with the system's vulnerability to tampering, as it lacks robust mechanisms to detect and prevent fraudulent activities. This opens the door for potential data manipulation or fake time entries, compromising the integrity and reliability of the attendance tracking system.

Addressing these challenges is essential to improve the overall effectiveness and security of the attendance tracking system. The study will focus on:

- How does extended data processing time affect attendance system efficiency, and what strategies improve speed without compromising accuracy?
- What challenges exist in accurately tracking attendance records, and how can precision be enhanced, especially in cases of incorrect inputs or missing punch events?
- What factors contribute to system vulnerabilities, and what security measures can be implemented to detect and prevent tampering, ensuring system integrity and reliability.

Scope and Delimitation

This study is centered on the comprehensive examination of employee attendance management at Penaranda National High School. Two primary respondent groups, encompassing employees and administrators, will actively contribute to the evaluation and implementation phases of the proposed system.

This study examines employee attendance management at Penaranda National High School. The proposed system is created using Laravel for the backend, Socket.io (Soketi) for the server, and Vue.js for the client. It includes biometric hardware for precise input and can monitor employee activities in real time.

Significance of the Study

Studying and implementing a real-time biometrics attendance system offers numerous benefits for organizations, including enhanced accuracy, time and cost efficiency, mitigation of time theft and fraud, data-driven decision making, and improved security.

- Locale - School: The study on real-time biometrics is of paramount importance to the school locale as it fortifies security measures by allowing only authorized access, safeguarding vital assets,

and ensuring the safety of students. Concurrently, it streamlines workforce management, curbing absenteeism and reducing operational costs, ultimately channeling resources towards other critical school initiatives.

- Employees and HR: For employees and HR personnel, the implementation of real-time biometrics is pivotal. It enhances the precision and accountability of HR management processes, thus enabling data-driven decisions and the efficient allocation of resources, which benefits both the workforce and the HR department.

- Researchers: Researchers will benefit from the study as it provides us with the privilege to assist schools through research and offers an opportunity to explore new technologies and innovations.

- Future Researchers: This study will provides an invaluable foundation for future researchers who wish to delve into the field of biometrics. It offers a reference point for future exploration, encouraging them to build upon the work and create further innovations, ultimately advancing the application of biometrics in educational settings.

Definition of Terms

1. Biometrics refers to the measurement and statistical analysis of people's unique physical and behavioral characteristics, often used for secure authentication or identification purposes.

2. Real-time Authentication Real-time authentication is the process of verifying the identity of a user or system immediately upon request, ensuring timely and up-to-date access control.

3. Security Verification involves the assessment and confirmation of the integrity and authenticity of a system or user, typically through the use of cryptographic protocols or authentication mechanisms.

4. Identification is the process of establishing or confirming the identity of an individual or entity, often through the use of personal information, credentials, or biometric data.

5. **PIN (Personal Identification Number)** A numeric code utilized for access or authentication.

6. **Schiphol Privium scheme** A membership program facilitating expedited airport services.

7. **Time theft** The fraudulent manipulation of work hours.

8. **Buddy punching** Occurs when one employee clocks in on behalf of another.

9. **Multimodal biometric** Involves the use of multiple biometric modalities for identification and verification.

10. **Framework** A structured set of guidelines, tools, and conventions providing a foundation for developing software applications, ensuring consistency and efficiency in the development process.

11. **Database** A organized collection of data stored electronically, typically in tables with relationships, enabling efficient data retrieval, storage, and management for various applications and systems.

CHAPTER II

Research Methodology

This chapter represents the key methods and procedures integral to our study, including details on research design, data gathering techniques, instruments used for data collection, the chosen research locale, and the identified respondents.

Research Design

This chapter initiates the analysis of the project's research design methodology and the evolution of the system's operation, process, and testing. In light of this, the researchers have opted for the Agile model as the software development life cycle for the proposed system. This choice aims to enhance adaptability and collaboration throughout the development process, fostering a more iterative and user-focused approach. The Agile model is expected to provide a dynamic framework, ensuring not only a comprehensive grasp for the researchers but also a user-friendly experience for the intended users of the proposed system.

Figure 2 Agile Model

Research Locale

The research will be conducted at Peñaranda National High School, driving specific requirements for the biometrics attendance system. This involves understanding student and faculty demographics, school infrastructure, and relevant protocols. Stakeholder insights from administrators and teachers will inform the system's customization, ensuring effective implementation within the school's unique operational context.

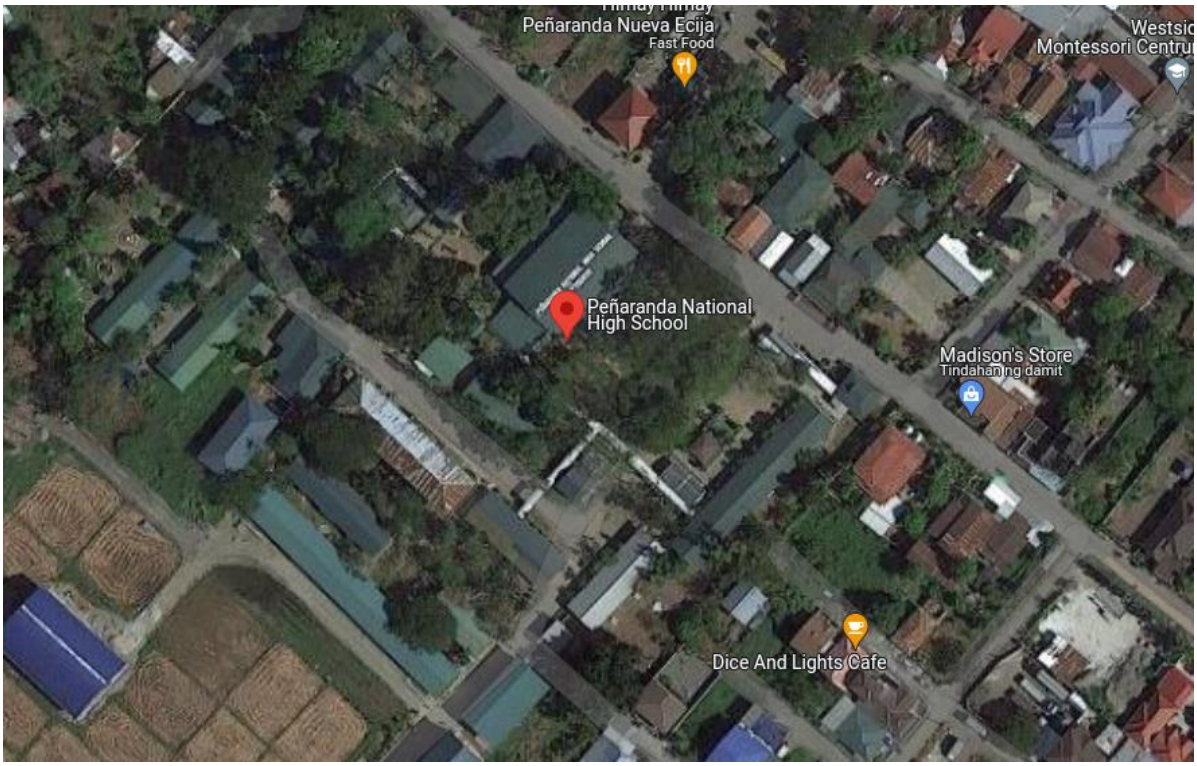


Figure 3 Peñaranda National High School

To gather the required data for the study, the researcher conducts various interviews and surveys to gather user requirement and understand the organization needs. Interviews involved face-to-face encounters with selected respondents, providing an opportunity for in-depth discussions and a deeper understanding of the current problems faced by the current attendance system.

Research Instrument

In the research study, questionnaires served as the primary research instrument for collecting essential data. Structured with clear and concise questions, these surveys were designed to systematically gather information from participants. The use of questionnaires provided a standardized approach, ensuring consistency in responses and facilitating an organized data collection process.

The researchers also utilized the Likert scale, a widely used psychometric response scale in questionnaires and survey research. This scale allows respondents to provide their perception and evaluation of the Real-time Biometrics Attendance by ranking it from one to five, with five indicating the highest rank and one representing the lowest rank.

Mean Value	**Criteria**
4.21 – 5.00	Strongly Agree
3.41 – 4.20	Agree
2.61 – 3.40	Neutral
1.81 – 2.60	Disagree
1.0 – 1.80	Strongly Disagree

Table 1 Rating Scale Criteria

Data Gathering Procedure

The development of the proposed system is a nuanced process, involving a combination of research methods to gather essential data. Questionnaires, web searches, and face-to-face interviews with respondents serve as key instruments in obtaining a comprehensive understanding of the system's requirements. Questionnaires provide a structured approach for systematic data collection, web searches offer access to relevant online information, and interviews allow for personalized insights. the development trajectory follows a strategic sequence. Initial planning and analysis involve scrutinizing the gathered information, identifying patterns, and assessing the feasibility of the proposed system. The subsequent stages encompass the creation of the system's structure, architectural design, coding, rigorous testing, and ultimately, implementation. This systematic approach ensures a well-informed and methodical development process, aiming to deliver a robust system that meets the identified needs and seamlessly integrates into the intended environment.

Requirements Analysis

The researchers aim to gain insights into the details of the current state of the system, seeking a comprehensive understanding for the study.

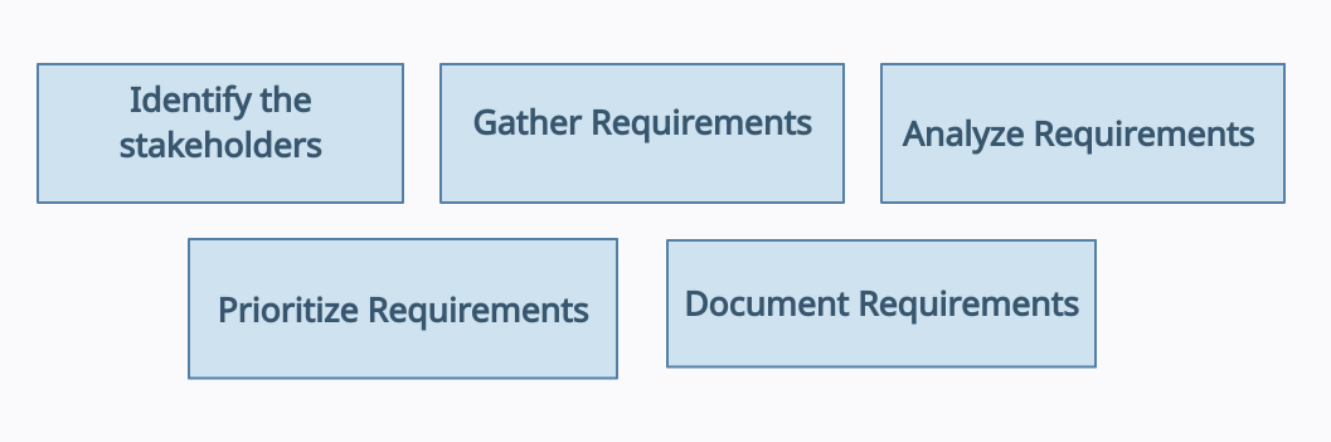


Figure 4 Analysis

Statistical Treatment of Data

In this section are the details of the statistical treatment of data collected through our survey. Understanding the nuances of participants' responses is crucial for extracting meaningful insights from our study. The responses have been gauged on a scale ranging from 4.21 to 5.00 for 'Strongly Agree,' 3.41 to 4.20 for 'Agree,' 2.61 to 3.40 for 'Neutral,' 1.81 to 2.60 for 'Disagree,' and 1.0 to 1.80 for 'Strongly Disagree.

The researchers used different statistical methods to uncover patterns, trends, and variations in the data. This will involve key statistical measures such as:

- Mean (Average):

Mean = Σ Values / Number of Observations

- Standard Deviation:

Standard Deviation = $\sqrt{(\Sigma(xi - Mean)^2 / Number\ of\ Observations)}$

- Percentage Distribution:

Percentage = (Frequency of Category / Total Number of Responses) × 100

This analysis will give us a clear picture of what respondents think. It will help us make informed decisions by interpreting the survey results thoroughly.

CHAPTER III

Results and Discussion

This chapter details how we developed the system and refined its components. It also discusses the findings and insights derived from the data collected during the evaluation phase.

System Requirements

In order for the system work effectively, it is vital to meet the following hardware and software requirements:

Software Requirements	Hardware Requirements
• Windows/Linux Operating System (*preferred Ubuntu base distro on linux and Windows 10 or higher on windows*) • Any Modern Browser*(preferred Firefox and Chrome)* • Docker Desktop on windows(since cron job only works with unix base system)	• RAM (8 GB or Higher) • CPU (i3 or Higher) • Hard Disk (120 GB or Higher) • ZKTeco Device with TCP/IP support • LAN cable

Table 2 System Requirements

In developing the project, the following technology tools will be used:

VS Code - In the development of the system, we made use of Microsoft Visual Studio Code for encoding the source code of the system, in order to be the accurate and fast acquisition of data and information.

Laravel – a free open-source PHP framework. It provides web developers tools and resources for building modern PHP web applications.

VUE - a JavaScript framework that facilitates the user interface development of websites and single-page applications.

