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The Implementation of Attendance Management System Using Biometrics for San Sebastian College-Recoletos Canlubang Campus.

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March 3, 2025



CHAPTER I

Introduction

I. Background of the Study

Education promotes critical thinking, creativity, and innovation and is essential to both individual and societal advancement. We must optimize educational systems in order to maximize its impact, particularly in the digital age. Even though technology has the ability to change lives, consistent attendance is still essential for students to succeed. It promotes participation, education, and the acquisition of critical abilities. However, conventional attendance techniques are frequently inaccurate and ineffective. A solution is provided by biometric attendance systems, which use secure fingerprint recognition to automate and enhance attendance tracking.

This research is driven by a strong belief in the potential use of technology to enhance the educational experience. As a student in San Sebastian College-Recoletos Canlubang I have a desire for the school to have a robust education system that will effectively optimize the way we learn within the campus and one of the most optimal way is through the implementation of a biometric attendance system. The observations I have made with the current attendance is that many of the students do not attend events/classes due to a lack of attendance discipline. The school often says that the attendance is a must without actually having a way of recording the attendance for each



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student, and where there is an attendance sheet the lines are long and tedious. With a biometric attendance system the school can function more efficiently and effectively by cutting the time and manpower required for the traditional way of taking attendance.

San Sebastian College-Recoletos Canlubang is an educational institution made in 2006 that promotes punctuality but has no strong foundation for an attendance system. San Sebastian College Recoletos is devoted to improving the quality of education environment within the school, with the use of technology we are able to provide a system that will enhance the efficiency and effectiveness of attendance and log taking in the school environment. The school is currently utilizing the traditional method of attendance. The traditional method is as stated before time-consuming, prone to human error, and susceptible to inaccuracies, this makes the

According to Khan (2022) an increase of 0.52% per lecture and 1.7% per lecture attendance for the two units, respectively, indicated a statistically significant relationship between attendance and performance. With these statistics this shows that attendance has become a staple for an efficient and effective education system.

This study focuses on an attendance system that utilizes a biometric device to monitor the student attendance. The center of the entire project revolves around the biometric device to gather fingerprint data from each student and then proceed to systematically log it into the respective database. Wherein faculty members will be able



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to view which students attend, what time they attended, and proceed to make reports according to the absentees. This allows the school to monitor the student in an efficient way which allows them to exhibit educational prowess.

II. Overview of the Current State of Technology

Recent years have seen a significant advancement in biometric technology, which is now a fundamental component for modern identification and security systems. Because of its precision, affordability, and simplicity of integration, fingerprint recognition in particular is one of the most extensively used biometric technologies. These days, fingerprint scanners are extremely complex devices that can take high-resolution pictures and match fingerprints with very few errors by utilizing sophisticated algorithms. These days, a wide range of industries, including banking, education, healthcare, law enforcement, and cellular devices frequently use these systems.

III. Objective of the study

A. General Objective

1. To implement a user-friendly and secure biometric attendance system tailored to the specific needs of San Sebastian College-Recoletos Canlubang Campus.

B. Specific Objective



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1. To implement a functional prototype of the biometric attendance system, incorporating fingerprint recognition technology.
2. To enhance the efficiency of attendance monitoring and reporting.
3. To develop a system that accurately logs student entry and exit times.

IV. Significance of the Study

The study, The Implementation of an Attendance Management System Using Biometrics for San Sebastian College Recoletos Canlubang Campus, has the potential to be an innovation for the institution. This system will improve overall operational efficiency, replace outdated manual processes, and streamline administrative duties.

For Students. This study is significant for students because it offers a quicker, easier, and more precise method of recording attendance. It ensures that their attendance data is safely stored and readily available, does away with the need for manual sign-ins, and lowers the possibility of mistakes.

For Teachers. This study is significant for teachers because it simplifies attendance tracking, saving them time and effort. In addition to giving teachers precise and up-to-date attendance data to monitor the participation of students, it frees them up to concentrate more on education than on administrative duties.

For the School. This study is significant for the San Sebastian College Recoletos Canlubang Campus, because it enhances administrative effectiveness and modernizes



attendance management. By implementing cutting-edge technology, the system improves the school's reputation, guarantees dedication to data privacy laws, and offers insightful information about student attendance trends to help with decision-making.

For Future researchers. This study is significant for future researchers because it can be used as a guide to create similar biometric systems. It opens the door for more innovation and study in this area by offering insights into the problems, fixes, and best practices associated with putting biometric attendance systems in place in educational institutions.

V. Scope and Limitations

A. Scope

- This research aims to implement an attendance system for a college using biometric scanners. The system will be designed to automate attendance tracking, improve accuracy, enhance efficiency, and provide real-time data.
- The proposed system consists of three main components: the database system, the scanner modules, and the HDD (Hard Disk Drive).
 - a) The Database system is used to record all data retrieved from the scanners and hold them in a database for users with authorizations to view student attendance information within San Sebastian College Recoletos, Canlubang.



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- b) The scanner modules are the scanners used to scan the fingerprint data of a college student. Each fingerprint holds a unique set of information per student that the scanner will be able to read and send corresponding information to the database via a wireless connection.
- c) The hard disk drive will serve as the repository for the database. All attendance data captured by the scanners and processed by the database system will be persistently stored on the HDD.

B. Limitations

- The system will be limited to only the college students of San Sebastian College Recoletos, Canlubang Campus.
- Sensitive student data, including attendance records and biometric data, will require strong security measures to prevent unauthorized access or breaches.
- The system's performance depends on the quality and reliability of the fingerprint scanners and network infrastructure.