Quasar - a popular open-source front-end framework for building user interfaces with Vue.js.

Pinia - a store library and state management framework for Vue.js.

Tailwind CSS - a utility-first CSS (Cascading Style Sheets) framework with predefined classes that you can use to build and design web pages

MySQL - an open-source relational database management system.

PhpMyAdmin -a free software tool written in PHP, intended to handle the administration of MySQL over the Web

LAMPP/XAMPP - a free platform that allows developers to test their code locally on their own computers.

Soketi an open-source WebSockets server

Figure 5 ZKTeco Tx628

Figure 5 displays the ZkTeco biometrics device that has TCP/IP support, a requirement for data communication between the hardware and the system

Designing Stage

After the researcher analyzed the data gathered from interviews and surveys, system designs were formulated for the Biometrics attendance system. The developed designs include the Use Case Diagram, Entity Relation Diagram, Context Diagram, and Data Flow Diagram, serving as crucial features guiding the development process. Constructing these system designs in the initial iteration is paramount, providing a roadmap for the development team to implement each deliverable outlined in the project's work breakdown structure.

In the initial design, the Use Case Diagram, visually represents the interaction of system users or roles with the real-time biometrics attendance system, as illustrated in Figure 6.

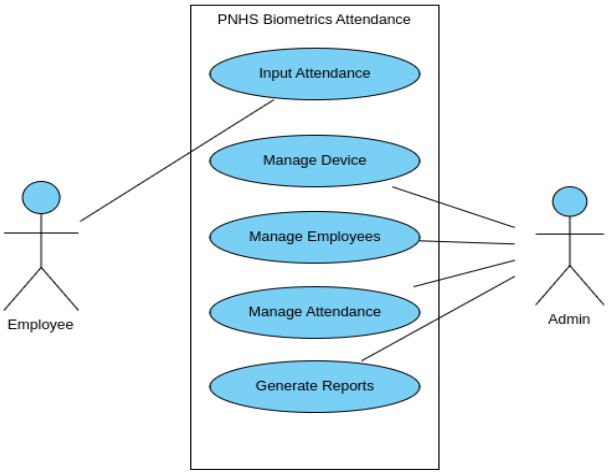


Figure 6 Use case Diagram

Figure 6 depicts an Administrator managing employees and hardware configurations. The role includes generating and downloading tailored reports for employees, fostering efficient communication and informed decision-making in the system.

A context diagram is a high-level view of a system. It's a basic sketch meant to define an entity based on its scope, boundaries, and relation to external components like stakeholders. as shown in Figure 7.

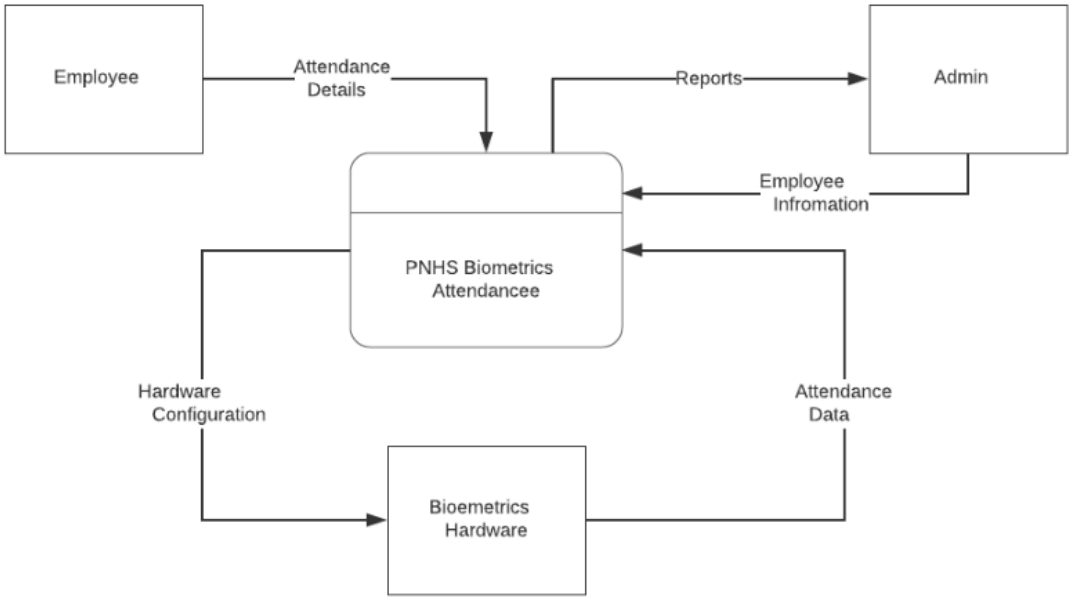


Figure 7 Context Diagram

A Data Flow Diagram (DFD) is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement as shown in figure 8.

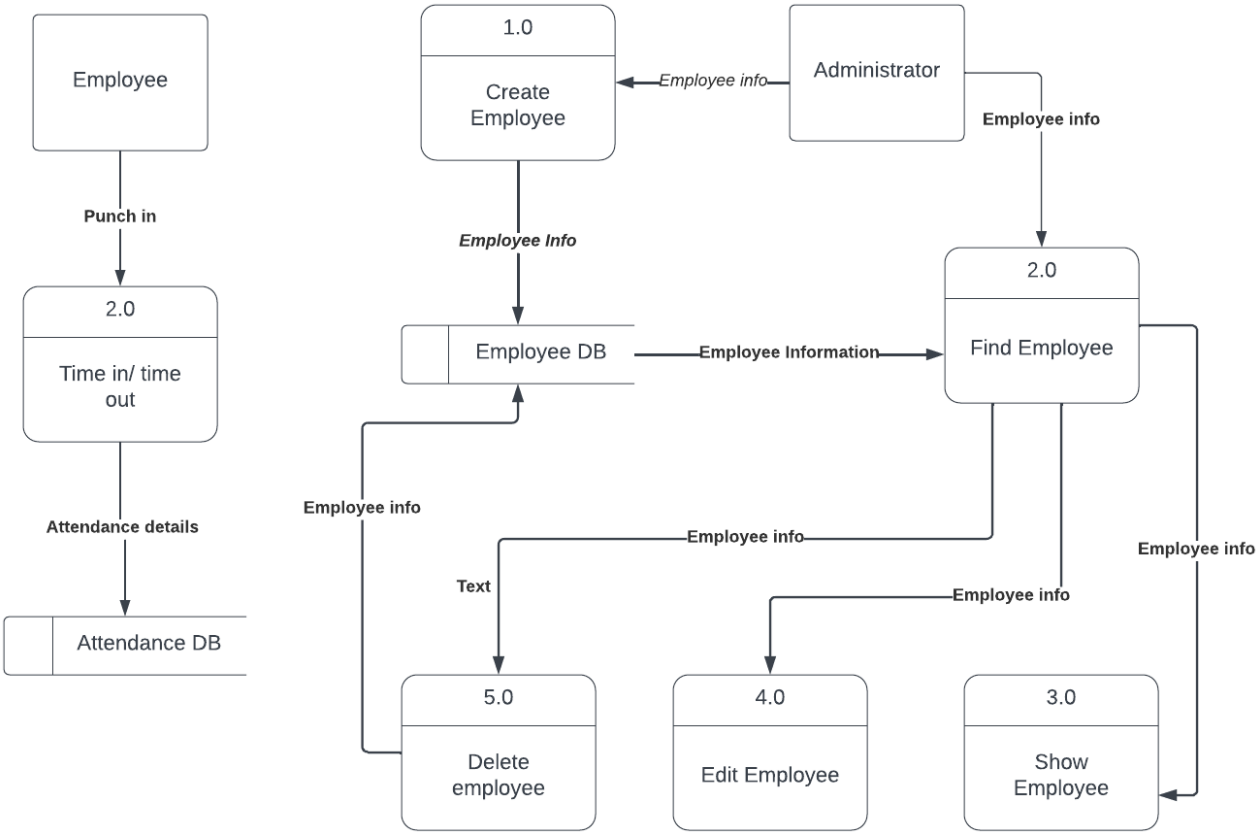


Figure 8 Data flow diagram

Figure 8 illustrates the Data Flow Diagram for real-time biometrics, detailing the flow of information within the system among employees and administrators. The diagram provides specific details about how the data interacts with the database, outlining processes and interactions. This offers a comprehensive overview of the system's functionality.

An Entity-Relationship Diagram (ERD) is a visual representation that depicts the relationships between entities in a database. It provides a concise overview of how different entities interact and relate to each other within a system.

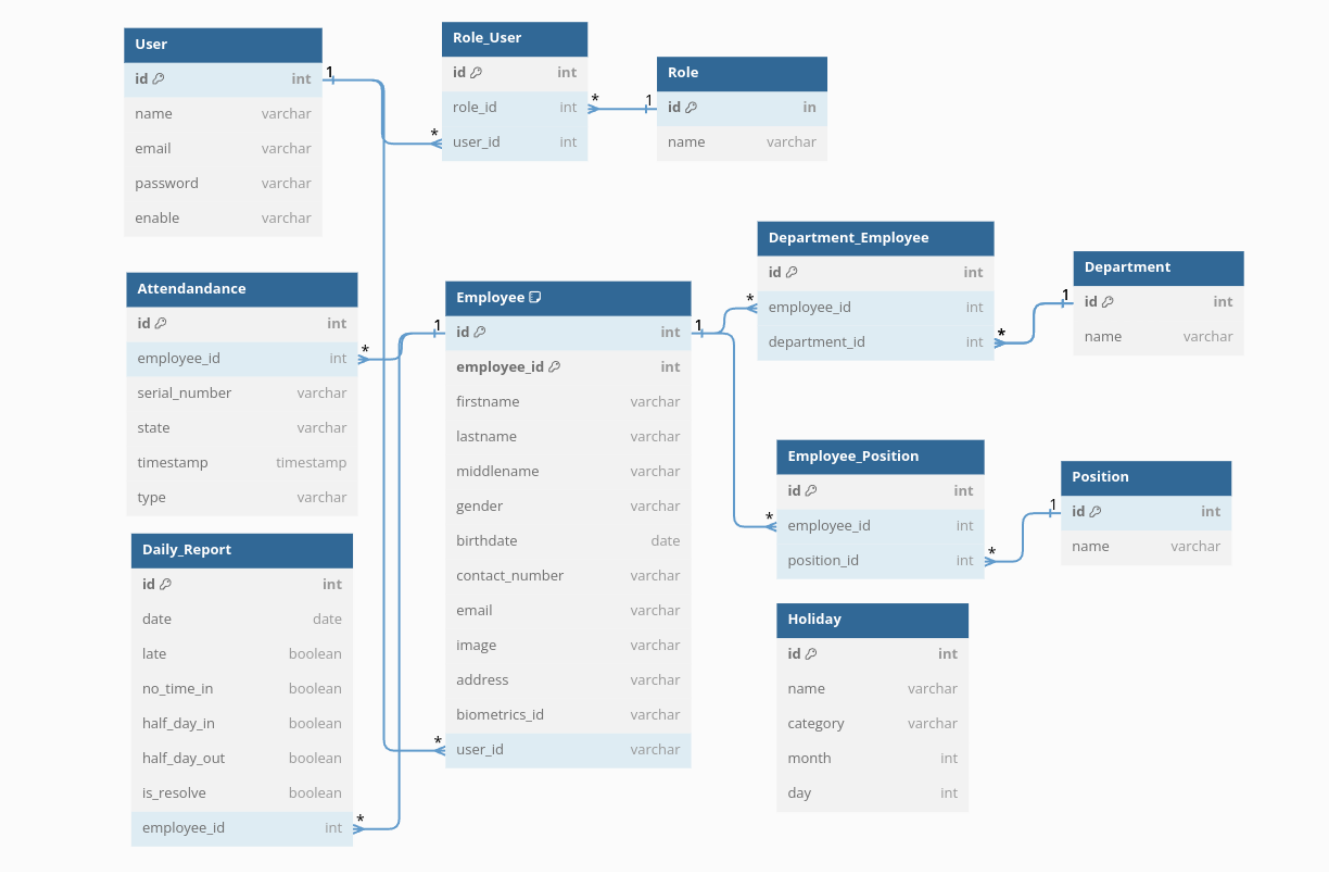


Figure 9 Entity-Relationship Diagram

Figure 9 provides a comprehensive view of the system by showcasing the relationships among all entities, including crucial aspects such as employee data, attendance, and daily reports. The diagram serves as a valuable tool for understanding how entities like employees collaborate, contributing to the overall functionality of the system, especially in managing attendance and generating daily reports.

Development Stage

The researchers employ Laravel for server-side development, Vue for the client-side interface, and Soketi (WebSocket) for real-time data transfer from biometric hardware to the user interface, following the MVC pattern. The system is structured into two components: the API and the client. It utilizes MySQL for efficient data management and relies on the VS Code text editor for streamlined development and maintenance.

On the server-side of the development, the researchers initially implement scaffolding for authentication. Fortify is chosen due to its agnostic implementation, providing high customization capabilities during the system development process. Additionally, Sanctum is incorporated to meet specific usage requirements, ensuring a comprehensive and secure authentication framework for the overall system. We also use MVC architecture as it offers a structured and modular approach to development. MVC provides a clear separation of concerns, allowing for the independent development and maintenance of different components.

Upon selecting the appropriate tools and frameworks, the researchers proceeded to create models that accurately represent the entities outlined in the Entity-Relationship Diagram (ERD) from the previous section (see Figure 9). These models serve as a direct translation of the ERD, capturing the essential attributes and relationships identified for the seamless development of the system as shown in figure 10.

Figure 10 Models

Following entity model creation, researchers introduced a 'manager' layer to optimize controllers. Serving as intermediaries, managers handle requests, interact with models, and streamline responses. This addition aims to maintain controller cleanliness and prevent complexity by delegating intricate tasks to managers, fostering a more modular and organized system structure(see Figure 11).

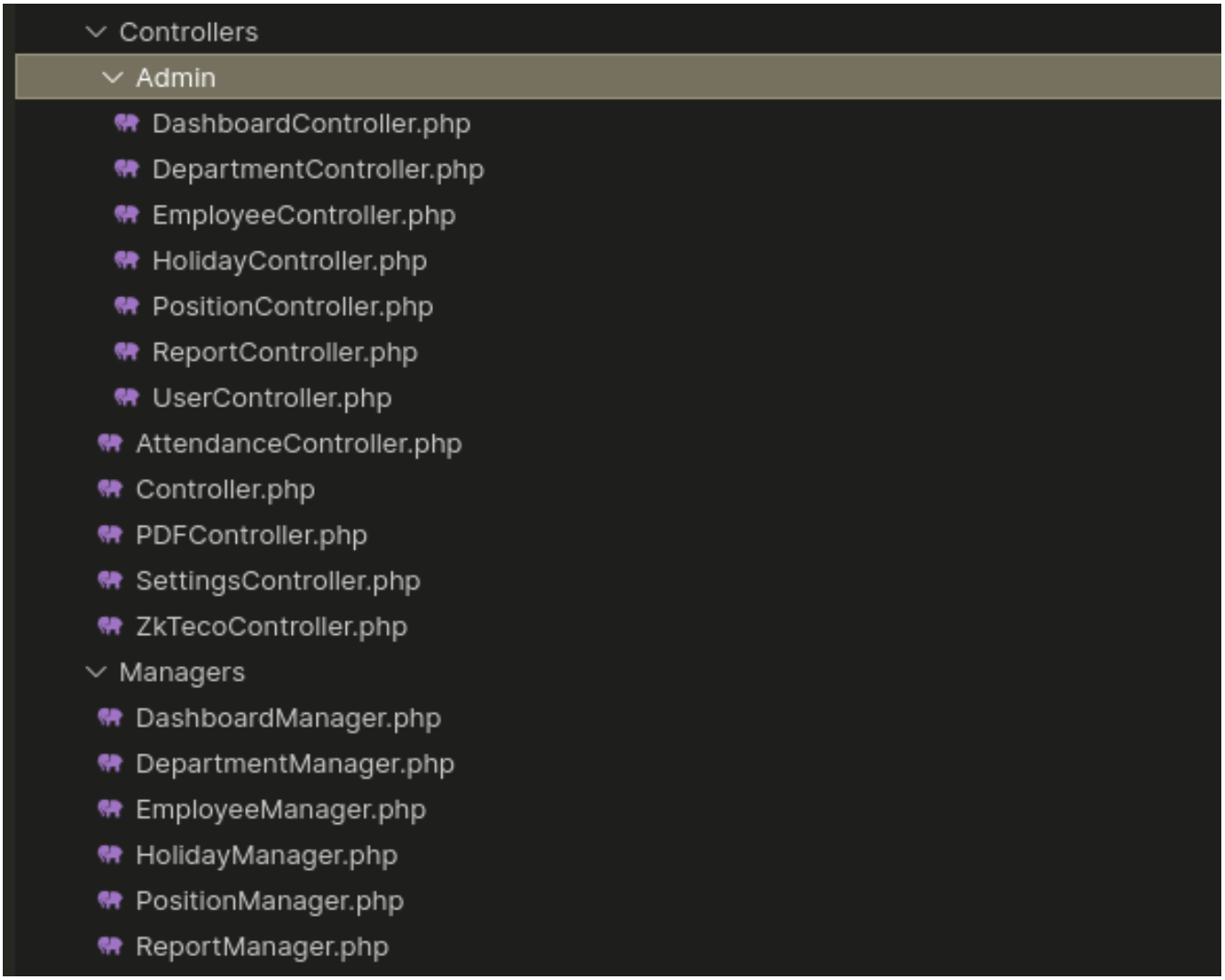


Figure 11 Managers and Controllers

The next step involved developing middleware to regulate the requests and responses within the system. This middleware plays a crucial role in managing the flow of data, ensuring secure and efficient communication between different components of the application.

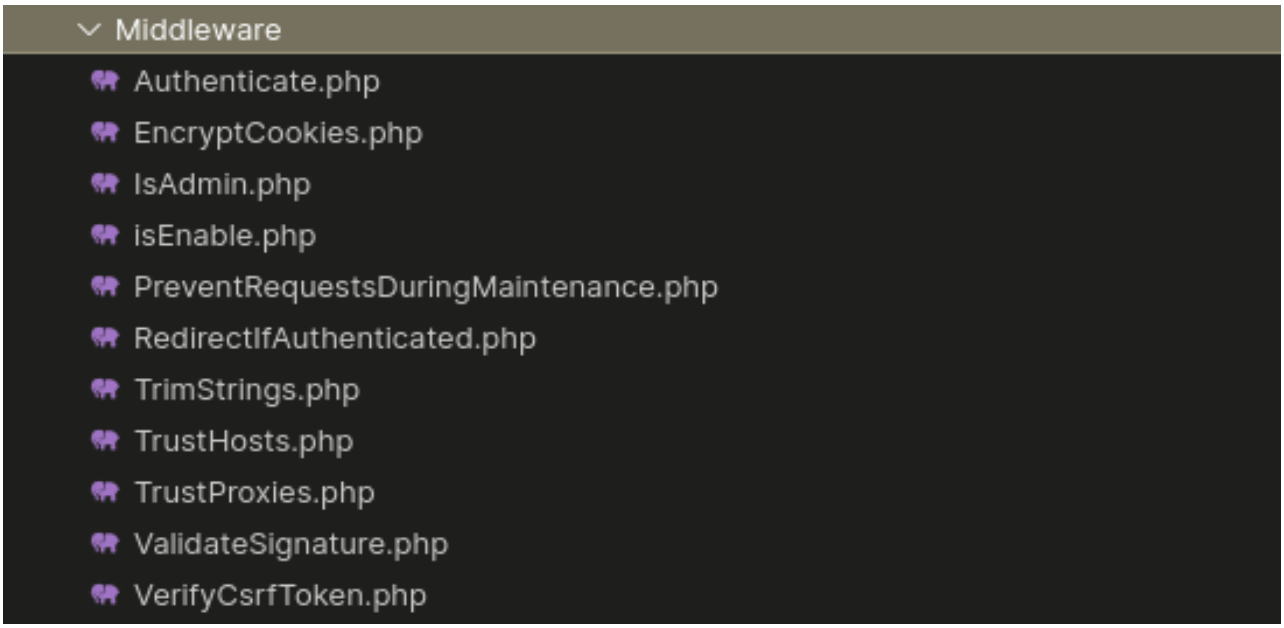


Figure 12 Middlewares

Additionally, we organized all external libraries on the Service layer, including the ZKteco SDK and DomPDF wrapper. This strategic placement ensures a centralized and cohesive integration of third-party tools, enhancing maintainability and providing a clear separation of concerns within the system architecture.

Figure 13 Services

On the client side, the researchers employed a Single Page Application (SPA) setup to manage API requests and responses from the server. Pinia was selected for state management, offering an efficient solution to handle client-side state. Additionally, Axios was chosen as the HTTP request handler, facilitating seamless communication with the server and enhancing the overall responsiveness and user experience of the system. Quasar was integrated as the UI component, contributing to accelerated development with its feature-rich framework, thereby streamlining the user interface design process.

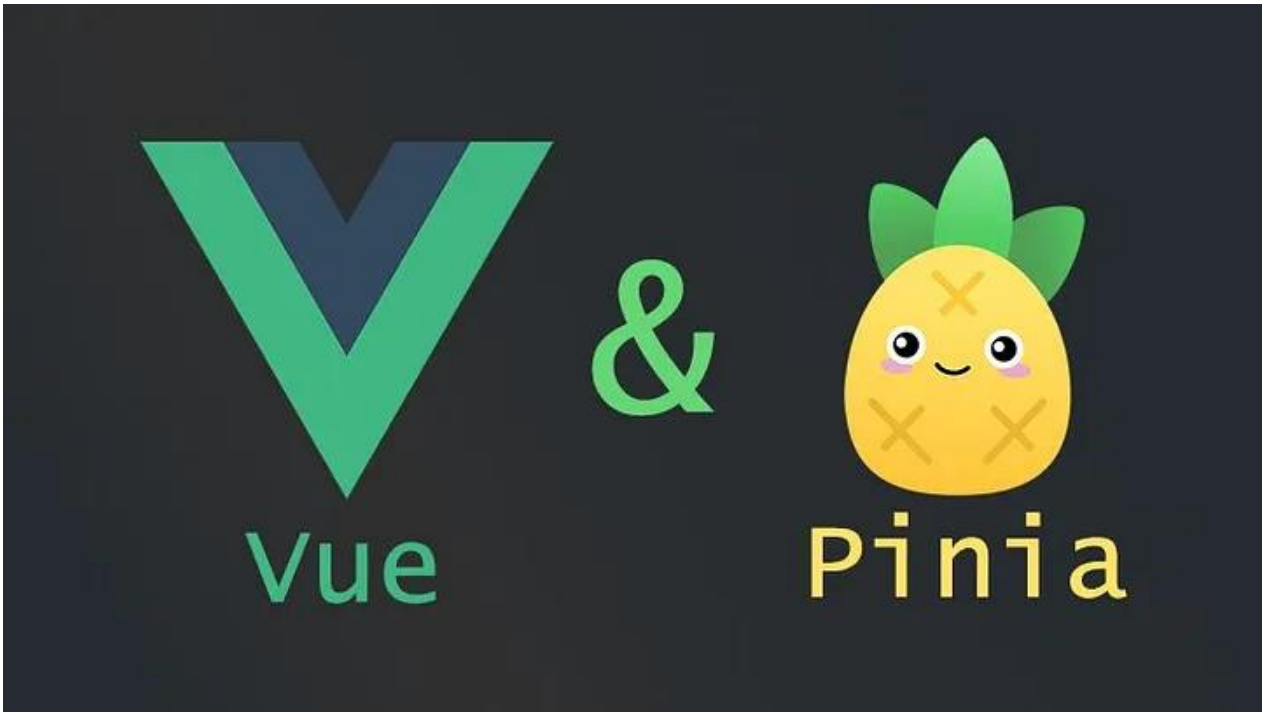


Figure 14 Vue and Pinia

In summary, this combination results in a well-structured and efficient system, delivering a responsive user interface and robust data management. The successful synergy of these technologies forms a foundation for a maintainable, and user-centric application.

Testing and Debugging

The researchers have employed a diverse array of testing methodologies on the system. This includes the verification of all inputs, unit testing for individual functions, and the execution of all functions to identify possible bugs and errors.

Image 1 System Trial and Error

Unit testing was conducted before implementing each function, ensuring the robustness and reliability of the system (see Figure 15).

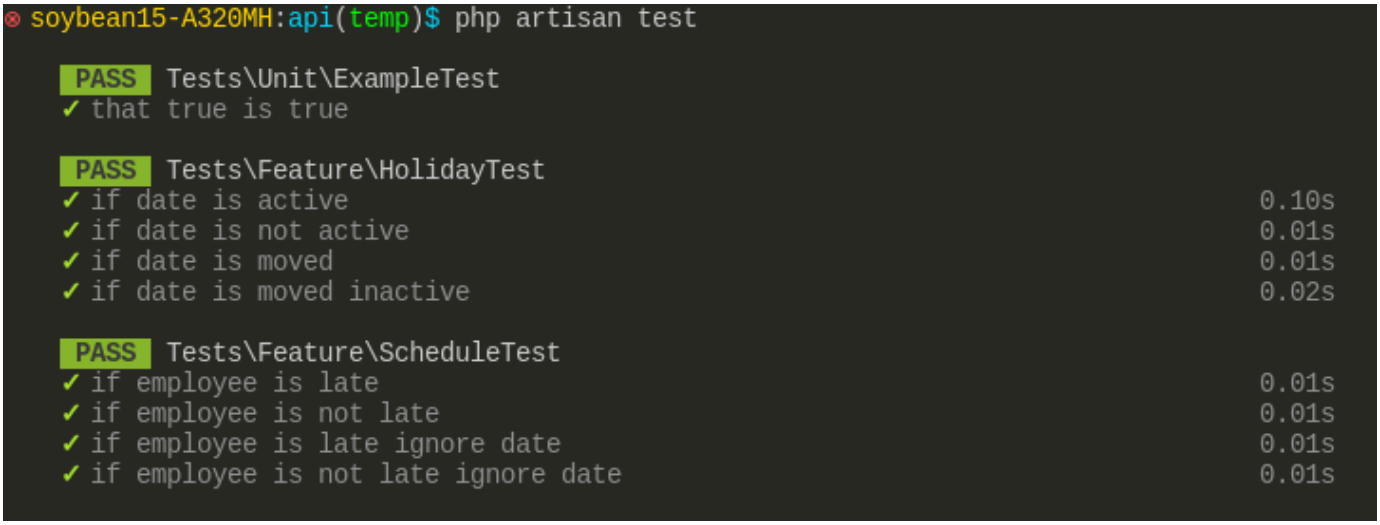


Figure 15 Unit Testing

Pilot testing will be conducted by the researchers with school employees and administrators to evaluate the feasibility and features of the proposed system.