VI. Conceptual Framework

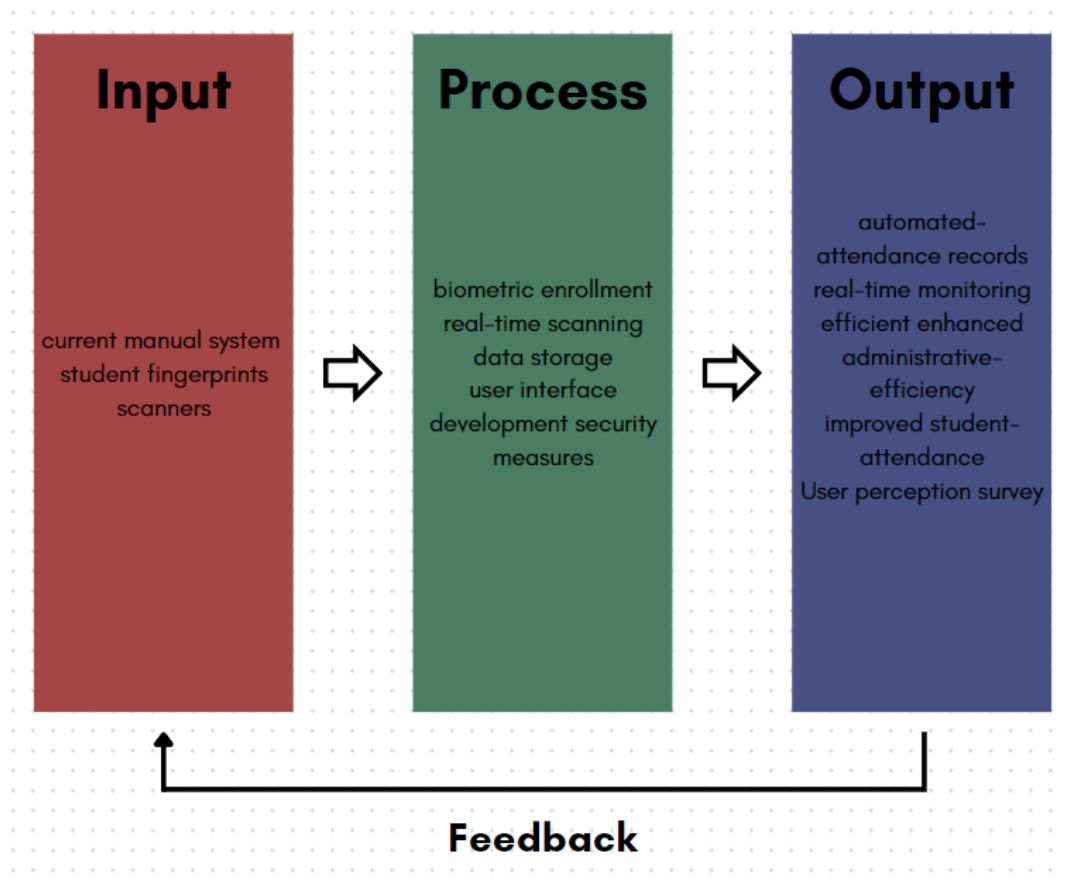


Figure 1.0

The figure outlines the flow of this study, implementing a biometric attendance system at San Sebastian College Recoletos Canlubang. Input includes the current manual system, student fingerprints, and scanners. Process covers biometric enrollment, real-time scanning, data storage, user interface development, and security measures. Output consists of automated attendance records, real-time monitoring, user perception



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survey, efficient enhanced administrative efficiency, and improved student attendance. Through the development of a biometric system prototype, this study seeks to increase attendance efficiency and accuracy. The results will guide future system improvements.

VII. Definition of Terms

The following terms are defined conceptually and operationally for a better understanding of the topic:

Attendance Management System: A system designed to track and record the presence of individuals, in this case, students, at a specific location or event, such as classes or school events.

Attendance Proxy: The act of one person marking attendance on behalf of another, leading to inaccurate records.

Authorization: The process of giving someone permission to do or have something.

Biometrics: The measurement and statistical analysis of people's unique physical and behavioral characteristics, used for identification. In this context, it refers specifically to fingerprint recognition.



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Database System: A structured set of data held in a computer, especially one that is accessible in various ways. In this project, it refers to the system used to store and manage student attendance records.

Fingerprint Enrollment: The initial process of capturing and storing an individual's fingerprint data into a biometric system for identification and verification purposes.

Fingerprint Recognition: A biometric technology that identifies individuals based on the unique patterns of ridges and valleys in their fingerprints.

Prototype: A preliminary version of a device or system that serves as a model for later stages of development.

Scanner Module: The hardware component of the biometric attendance system that captures and processes fingerprint data.

Wireless Connection: Data transfer without the use of electrical conductors or wires.



CHAPTER II

I. Review of Related Literature

This chapter presents a review of relevant literature and studies that support the research on the topic: The Implementation of Attendance Management System Using Biometrics for San Sebastian College-Recoletos Canlubang Campus. The researcher is influenced by research of Rahman et al. (2023) titled FINGERPRINT BASED BIOMETRIC ATTENDANCE SYSTEM. All the cited articles, journals, and literature are based on previous studies made by previous researchers. The researcher included a review of literature on the following topics, as they are the study's key variables: (1) Biometric Technology, (2) Biometric technology in different fields, (3) Database Management Systems, (4) Attendance importance, (5) Attendance management system, (6) Biometric attendance management system, (7) Impact of BAMS

Biometric Technology

The use of distinct biological traits to identify and authenticate people is known as biometric technology. Fingerprints, facial features, iris patterns, voice recognition, and even DNA are examples of these traits. In order to solve security issues, biometrics presents an intriguing window of opportunity to enhance the usability and security of the Internet of Things. It can also be crucial in securing a variety of new IoT devices (Yang et al., 2021). Biometrics provide a secure way to be able to securely identify a person by their personal identification traits. With this biometrics has paved a way for technology



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to be more secure and according to Kumar et al. (2023) biometric technology is so reliable that biometric technology is currently the most in-demand trend. According to Khandekar and Bendale (2023) there are 2 kinds of biometric identification; the Physiological biometrics which uses the physical characteristics of an individual like the fingerprint or the iris, and the Behavioral biometric which identifies the behavioral traits of a person like handwriting style or their manner of walking.