Releasing

The system will be deployed locally at the PNHS office. This installation will be facilitated through the use of Docker, streamlining the management of essential packages for improved efficiency and maintenance.

Project Evaluation

The result of the system evaluation using the FURFS Model (Functionality, Usability, Reliability, Performance and Supportability) are presented and interpreted in the tables below.

Functionality

Table 3 shows the result of the respondents' rating on the features of the system in terms of functionality. The lowest mean obtained was 4.10. The data shows that the system was very low in providing comprehensive and meaningful error messages for user guidance. The possible reason that causes the result is due to the system lacked comprehensive user training materials or documentation, users might not have been adequately prepared to handle errors on their own.

The highest mean obtained was 4.80. The data shows that the system was very high in terms of security and organized records. The possible reason that causes the result is due to extensive username and password functionality, and well-organized employee management.

Indicators	Mean	Interpretation
1. Records and organized employees.	4.80	Strongly Agree
2. Generating reports is relatively fast and accurate.	4.54	Strongly Agree
3. The system provide comprehensive and meaningful error messages for user guidance	4.10	Agree
4. The system is secured by user's username and password	4.80	Strongly Agree
Average	**4.56**	**Strongly Agree**

Table 3 Respondents' rating on the Functionality of the system

Usability

Table 4 shows the result of the respondents' rating on the features of the system in terms of usability. The lowest mean obtained was 4.61. The data shows that the system was very low in providing consistent look and feel. The possible reason that causes the result is due to the lack of standardized design guidelines or poor UI design practices. Probably in terms of naming conventions and other users' preferences.

The highest mean obtained was 4.71. The data shows that the system's modules was very high in presenting readable font. The possible reason that causes the result is due to the effective use of font styles and spacing, ensuring optimal legibility.

Indicators	Means	Interpretation
1. The user interface is user-friendly and easy to navigate	4.66	Strongly Agree
2. System's modules provides consistent look and feel.	4.61	Strongly Agree
3. The system's modules are presented with readable font	4.71	Strongly Agree
4. The System configuration are easy to set up .	2.60	Neutral
5. The system provides intuitive components design.	4.20	Agree

Average	**4.15**	**Agree**

Table 4 Respondents' rating on the Usability of the system

Reliability

Table 5 shows the result of the respondents' rating on the features of the system in terms of reliability. The lowest mean obtained was 2.60. The data shows that the system was very low in tracking user activity. The possible reason that causes the result is due system limitation of the system that is not saving administrator activity. The highest mean obtained was 4.78. The data shows that the system was very high in properly dated and accounted for reports. The possible reason that causes the result is due to the automated data synchronization and real-time updates from integrated systems

Indicators	Means	Interpretation
1. User inputs are strictly validated	4.73	Strongly Agree
2. Duplicate records were minimized.	4.10	Agree
3. Data modification can be done with ease.	4.61	Strongly Agree
4. The system provides user's log-in and data access trail to track down user's activity.	2.60	Disagree

5. Reports are properly dated and accounted for.	4.78	Strongly Agree
Average	4.32	Strongly Agree

. *Table 5* Respondents' rating on the Reliability of the system

Performance

Table 6 shows the result of the respondents' rating on the features of the system in terms of performance. The lowest mean obtained was 4.51. The data shows that the system was very low in terms of response time and processing. The possible reason that causes the result is due to the system's high server load or inadequate server resources to handle concurrent user requests. The highest mean obtained was 4.56. The data shows that the system was very high in terms of retrieving the data from every office. The possible reason that causes the result is due to the implementation of state management and data caching, reducing the need for repeated data fetching.

Indicators	Means	Interpretation
1. Response time and processing time are in acceptable range.	4.51	Strongly Agree
2. Usage of computer resources is maximized.	4.54	Strongly Agree
3. Data retrieval in every office is fast and easy.	4.56	Strongly Agree

Average	**4.54**	**Strongly Agree**

Table 6 Respondents' rating on the Performance of the system

Supportability

Table 4.6 shows the result of the respondents' rating on the features of the system in terms of supportability. The lowest mean obtained was 2.10. The data shows that the system was very low in terms of system compatibility. The possible reason that causes the result is due to the limitation of task scheduling on windows system. The highest mean obtained was 4.61. The data shows that the system was very high in terms of operating systems compatibility, support back-up and restoration procedures. The possible reason that causes the result is due to proactive maintenance, ensuring smooth operation across various platforms.

Indicators	Means	Interpretation
1. The system can be installed in any computer system with compatible operating system.	2.10	Disagree
2. Supports data back-up and restoration procedures.	4.61	Strongly Agree
3. The system can be installed with minimum hardware requirements	4.10	Agree
Average	**3.60**	**Agree**

Table 7 Respondents' rating on the Supportability of the system

Maintainability

Table 8 shows the result of the respondents' rating on the features of the system in terms of maintainability. The lowest mean obtained was 4.71. The data shows that the system was very low in terms of the level access of the system. The possible reason that causes the result is due to the lack of flexibility in adding new access levels.

The highest mean obtained was 4.73. The data shows that the system was very high in terms of changes that can be made with ease. The possible reason that causes the result is due to a user-friendly and intuitive interface that allows users to customize settings and configurations easily.

Indicators	**Means**	**Interpretation**
1. Levels of access of other users are determined by the system's administrator.	4.71	Strongly Agree
2. Changes can be made with ease.	4.73	Strongly Agree
Average	**4.72**	**Strongly Agree**

Table 8 Respondents' rating on the Maintainability of the system

Table 8 shows the summary of the respondent's rating on the system in terms of Functionality, Usability, Reliability, Performance, Supportability and Maintainability. The average mean of 4.64 interpreted as strongly agree shows that the system was recognized and has met the requirements set-forth by the respondent.

Indicators	**Means**	**Interpretation**
1. Functionality	**4.56**	Strongly Agree
2. Usability	**4.15**	Agree
3. Reliability	**4.32**	Strongly Agree
4. Performance	**4.54**	Strongly Agree
5. Supportability	**3.60**	Agree
6. Maintainability	**4.72**	Strongly Agree
Average	**4.31**	**Strongly Agree**

CHAPTER IV

Summary, Conclusions and Recommendations

This chapter presents a concise summary of the key findings and insights obtained throughout the study. It then offers a comprehensive conclusion, encapsulating the implications of the research. Finally, recommendations are provided to guide future actions and improvements based on the study's outcomes.

Summary

In our capstone project, "PNHS Biometrics Attendance with Live Data," the researchers use agile approach to build the attendance system. It's made with Laravel and Vue, plus Soketi for quick updates. Employees enjoy a secure and easy way to mark attendance with biometrics, cutting down on errors.

This research benefits administrators too. They get real-time updates on attendance, helping them manage things better. The goal is to make attendance tracking at PNHS smooth and accurate for everyone involved.

Conclusions

The following conclusions were drawn based on the findings of the study:

1. Successful implementation of "PNHS Biometrics Attendance with Live Data" system
2. Agile methodologies employed for flexible and efficient development
3. Utilization of Laravel and Vue for robust backend and frontend respectively
4. Integration of Soketi for seamless WebSocket functionality
5. Enhanced accuracy and security through the incorporation of biometrics
6. Simplified attendance recording process for employees

7. Empowered administrators with real-time insights for efficient management
8. Demonstrates the positive impact of technology in educational institutions
9. Paves the way for continued advancements in educational technology and administrative efficiency.

Recommendations

The following recommendations are made based on the aforementioned conclusion and observations.

1. Upgrade the homepage for a better presentation of live data.
2. Investigate alternative WebSocket solutions to mitigate heavy processing demands.
3. Implement effective success displays for hardware configurations.
4. Logs of users activities.

References

Teachmint. (2023, Jul 20). Why it is important to have an effective student attendance management system. https://blog.teachmint.com/why-it-is-important-to-have-an-effective-student-attendance-management-system

R. L. German and K. S. Barber, Current Biometric Adoption and Trends, 2018, https://identity.utexas.edu/assets/uploads/publications/Current-Biometric-Adoption-and-Trends.pdf

adrobinoga. (2020). zk-protocol. https://github.com/adrobinoga/zk-protocol

Int J Interact Des Manuf. (2021). 15(2-3), 365–380. https://doi.org/10.1007/s12008-021-00760-6

Thales. (2020). Biometrics: Authentication and Identification (Definition, Trends, Use Cases, Laws and Latest News)—2020 Review. Retrieved July 7, 2020, from https://www.thales-group.com/en/markets/digital-identity-and-security/government/inspired/biometrics

Šošević, U., Milenković, I., Milovanović, M., & Minović, M. (2013). Support platform for learning about multimodal biometrics. Journal of Universal Computer Science, 19(11), 1684–1700.

Gold, S. (2010). Biometrics in education: Integrating with the real world. Biometric Technology Today, 2010(4), 7–8.

Nita, S., & Mihailescu, M. (2018). Proposing a secure e-learning system based on biometric authentication and homomorphic encryption. In 14th International Scientific Conference eLearning and Software for Education, Bucharest, pp. 47–52.

Prabhakar, S., Pankanti, S., & Jain, A. K. (2003). Biometric recognition: Security and privacy concerns. IEEE Security & Privacy, 99(2).

Meng, W., Wong, D. S., Furnell, S., & Zhou, J. (2014). Surveying the development of biometric user authentication on mobile phones. IEEE Communications Surveys & Tutorials, 17(3), 1268-1293.

Jain, A. K., Ross, A. A., & Nandakumar, K. (2011). Introduction to biometrics. Springer Science & Bus

Appendix A: Reference Library

1. DOMPDF

Description: DOMPDF is a PHP library for converting HTML to PDF. It provides an easy way to generate PDF documents dynamically.

GitHub Repository: https://github.com/dompdf/dompdf

2. ZKTecko Biometrics Laravel Library

Description: Zkteco is a Laravel wrapper for integrating ZKTeco biometric devices with Laravel applications. It simplifies the communication with ZKTeco devices.

GitHub Repository: https://github.com/raihanafroz/zkteco

3. Soketi

Description: Soketi is a platform with documentation for WebSocket-based communication. It provides information and resources for integrating WebSocket functionality into applications.

Documentation Link: https://docs.soketi.app/

4. Quasar Framework

Description: Quasar is a Vue.js framework that allows developers to build responsive and high-performance web applications for various platforms, including web, mobile, and desktop.

Official Website:https://quasar.dev/

5. Pinia

Description: Pinia is a state management library for Vue.js applications. It provides a simple and powerful way to manage the state of your application, designed with the Composition API in mind.

Official Website: https://pinia.vuejs.org/

Appendix B: Data Gathering Instrument

Name: _____

Date : _____

System Evaluation Questionnaire

Thank you for taking the time to evaluate our developed system. Your feedback is crucial in understanding your perceptions. Please use the following scale to express your opinions:

- **4.21 – 5.00:** Strongly Agree
- **3.41 – 4.20:** Agree
- **2.61 – 3.40:** Neutral
- **1.81 – 2.60:** Disagree
- **1.0 – 1.80:** Strongly Disagree

Functionality

1. The user interface of the system is intuitive and user-friendly.
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
2. The system's response time for generating reports is satisfactory.
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
3. The error messages provided by the system are comprehensive and helpful.
   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
4. The system adequately ensures security through user authentication.
   - Strongly Agree
   - Agree
   - Neutral

- Disagree
- Strongly Disagree

5. Overall, how satisfied are you with the functionality of the system?

- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Usability

1. The user interface of the system is intuitive and user-friendly.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. The system's response time for generating reports is satisfactory.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

3. The error messages provided by the system are comprehensive and helpful.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

4. The system adequately ensures security through user authentication.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

5. Overall, how satisfied are you with the functionality of the system?

- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Reliability

1. User inputs are strictly validated.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Duplicate records were minimized.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

3. Data modification can be done with ease.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

4. The system provides user's log-in and data access trail to track down user's activity.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

5. Overall, how satisfied are you with the functionality of the system?

- Very Satisfied

- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Performance

1. Response time and processing time are in an acceptable range.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Usage of computer resources is maximized.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

3. Data retrieval in every office is fast and easy.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

4. Overall, how satisfied are you with the functionality of the system?

- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Supportability

1. The system can be installed in any computer system with a compatible operating system.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Supports data back-up and restoration procedures.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

3. The system can be installed with minimum hardware requirements.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Maintainability

1. Levels of access of other users are determined by the system's administrator.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

2. Changes can be made with ease.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Your input is highly appreciated. Thank you for your participation!