Biometric technology has evolved significantly over the years, becoming a crucial component in identity verification and security systems.. Biometrics have been used way further than one can imagine that date back even in the BCE times where merchants would use fingerprints as identifiers for their business transactions. However this growing technology does not come with perfection, it has its downsides as well. According to Migliorini (2023) one particular kind of harm that results from using biometrics to identify and categorize individuals without a legitimate legal basis is known as "biometric harm.". But we have not taken these problems and ignored them. A few countries have made laws that help prevent a lot of the harms that come with dealing with biometric technology and according to Wodajo (2024) 33 African countries have adopted personal data protection laws that combat these potential harms.

Applications for biometric systems are growing in number, including financial transactions, border control, law enforcement, and smartphone unlocking. For example,



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fingerprint scanners are frequently used to authorize mobile payments and unlock smartphones. All and every modern smartphone has biometric technology integrated in the device to ensure efficiency and user satisfaction. Biometric technology is not limited to smartphones, according to Dargan and Kumar (2020) and Meden et al. (2021) biometric authentication is widely used by many various fields of expertise, but a focus is put especially on law enforcement or forensics.

Biometric Technology in Different Fields

As stated before, biometric technology is prevalent in our modern society in many different fields. These fields include but are not limited to law enforcement, healthcare, educational institutions, and many other various fields.

Utilizing distinct biological traits for identification and authentication, biometric technology is widely used in law enforcement. While facial recognition technology helps identify people in surveillance footage and public areas, fingerprint identification helps law enforcement with criminal investigations by matching suspects to evidence from crime scenes. According to Lynch J. (2020) Today's law enforcement agencies have access to hundreds of millions of photos of law-abiding Americans. This way police officers have an access to the public's faces which is used for biometric purposes such is according to Jansen et al. (2021) from being primarily used for investigations to being used for intelligence gathering and policing in real time. The way they process this



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is through FRT or Facial recognition technology, which uses a camera and then compares the biometric information supplied by a captured image from a photo or video to other images in a data set in order to identify a face (Martin, C., 2020). With that biometrics has undeniably transformed law enforcement as a whole but with great power comes great responsibility, such a tool as this should be used with discretion as consideration of privacy concerns, ethical implications, and the potential for bias.

A vast amount of growth has taken place in the field of biometrics and in the healthcare industry (Mason et al., 2020). With its potential advantages in patient identification, data security, and individualized care, biometric technology is being incorporated into healthcare systems more and more. Biometric technology is prevalent in healthcare, with the studies of Farid et al. (2021) they utilize multimodal biometric technology for identity management in Internet of Things and cloud computing-based personalized healthcare systems, and with the study conducted by Khan et al. (2020) where they integrate biometrics that utilize health data from wearable devices. With that we can fully realize this technology's potential to enhance human health and well-being for future generations by embracing it while tackling the related issues.

In educational institutions, biometric technology is primarily used with the distinctive biological characteristics in identification verification for educational activities. Educational activities include monitoring student behavior or emotions to



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change teaching strategy on time, class attendance, taking electronic tests, analyzing motivations and progress in a course, and conducting learning analysis (Hernandez-De-Menendez et al., 2021). This is also shown in the studies of Hernández-Mustieles et al. (2024) and Necochea-Chamorro et al. (2024) where they utilize biometric technology to solve a problem in their educational institutions respectively. By putting student privacy first, protecting data, and addressing potential biases, we can use biometric technology to make learning more secure, efficient, and equitable for all students.

Biometrics are not only limited to those fields but are also prevalent in office environments, border control, finance, and other fields of professions. According to Siswanto et al. (2023) his study proposed door automation through the use of biometrics that has increased employee safety and comfort with a low cost to install the product. Border control is also a common user of biometric technology, with biometric technology significantly impacting the safety and effectiveness of the control procedures. Automating biometric recognition can boost border control posts' border processing, and it's made easier by clearance processes (Kyeremeh et al., 2021). Finance is also a field that utilizes biometrics, the study conducted by Vasuki (2024) utilizes biometrics in order to have a secured merchant payment system. Our everyday lives are quickly becoming reliant on biometrics, which is changing how we travel, work, and engage with the outside world. We can use this potent technology to increase security,



boost productivity, and build a more connected and safe future by resolving ethical and privacy issues and making sure it is used responsibly and fairly.

Database Management Systems

Databases are now the foundation of almost every organization, from startups to large conglomerates, in today's data-driven world. They act as the main source of important data, giving companies the ability to make wise decisions, increase productivity, and obtain a competitive advantage. Studying the underlying theory and implementation techniques of the database's structure, storage, design, management, and application allows for the processing and analysis of its data (J. Yang et al., 2020). According to Chamberlin (2024) there were two relational query languages on the market in 1982: QUEL, which was marketed by RTI, and SQL, which was marketed by IBM and SDL, this paved the way for future developments in database technology.

A database management system (DBMS) is a piece of software made to build, maintain, and work with databases. Users can interact with the database effectively and safely thanks to its structured framework for storing, organizing, and retrieving data. Additionally, it manages a sizable collection of structural data, handles access, security, and storage, and permits multiple concurrent users to access data while preserving data integrity (Salim et al., 2020). According to Taipalus (2023) it is logical that different studies have compared the performance of different DBMSs in hopes of finding the most



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efficient one. They are now the foundation of information management in many different domains, transforming how companies run, research is carried out, and services are provided. The study conducted by Kaewsuwan and Khwunnak(2022) utilized DBMS technology in education where they made a registration system that stores its data in an online database system with systematic design and development according to guidelines. DBMS is also a rising trend in other fields of profession, like how the study conducted by Sivov and Bogatyrev (2023) utilizes a DBMS in a banking environment because according to them the banking sector assigns high priority to data storage. Abduqayumova (2023) has also made use of a DBMS in healthcare with their study about development of an electronic, SQL-based, user-friendly database management system for a nearby hospital in order to streamline operations. DBMS are not only limited to those fields they are also used in Manufacturing as the study conducted by Gamero et al. (2022) and even in government facilities as conducted by Imtiyaj et al. (2020). But similar to the database this is not perfect technology and comes with its flaws as it is also prone to attacks, according to Teimoor(2021) control measures that could be implemented to stop these attacks were looked into in order to educate both the general public and application developers about online security. Precautions are needed to be taken to be able to have a stable DBMS but even still one would still need a robust DBMS in order to have reliability and performance (Jani, 2022). To sum it up, database management systems are not limited to a particular field. They are present in many different fields, empowering many companies, promoting research, and enhancing the



efficacy and efficiency of different industries. The need for reliable and adaptable DBMSs will only increase as data volume and complexity continue to rise.

Attendance Importance

The foundation of both academic achievement and the general development of students is attendance. Regular attendance in the classroom lays the groundwork for learning that has a big impact on a student's future prospects, social-emotional development, and academic achievement. According to Daily et al. (2020) Chronic absentee students often struggle academically and might not take full advantage of everything that school has to offer. Multiple studies have shown the same outcome of students that are frequently absent have a hard time in academically succeeding, similar with the studies conducted by Laith and Vaillancourt (2022), Bowen et al. (2022), and Ansari and Gottfried (2021). Students developing absenteeism has become such an issue that it has become a national problem that needs to be addressed (Malika et al., 2021). Attendance does not only occur in students but can occur anywhere that requires presence like how the study of Schreyer and Ansari (2021) looked into how stadium attendance affects sports economists and sport management researchers or how the study conducted by Fernandes et al. (2023) talks about the phenomenon of absenteeism among municipal teachers. In summary, consistent attendance at school is not only necessary but also crucial to a student's growth on all levels academically, socially, and personally. Students can maximize their learning potential, form meaningful social relationships,



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and develop vital life skills that will benefit them throughout their lives by making attendance a priority.

Attendance Management System

Traditional approaches to tracking attendance are becoming obsolete and ineffective in today's world of growing digital transformation. Problems also arise when using a traditional or manual approach to taking attendances like proxies are possible risks when attendances are taken manually (Nadhan et al., 2022). A more accurate and efficient method of controlling student presence in educational institutions is provided by Attendance Management Systems (AMS), which have become an effective solution. According to Ukirde (2024) sophisticated attendance management systems are now used by modern businesses and educational institutions to improve efficiency and streamline procedures. The Automated Attendance System uses image processing techniques in the classroom to overcome the drawbacks of manual attendance taking methods (Suthari et al., 2023). An automated class attendance system also makes it less difficult for educators and administrators as they can keep tabs on students' attendance, monitor punctuality, and spot tardy or absent students (Rahman et al., 2023).

There are two ways to take attendance with the modern approach; Biometrics and RFID. Although both RFID (Radio-Frequency Identification) and biometrics are technologies used for attendance taking, their working principles are essentially



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different. According to Duan and Cao (2020) radio frequency identification is a type of non-contact data communication technology in which users can send radio frequency signals to the tag via a reader and receive response data from the tag. This phenomenon is a consequence of radar technology which was first developed between 1940 and 1950. On the other hand biometrics utilizes unique biological characteristics, such as facial features, fingerprints, or iris patterns, for identification. Biometrics have also faced challenges especially in facial recognition biometric systems when covid happened, since this limited the use of face recognition technology (Gomez-Barrero et al., 2022). With those two aspects of attendance taking have been introduced we have reached a cross-road on which one to choose, while both have their advantages and disadvantages they 1 up each other on various aspects. Even according to Sharma (2023) each of the two technologies has pros and cons of its own. RFID systems, for instance, are easier to scale and offer good security and tracking capabilities for a fraction of the price. However, biometric systems offer a more secure operation.

Biometric Attendance Management System (BAMS)

Biometric attendance taking systems (BAMS) have revolutionized the way organizations track employee time and attendance. This system combines all previously mentioned aspects such as database, biometrics, and attendance management systems. According to Moshayedi et al. (2022) one of the most time-consuming tasks in any school, university, or educational system is managing and collecting student attendance.



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Actually, collecting attendance is a laborious task that consumes lecture time and the teacher's energy. With this a biometric attendance management system (BAMS) becomes a staple for reliability and performance in taking attendance. There are multiple classifications of a biometric attendance management system (BAMS) that is split into 3 main categories of biometrics; Facial, Fingerprint, and Multimodal.

The most common component of biometric attendance has been fingerprint-based systems, which uses the distinctive ridge patterns on a fingertip to identify a user. According to Ocumen et al. (2020) it is given that no two people are thought to have the same fingerprints, fingerprint identification and verification is a widely used method of confirming someone's identity or authenticity in situations where security is an issue. Basically, fingerprints are considered as the foremost reliable type of thing to be used in biometric systems (Jain et al., 2020). Other than that, the ease of use is simpler as fingerprints are always with us (Lamin et al., 2021). Overall the fingerprint recognition technique is at the forefront of biometric identification because it offers good stability in terms of accuracy, throughput, size, cost, and ease of use. This has made it exceptional in commercial applications(Soyemi and Isinkaye, 2020).