Appendix C: System Requirments

1. Operating System

Ubuntu (version >20.0)
Windows (version >10)

2. Software Requirements

PHP (version >8.0)
Node.js (version >16.0)
Vue CLI (version >3.0)
Laravel (version >10.x)
Docker (for Laravel Sail) on Ubuntu/Debian
Docker Desktop + WSL2 on Windows

3. Hardware Requirements

Refer to Table 1 for detailed hardware requirements.

Note: Ensure that your system meets the specified requirements for optimal performance and compatibility. For Docker-related requirements, follow the recommended setup for your operating system.

Appendix D: Installation

Note: Make sure to install all the necessary software mentioned above to make it work.

Server Side

C.1 Navigate to your project folder *cd <your project directory>* and install dependencies using *composer install.*

C.2 To launch the app from the Docker container, execute *./vendor/bin/sail up. Note: Ensure that Docker is running before proceeding.*

2.3 Execute the following:

./vendor/bin/sail artisan key:generate

./vendor/bin/sail artisan migrate –seed

C.4 To verify if everything is running, execute `./vendor/bin/sail ps`. *Note:your server is accessible at http://localhost:8000.*

Client Side

C.5 Navigate to your project folder *cd <your project directory>* and install dependencies using *npm install.*

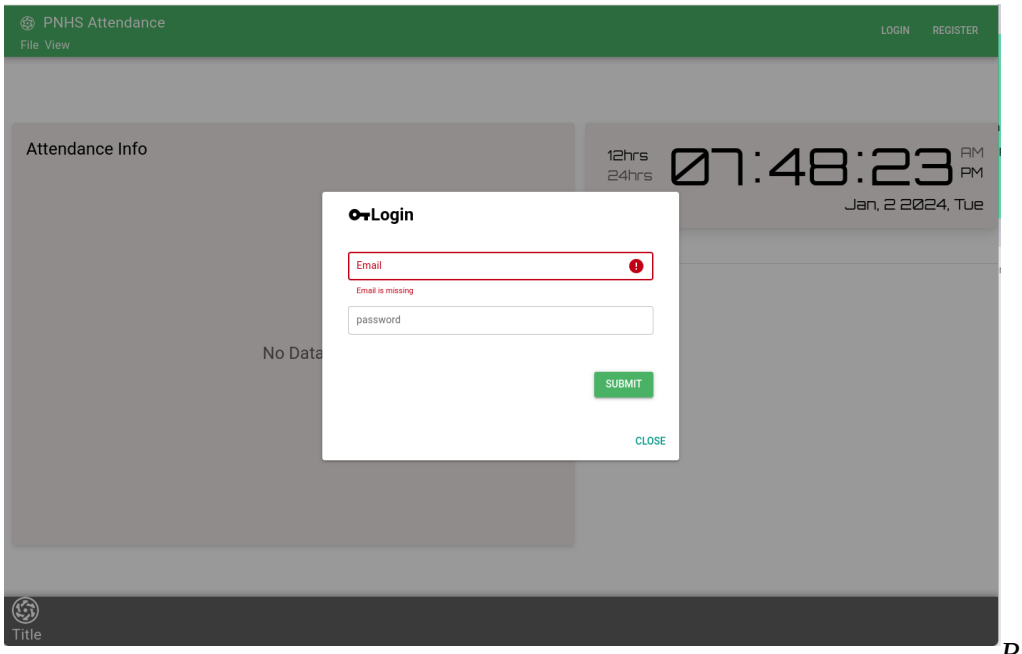
C.6 Execute npm run serve to run the client.*Note:your client is accessible at http://localhost:8080.*

Appendix E: User Manual

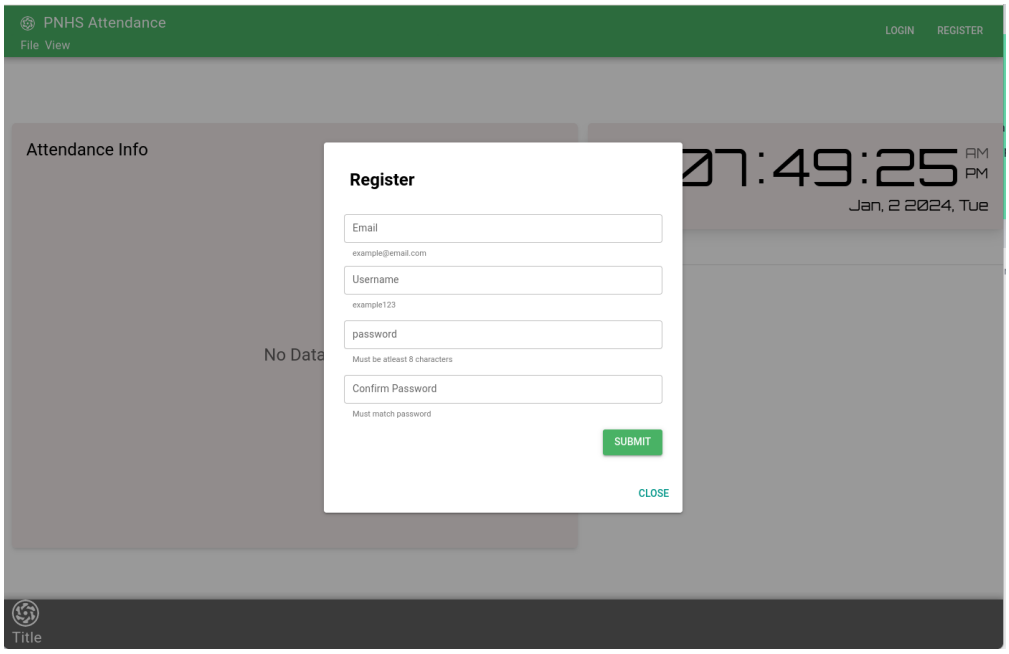
E.1 In your browser, navigate to http://localhost:8000.

E.2 On the homepage, you will find options for both login and registration.

Login Page

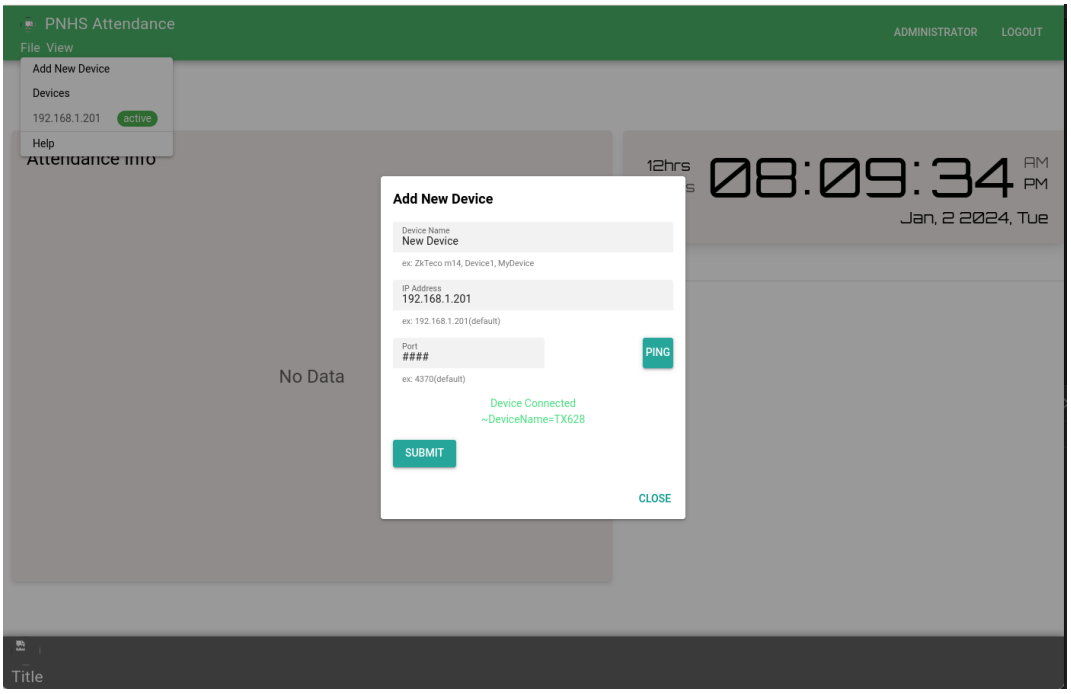


Register Page



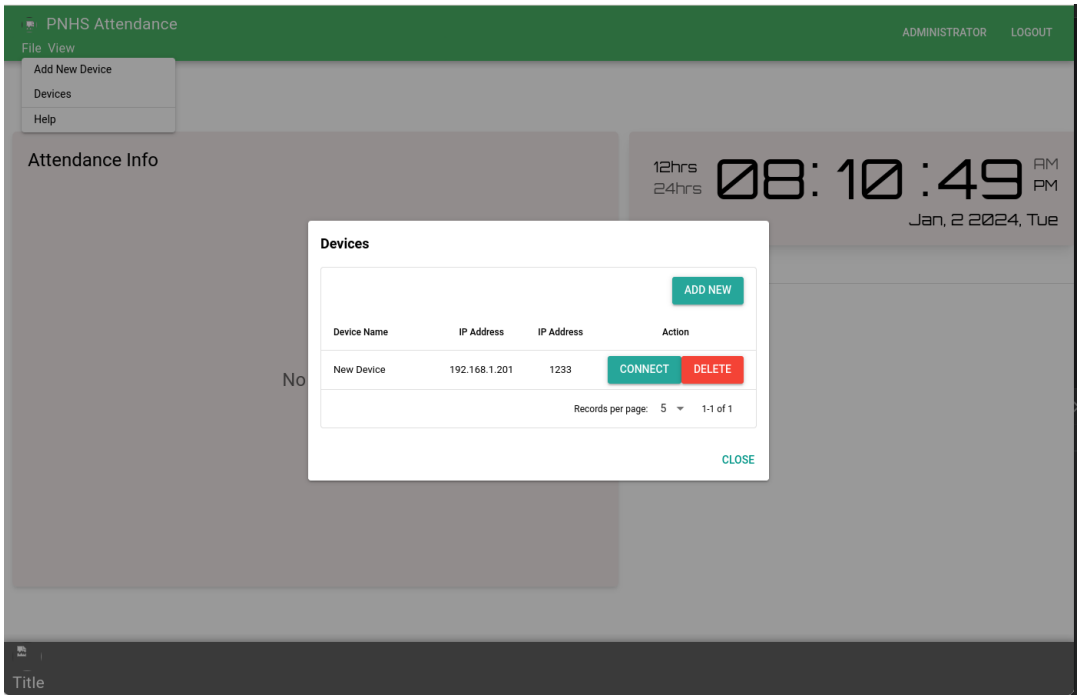
E.3 After logging into the system, you can configure the hardware from the "File" menu.

Add New Device



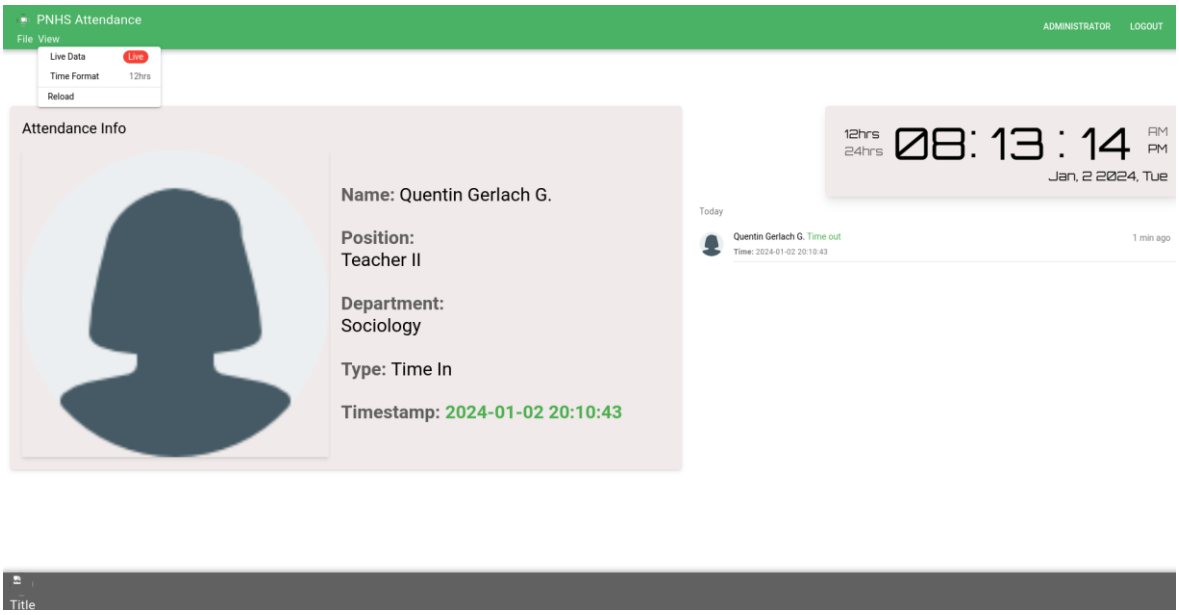
Note: Ensure IPv4 is configured in network settings. Prioritize pinging the device to confirm hardware connectivity.

Device List



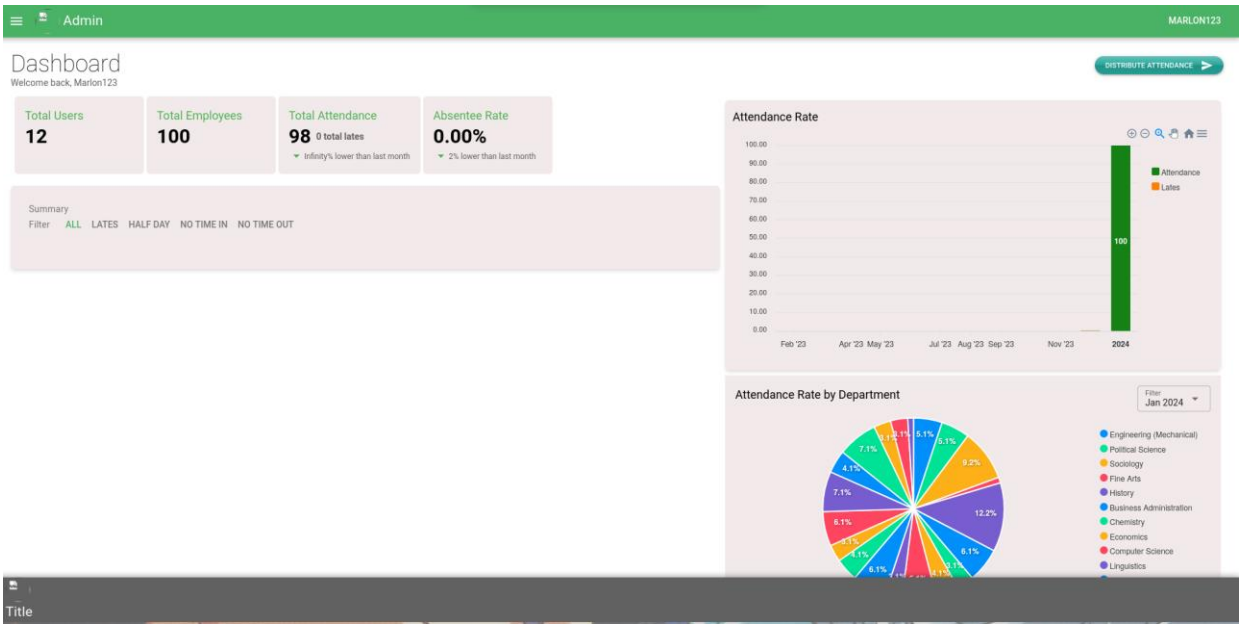
E.4 To activate the live data feature, click on "Live Data" under the "View" menu.

Live Data Sample

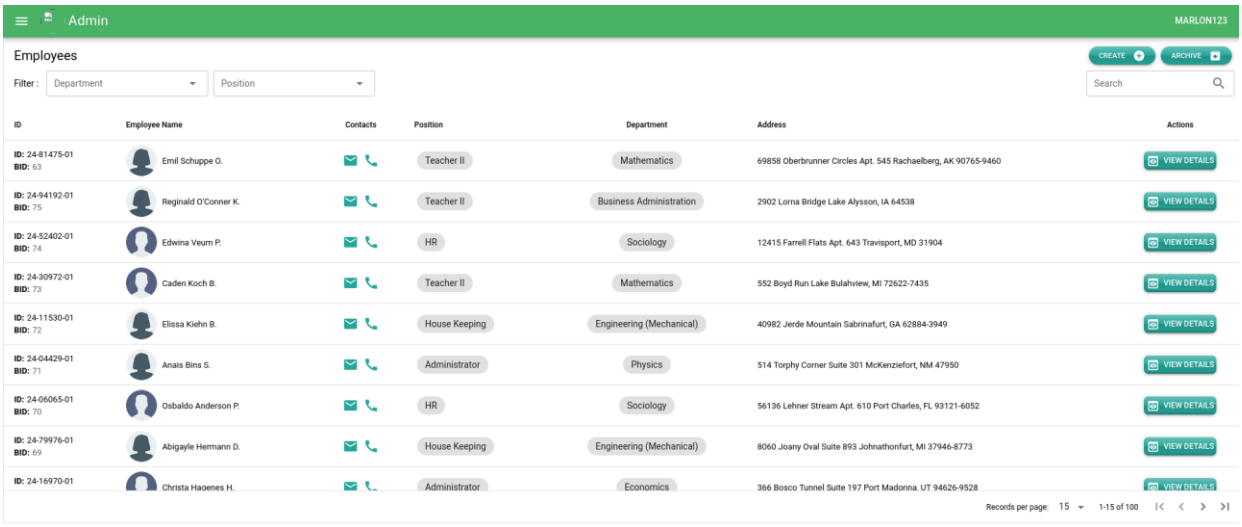


E.5 Administrator

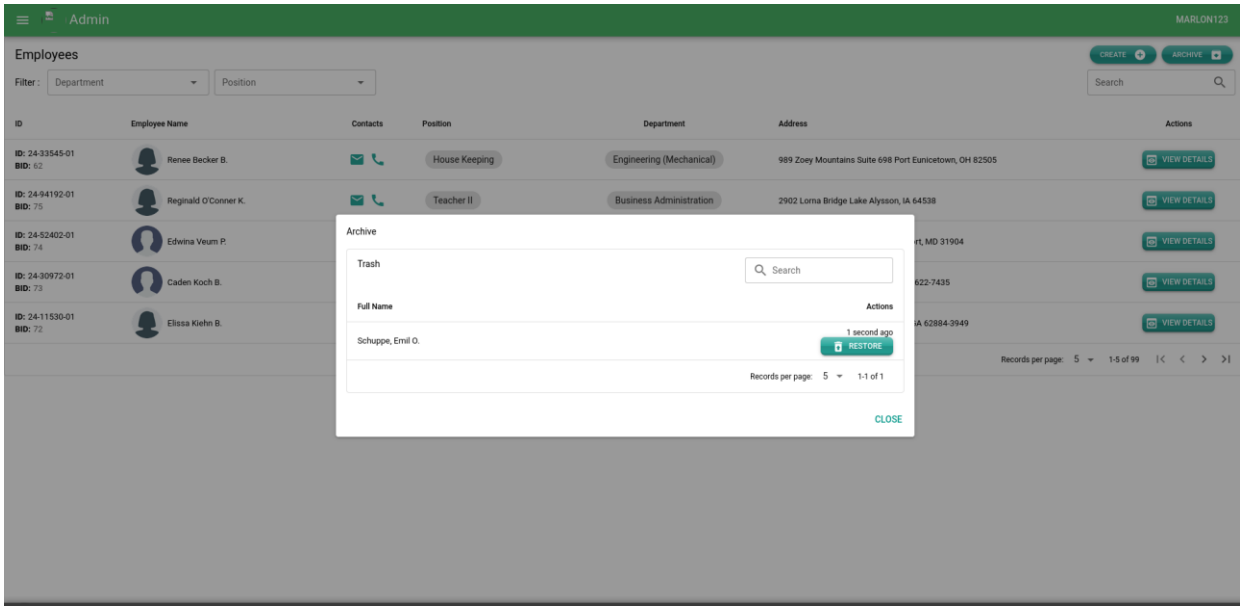
E.5.1 Dashboard



E.5.2 Employee List

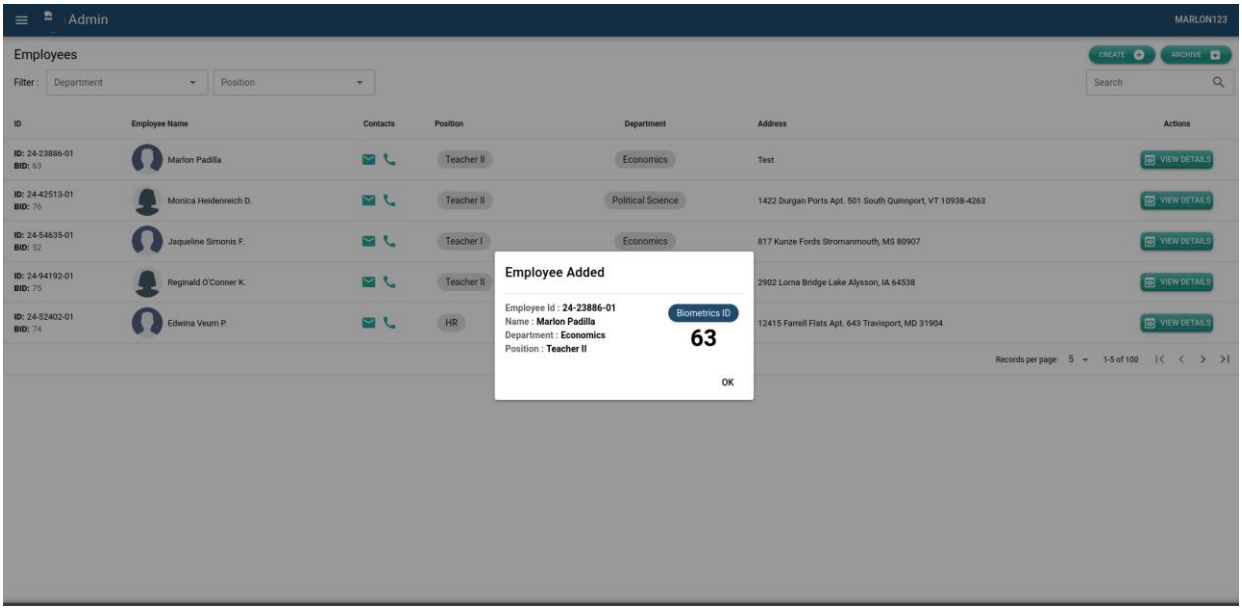


E.5.3 Archive for deleted Employees



Contact No.
Email:
www.neust.edu.ph

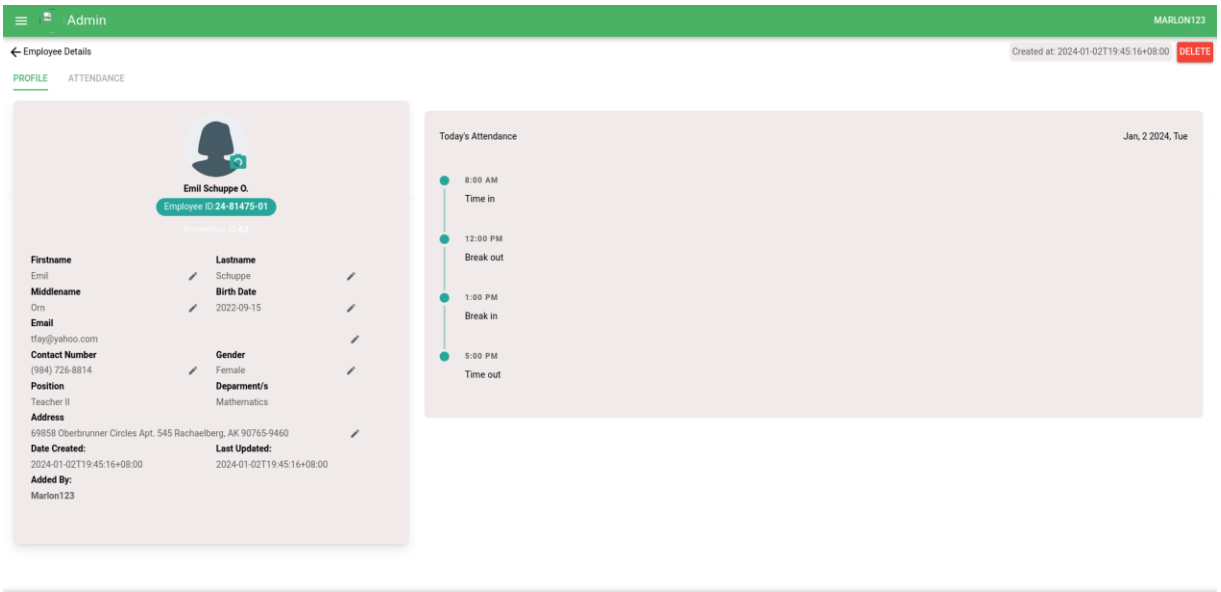
E.5.3 Add Employee



Note: Register the generated Biometrics ID on the hardware device during the setup process.