With their contactless and practical solution, facial recognition systems have become increasingly popular. Employees can be swiftly authenticated by these systems by examining distinctive facial features. According to Kamil et al. (2023) in order to



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record attendance, the user's identity must be verified through the face recognition process; on the other hand, the user's safety compliance must be verified through the detection of the face mask. This type of biometric is also reliable as the other types as shown in the studies of Bussa et al. (2020) and Gomes et al. (2020) where they both utilized facial recognition in their systems as a way of verification. Compared to the fingerprint recognition, facial recognition boasts its contactless way of taking identification but it also comes with its cons as it is prone to AI deep fakes which is popular these days and is more susceptible to environmental noise like sunlight or angles.

A single biometric recognition technology frequently has drawbacks, including being susceptible to individual differences and environmental interference. As a result, multimodal biometric recognition technology developed in response to contemporary demands. Combining various biometric data can greatly increase recognition stability and accuracy (Xiaoliang et al., 2024). According to Omotosho et al. (2021) numerous applications, including banking, access control, and information security, have embraced multimodal biometric recognition systems. With the combination of different biometric techniques, multimodal has become a more reliable source since it combines the best of both worlds in biometric recognition. This is shown in the studies of Mishra et al. (2020) and Mustafa et al. (2020) where they utilize multimodal biometric technology since according to them multimodal performs better than a single modality.



To sum up, biometric attendance systems have a number of benefits over conventional techniques, such as increased security, decreased time consumption, and improved accuracy. A number of variables, including financial constraints, security specifications, user experience, and the particular requirements of the company, influence the selection of the better system. The continuous development of biometric technology promises to further improve workplace attendance management's efficiency and security, even though issues like privacy concerns and misuse potential must be addressed.

Impact of BAMS

Modern workplaces and educational institutions have been significantly impacted by the introduction of biometric attendance systems, which have revolutionized the tracking and management of employee time and attendance. According to Yakubu Suale et al. (2023) the results indicated that the implementation of a biometric attendance management system diminishes absenteeism and improves attendance of the individuals. Also according to Agyemang, P. K. (2024) accurate data retrieved by the system can even impact the various administrative decisions and reporting. The impact of implementing this system is not only prevalent in educational environments but also in a professional workplace such as the study conducted by Jalo et al. (2023) where he implemented a biometric attendance management system (BAMS) and it had both a positive and negative impact. In conclusion, with the aim of improving



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education, this innovative attendance system combines the accuracy and convenience of biometric technology to create a more effective educational ecosystem. It not only gives teachers and students more authority, but it also advances society's larger goal of producing educated people who can advance social justice and have a positive influence on their communities (Nabi and Abdullahi, 2023).

Summary

As suggested by this chapter's literature review, various studies have been discussed that are relevant to this research. The researcher has discussed the implementation of a biometric attendance management system.

Biometric technology, utilizing distinct biological traits for identification and authentication (Yang et al., 2021), has become crucial in security systems (Kumar et al., 2023). It encompasses physiological biometrics (e.g., fingerprints, iris) and behavioral biometrics (e.g., handwriting) (Khandekar and Bendale, 2023). While offering enhanced security (Migliorini, 2023), it also raises concerns about "biometric harm," addressed by data protection laws in some regions (Wodajo, 2024). Biometrics finds applications in diverse fields like finance, border control, law enforcement, and smartphone unlocking (Dargan and Kumar, 2020; Meden et al., 2021). Law enforcement utilizes biometrics, particularly facial recognition technology (FRT), for investigations and intelligence



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gathering (Lynch J., 2020; Jansen et al., 2021; Martin, C., 2020). Healthcare increasingly integrated biometrics for patient identification and data security (Mason et al., 2020; Farid et al., 2021; Khan et al., 2020). Educational institutions employ biometrics for various purposes, including attendance, student behavior monitoring, and learning analysis (Hernandez-De-Menendez et al., 2021; Hernández-Mustieles et al., 2024; Necochea-Chamorro et al., 2024). Other applications include office environments, border control, and finance (Siswanto et al., 2023; Kyeremeh et al., 2021; Vasuki, 2024). DBMS are fundamental to modern organizations, enabling data management for informed decision-making (J. Yang et al., 2020; Chamberlin, 2024). DBMS software facilitates database creation, maintenance, and interaction (Salim et al., 2020). Performance comparisons are common (Taipalus, 2023), and DBMS are applied in diverse fields like education (Kaewsuwan and Khwunnak, 2022), banking (Sivov and Bogatyrev, 2023), healthcare (Abduqayumova, 2023), manufacturing (Gamero et al., 2022), and government (Imtiyaj et al., 2020). DBMS security is crucial due to vulnerability to attacks (Teimoor, 2021; Jani, 2022). Consistent attendance is crucial for academic success and student development (Daily et al., 2020; Laith and Vaillancourt, 2022; Bowen et al., 2022; Ansari and Gottfried, 2021). Absenteeism is a significant issue (Malika et al., 2021), impacting various sectors, including sports (Schreyer and Ansari, 2021) and teaching (Fernandes et al., 2023). Traditional attendance tracking methods are becoming inefficient (Nadhan et al., 2022). AMS offers a more effective solution (Ukirde, 2024; Suthari et al., 2023; Rahman et al., 2023). Modern AMS utilize