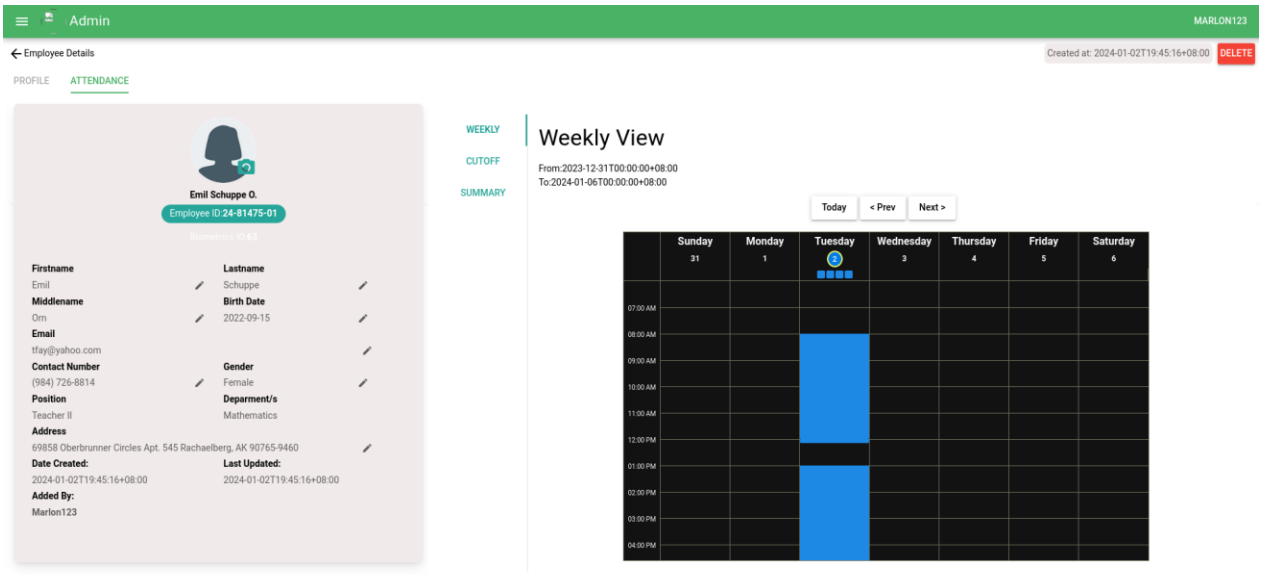
E.5.4 Employee Details

Profile

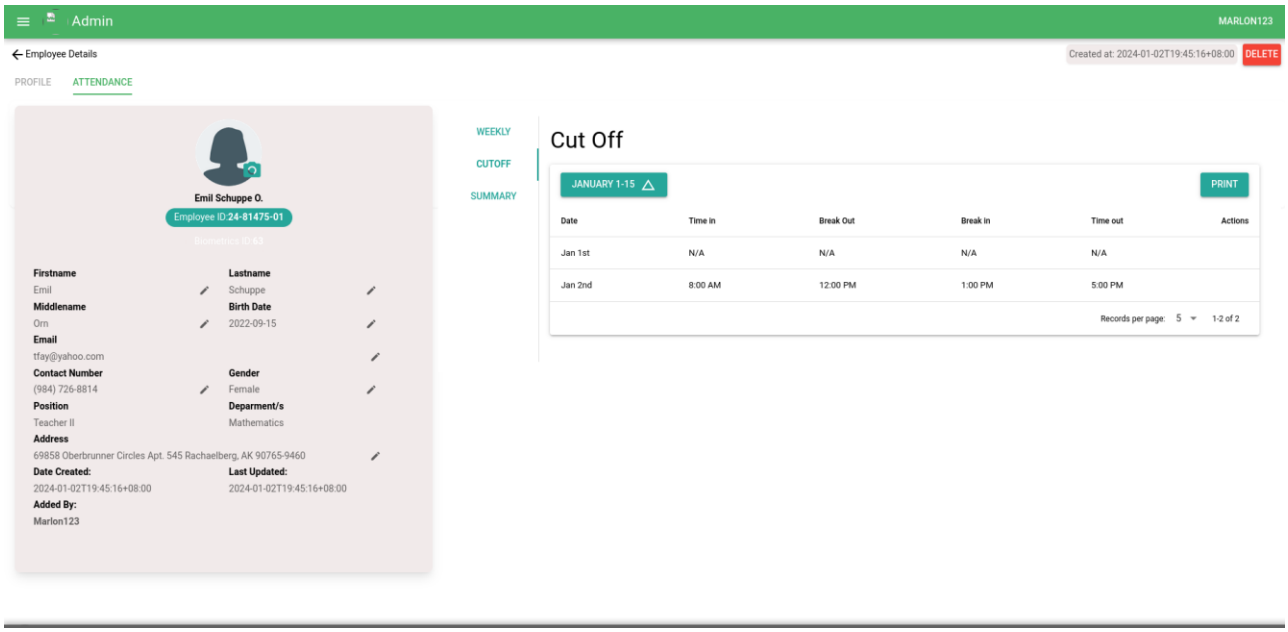


Contact No.
Email:
www.neust.edu.ph

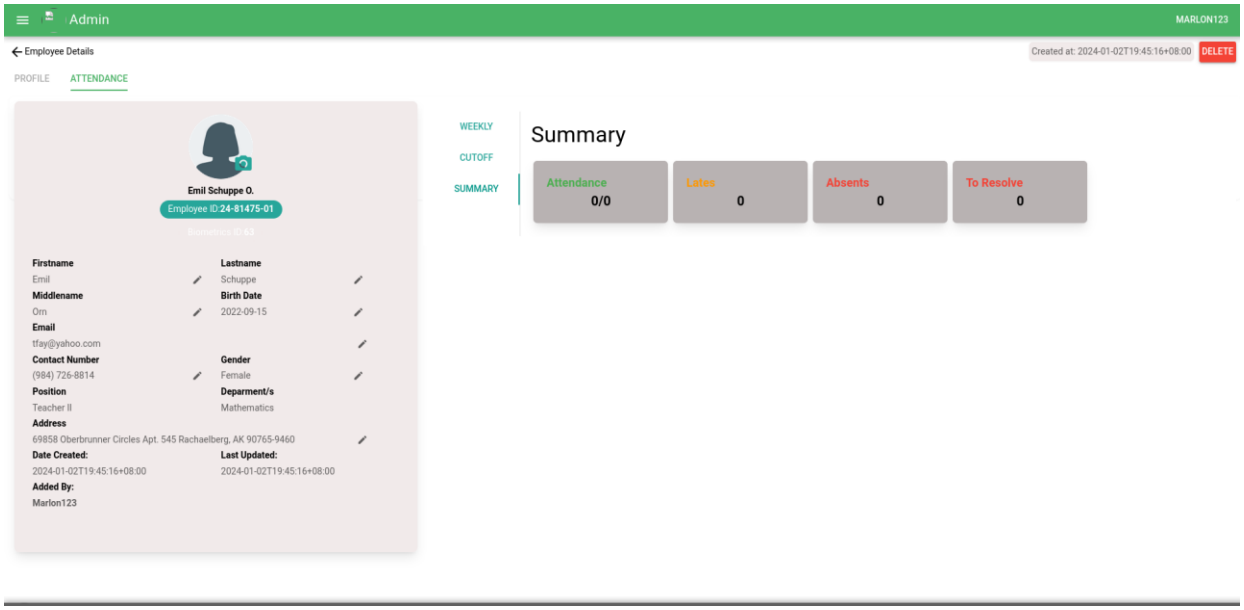
Calendar



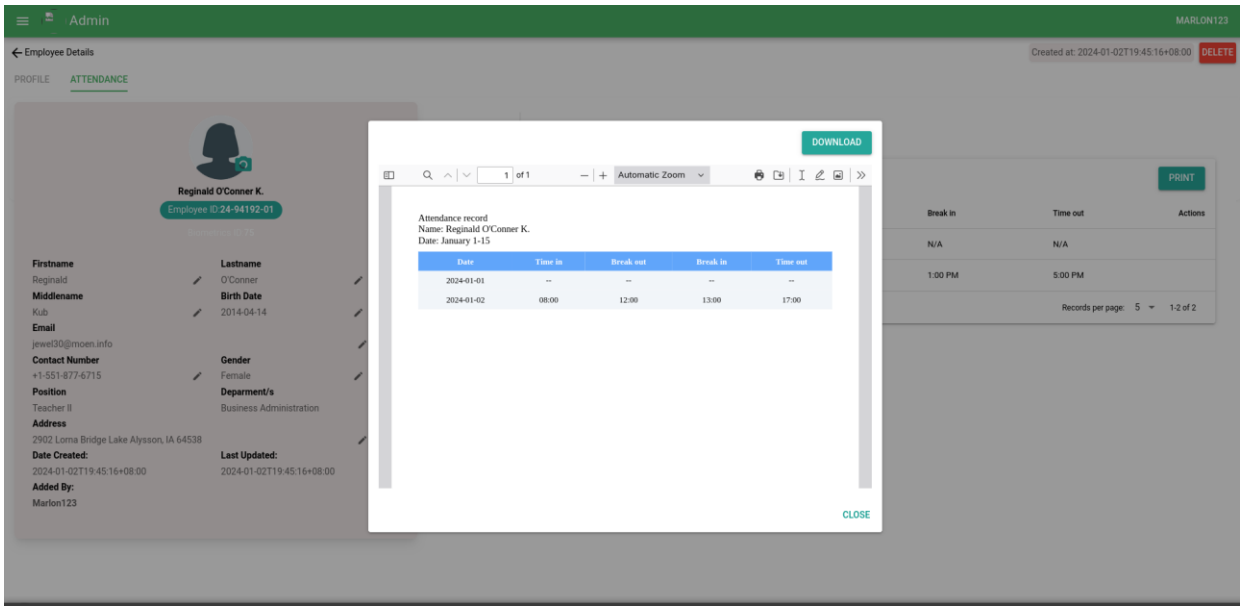
Cutoff



Summary

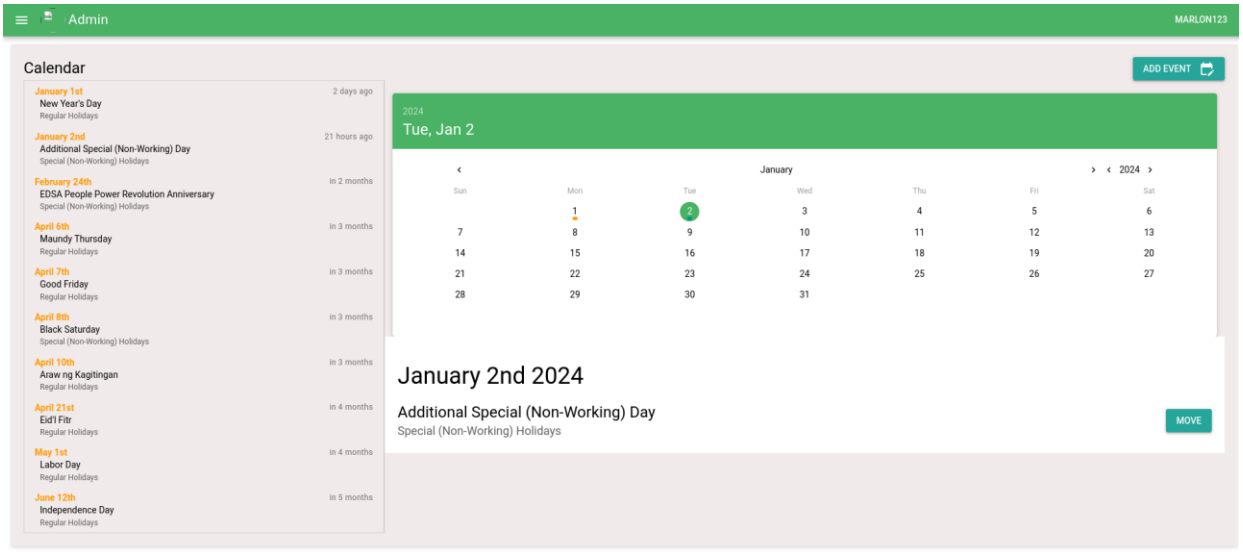


Generate PDF



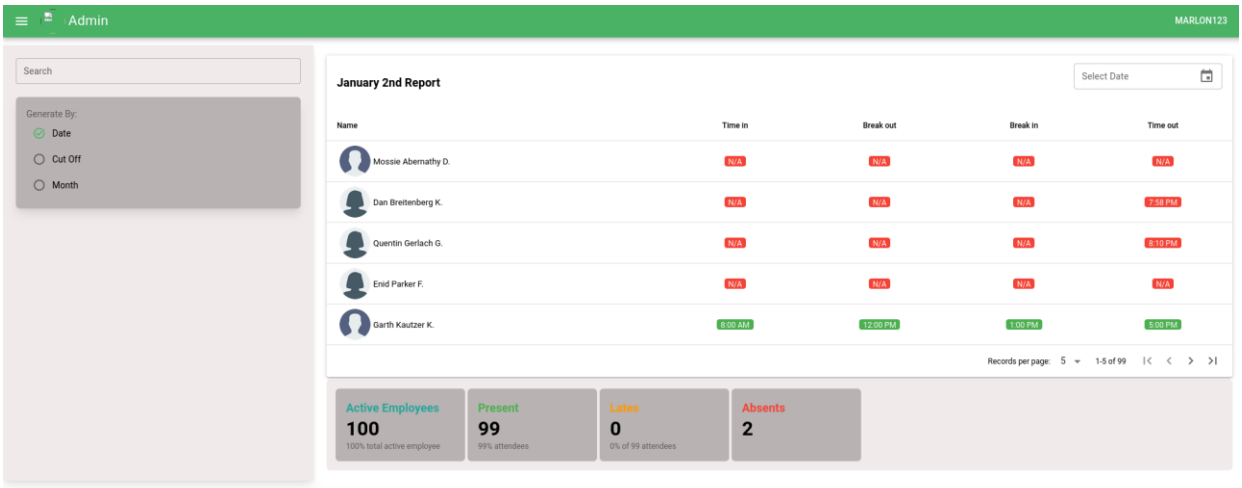
Contact No.
Email:
www.neust.edu.ph

E.5.5 Calendar

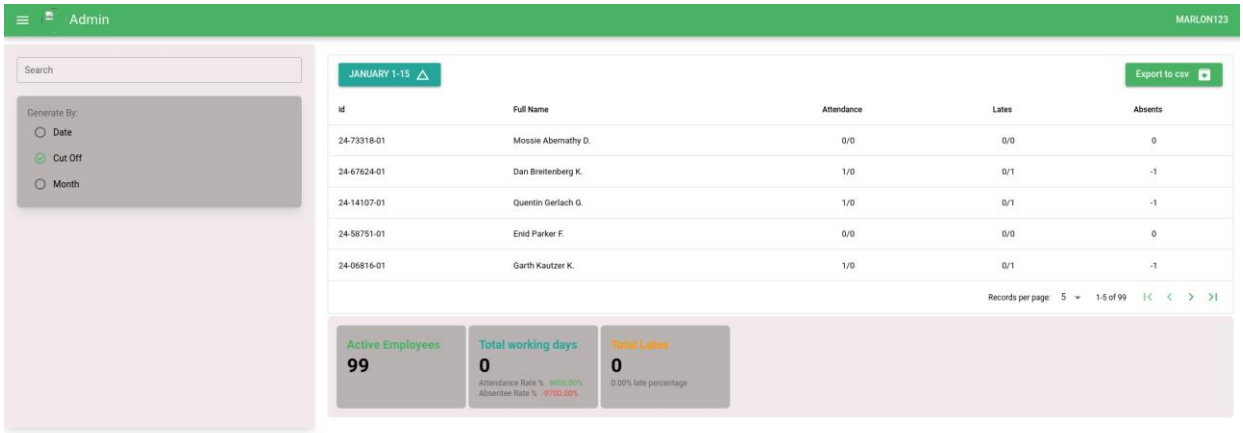


E.5.6 Reports

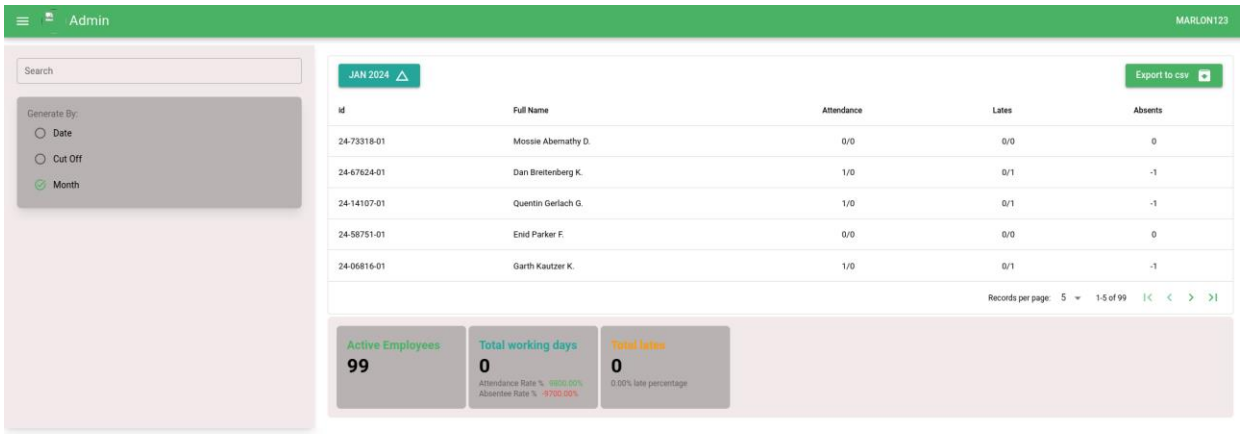
Reports by Date



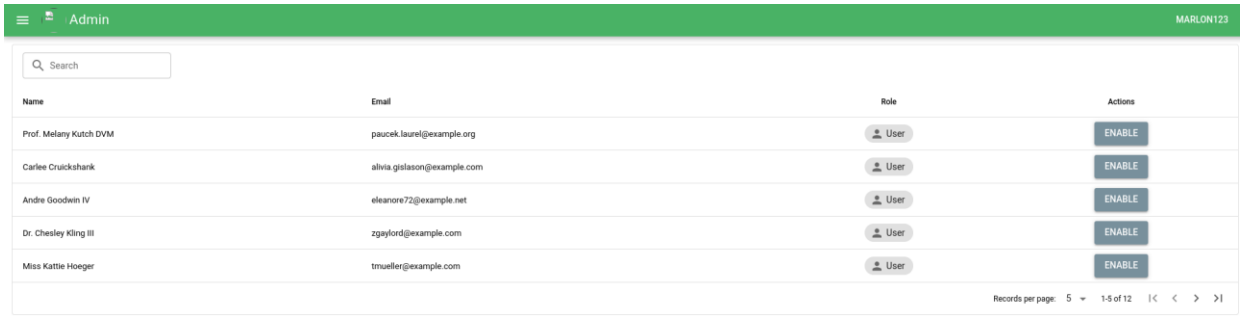
Reports by Cutoff



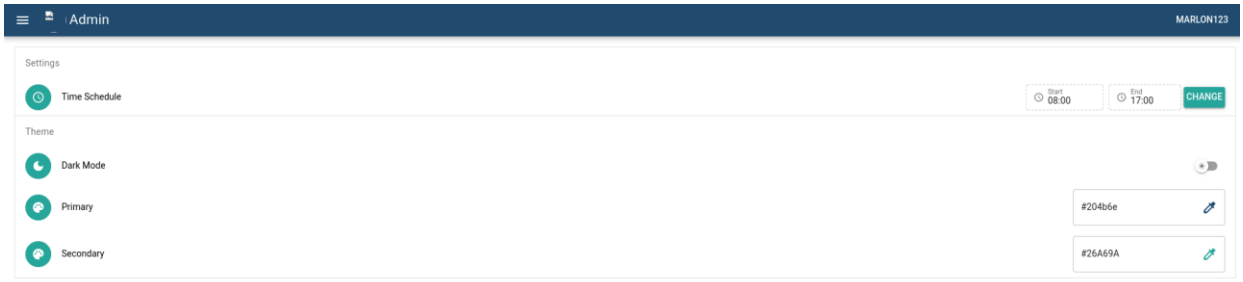
Report by Month



E.5.7 Manage Users



E.5.8 Settings



Appendix F: Estimated Cost of Deployment

Hardware Requirements

Lan Cable (20 meters)	₱190.00
ZkTeco Device with TCP/IP support	₱4000.00
TOTAL	₱4190.00

Minimum System Requirements

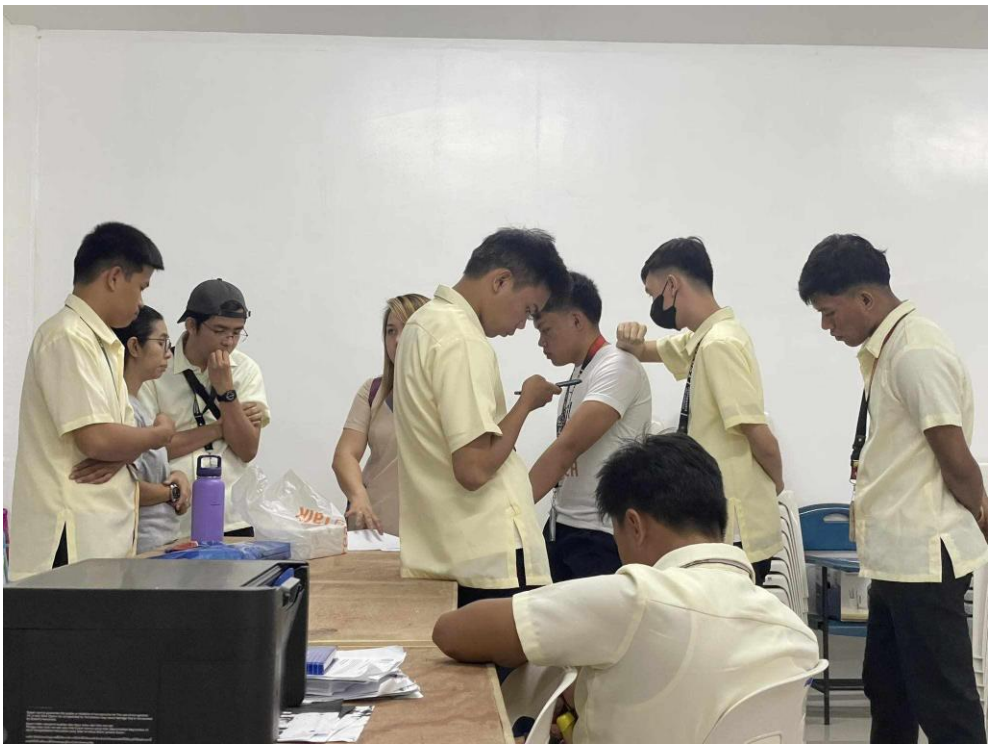
Intel i3 10th gen	₱3,999.00
DDR4 RAM 8GB 2666mhz	₱816.00
AMD A520M-A PRO Motherboard	₱3,425.00
SATA3 SSD120gb	₱585.00
Other Components	₱4000.00
Total	₱12825.00

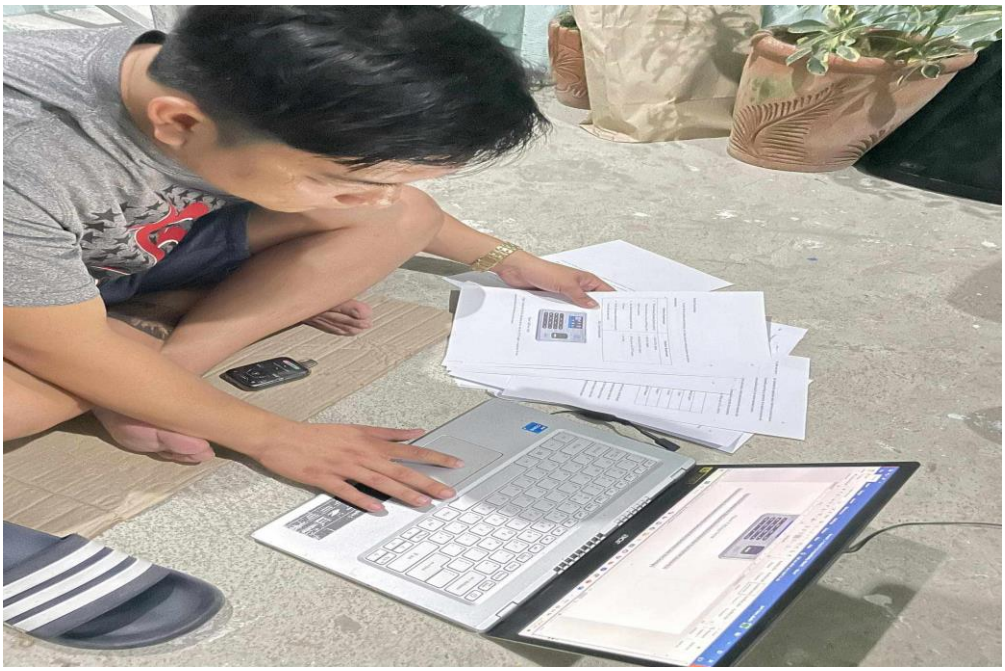
Recommended System Requirements

Intel i5 10th gen	₱12,914.00
DDR4 RAM 16GB 2666mhz	₱1,535.00
AMD A520M-A PRO Motherboard	₱3,425.00
SATA3 SSD480gb	₱1,876.2
1TB HDD	₱859.00