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biometrics or RFID (Duan and Cao, 2020). While RFID offers scalability and affordability, biometrics provides enhanced security (Sharma, 2023). Facial recognition systems have faced challenges due to the COVID-19 pandemic (Gomez-Barrero et al., 2022). BAMS combines biometrics, databases, and attendance management, addressing the time-consuming nature of traditional attendance tracking (Moshayedi et al., 2022). BAMS can be categorized by biometric type: fingerprint, facial, and multimodal. Fingerprint-based systems are common due to their reliability and ease of use (Ocumen et al., 2020; Jain et al., 2020; Lamin et al., 2021). Facial recognition offers contactless identification but is susceptible to environmental factors and deep fakes (Kamil et al., 2023; Bussa et al., 2020; Gomes et al., 2020). Multimodal systems combine multiple biometric modalities for increased accuracy and robustness (Xiaoliang et al., 2024; Omotosho et al., 2021; Mishra et al., 2020; Mustafa et al., 2020). BAMS have significantly impacted workplaces and educational institutions, reducing absenteeism and improving attendance (Yakubu Suale et al., 2023; Agyemang, P. K., 2024). They also influence administrative decisions (Agyemang, P. K., 2024). While positive impacts are evident, challenges exist (Jalo et al., 2023). BAMS contributes to a more effective educational ecosystem, empowering teachers and students (Nabi and Abdullahi, 2023).



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Process Model Development

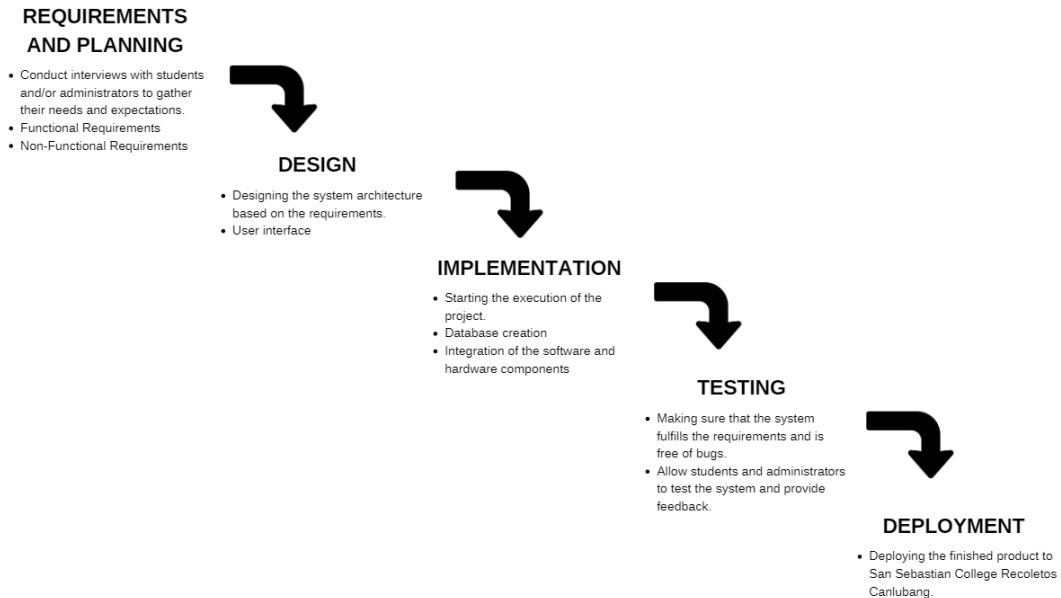


Figure 2.0

The researcher used the waterfall method for their study because it offered a straightforward, step-by-step approach that was perfect for a project with clearly defined requirements. Every stage, from planning to deployment followed a logical flow, guaranteeing security and stability which are two essentials when managing sensitive biometric data.

Requirement Stage

Hardware requirements

- Fingerprint scanner: An input device that will take fingerprint data of each individual as a unique identifier.



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- **Server:** A dedicated server with sufficient processing power (minimum dual-core processor), RAM (at least 8 GB), and storage capacity (SSD preferred for speed) to handle data processing and storage.
- **Network Infrastructure:** Reliable internet connectivity (preferably fiber optic) and a secure local network (LAN) to facilitate data transmission between biometric devices and the server.

Software requirements

- **Operating System:** A stable 64-bit operating system such as Windows Server or Linux that supports the required applications and database management systems.
- **MySQL:** The world's most popular open source database and will serve as the database for the entire system.

Design Stage

The research design follows a structured process model development to ensure the system meets its functional and non-functional requirements. The design process is divided into stages; planning, design, implementation, testing, and deployment. These stages will serve as a guide to the researcher to be able to conduct the project in a uniform manner.

Functional Decomposition Diagram



A Functional Decomposition Diagram (FDD) is a hierarchical graphical representation used to define and analyze the functional requirements of a system. It employs a top-down approach, breaking down a complex function into progressively simpler sub-functions .

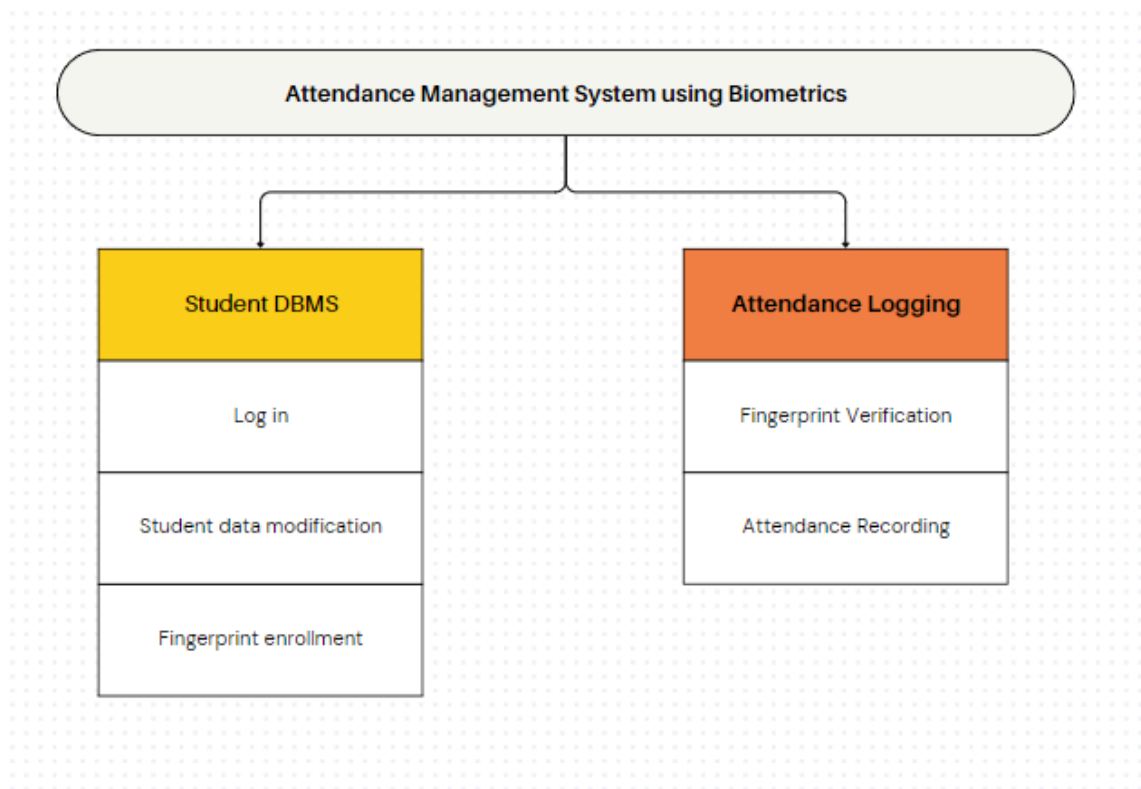


Figure 3.0

This figure illustrates the attendance management system which is the root. Then branches out to its 2 major functions which are the student DBMS and Attendance Logging. These main branches, in turn, further subdivide into more granular



sub-functions which are in Student DBMS; Login, student data modification, and fingerprint enrollment, and Attendance logging; Fingerprint verification and Attendance recording.

Case Diagram

A case diagram, often referred to as a use case diagram, is a visual representation of the interactions between users and a system.

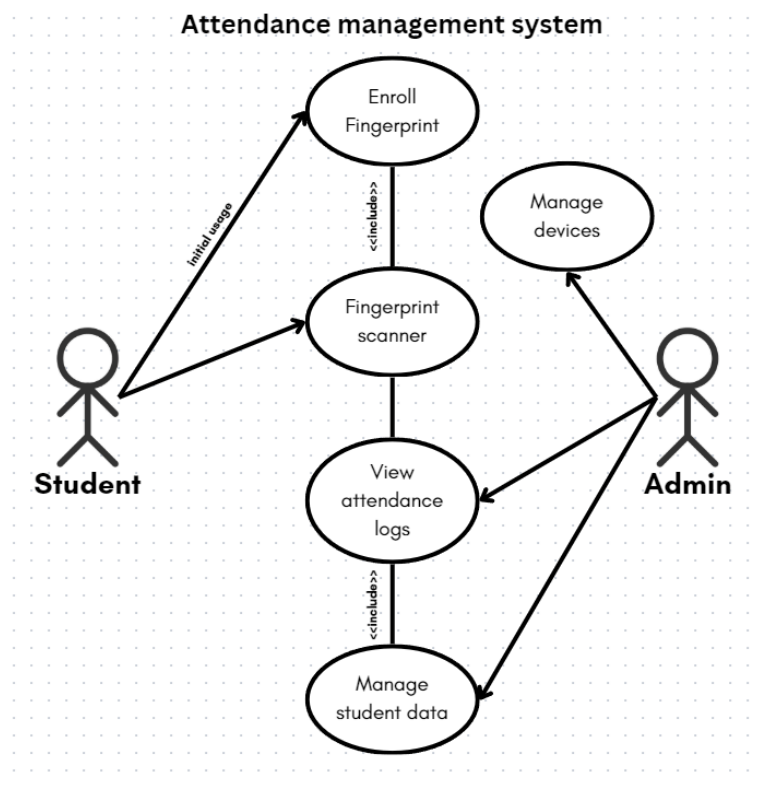


Figure 4.0



The figure shows that the student/user initially enrolls their fingerprint into the system then the database stores that information which is then recognized by the fingerprint scanner. The system then retains that information which will then be able to be viewed by the admins. The admins are also able to manage the scanners or devices and manage the student data if there are any errors.