Other Components	₱7000.00
Total	₱27609.2

Note: The estimated price is based on January 2023; please be aware that it might vary in the future.

Appendix G: Project Work Photos





Marlon Padilla

A dedicated student of Nueva Ecija University of Science and Technology, currently taking Bachelor of Science in Information Technology.

Personal Details

Email : marlonpadilla1593@gmail.com

Contact: 09272148745

Citizenship: Filipino

Civil Status: Single

Height: 5’7

Weight: 70kg

Address: 357, Hulo Street, Sinasajan Penaranda, Nueva Ecija

JANUS S. ABESAMIS

A dedicated student of Nueva Ecija University of Science and Technology, currently taking Bachelor of Science in Information Technology.

Personal Details

Email : janusa1616@gmail.com

Contact: 0966-840-2581

Citizenship: Filipino

Civil Status: Single

Height: 5’6

Weight: 76kg

Address: 157 Lacuna St., Brgy. San Josef, Penaranda, Nueva Ecija

JOWEL A. DE GUZMAN

A dedicated student of Nueva Ecija University of Science and Technology, currently taking Bachelor of Science in Information Technology.

Personal Details

Email : joweldeguzman07@gmail.com

Contact: 09350585654

Citizenship: Filipino

Civil Status: Single

Height: 5’6

Weight: 76kg

Address: 10 Rizal street Barangay Poblacion I Penaranda, Nueva Ecija