Requirements Modelling

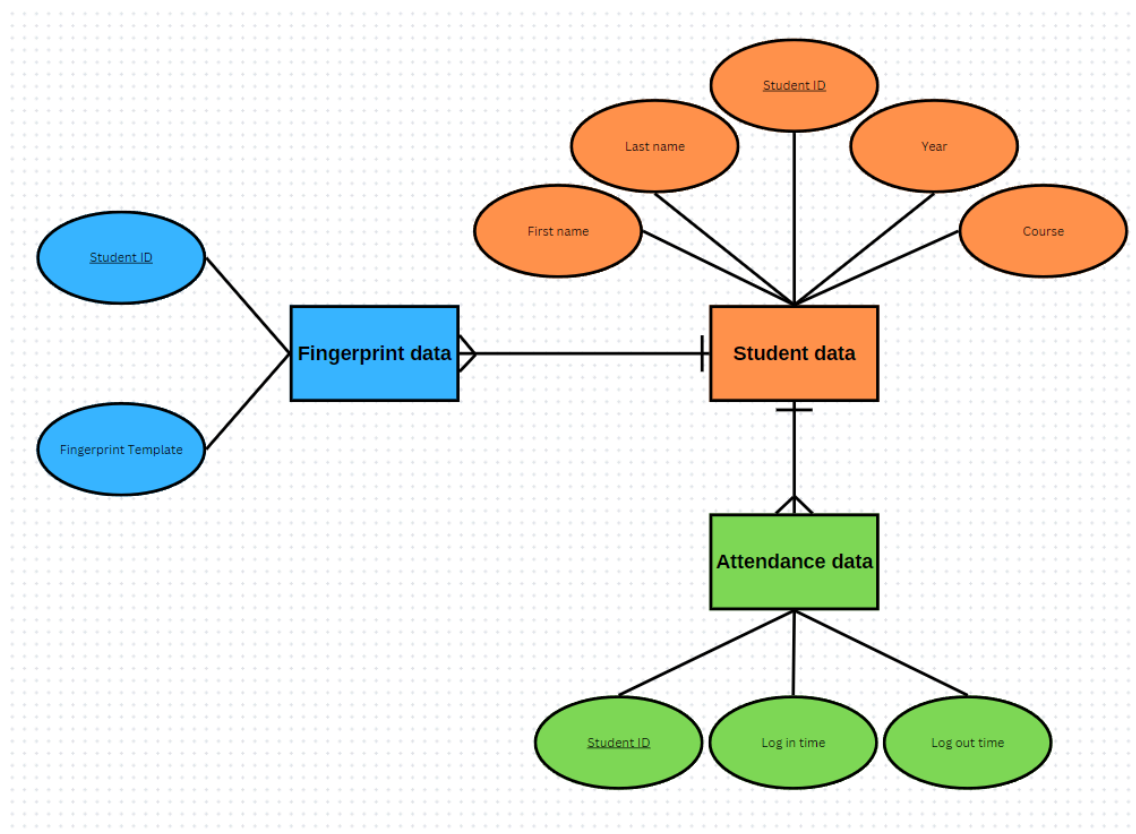


Figure 5.0



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The ERD serves as the database structure for how the system application will work. Just like in the diagram the entity is the student data that will record the attributes of the user's first name, last name, Student ID, year, and course. Fingerprint data will contain the fingerprint template of each student which will correspond to the student id/ the owner of the fingerprint. Attendance data will contain the log in time, log out time, and will correspond to the student ID.

Functional requirements

- The system will use fingerprint data to accurately record student attendance.
- Attendance records will be safely stored in a reliable database by the system.
- Authorized personnel will be able to view and access the attendance records through the system.

Non Functional requirements

- The system will adhere to data privacy regulations in order to protect student data.
- The system requires minimal downtime and is reliable and available around-the-clock.
- The system shall be user-friendly and easy to use.



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Research

The project consists of a biometric device to be able to collect data from the students and a database that will be able to hold all the said data. The objectives of this project is to implement a functional prototype of the biometric attendance system, using fingerprint recognition technology, streamline administrative processes related to attendance management, and to create a system that accurately logs student entry and exit times. The project is estimated to require around 1k pesos and the estimated finalization of the prototype to be 8 months, building on a similar fingerprint based biometric attendance system project by Rahman et al. (2023).

Population of the study

This researcher will conduct their study in San Sebastian College Recoletos Canlubang Campus. The target population for this study is the college students that are currently enrolled in San Sebastian College Recoletos Canlubang this school year 2024 - 2025.

Data gathering tool

To ensure the successful Implementation of an Attendance Management System Using Biometrics, a range of data collection instruments are going to be used. These instruments were chosen to gather quantitative information that shed light on system



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performance, user needs, and general usability. Questionnaires are the main instruments that are utilized.

Data gathering procedure

In order to gather the applicable data for this study, the researchers will undergo through the following data gathering process:

1. The researcher will prepare questions that are to be answered by the respondents in an interview
2. The researcher will prepare a consent letter that will ask the school for permission to conduct a survey to the students.
3. With the approval of the Dean, the researcher will start to conduct the interview to the students of San Sebastian College Recoletos Canlubang.
4. The researcher will then use the collected data from the interview for the study.

Documentation of the current system

Description of the current system

The current system of taking and storing attendance in San Sebastian College Recoletos Canlubang Campus is the manual and traditional system. The system for taking attendance is the simplest way, which is writing your name, time in/time out, signature, year, and course, which in itself is not a bad way of taking attendance but at



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the same time it is not the most efficient one either. Same with the attendance taking the way of storing is also outdated in which their attendance sheets are stored in a drawer in the Student Affairs Office. These methods which are manual are prone to many errors such as difficulty in finding past attendance sheets, pen could possibly run out of ink, possible attendance proxies, and many more downsides to using the manual methods.

Hardware and Equipment set up

The hardware and equipment that are being used to take attendance in San Sebastian College Recoletos Canlubang Campus are as follows; Pen, and paper.

Software and applications being used

There are no software and applications being used in the current system since the current system is manual and traditional.

Summary

This chapter outlines the usage of a quantitative research design and survey research methodology to develop a biometric attendance management system for San Sebastian College-Recoletos Canlubang Campus. The waterfall method of system development, which includes requirement collection, design, implementation, testing, and deployment, will be used in this project. In order to store and manage student attendance data, the system will include fingerprint scanners, a dedicated server, and a MySQL database. To demonstrate the system's operations and user interactions, a use case diagram and functional



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decomposition diagram will be employed. The goal of the system is to replace the current manual attendance system which is prone to errors and inefficiencies, with a biometric system that is more accurate and efficient. College students will be interviewed to gather data for the project, which will comply with data privacy laws.



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