FINGERPRINT ATTENDANCE SYSTEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in partial fulfillment of the requirements for the
Bachelor of Computer Science (Computer Security) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
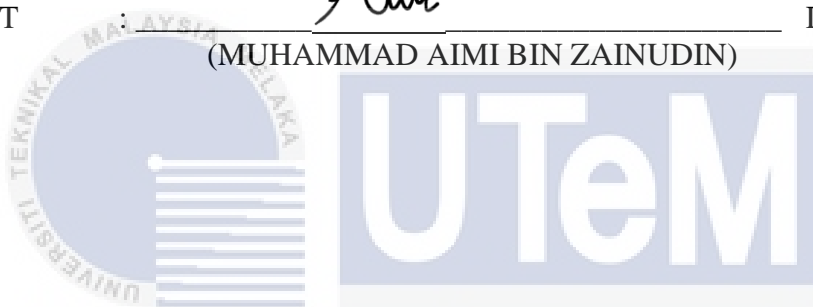UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I hereby declare that this project report entitled

FINGERPRINT ATTENDANCE SYSTEM

is written by me and is my own effort and that no part has been plagiarized

without citations.

STUDENT : _____ Date : 06/9/2021

(MUHAMMAD AIMI BIN ZAINUDIN)

I hereby declare that I have read this project report and found

this project report is sufficient in term of the scope and quality for the award of

Bachelor of Computer Science (Computer Security) with Honours.

SUPERVISOR : _____ Date : ١٠/٩/٢٠٢١

(PROF. DATUK TS. DR. SHAHRIN BIN SAHIB)

DEDICATION

I dedicated this work to my dearest beloved parents, Zainudin bin Abd Majid and Habibah binti Isnin who always keep motivating me and supporting me to get through everything in my studies. Thank you so much for all of your support and encouragement throughout the years.

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I also want to thank my wonderful parents for their encouragement and support during this project.

ABSTRACT

The project is an employee attendance scheme that uses a biometric fingerprint scanner to monitor the timing of their arrival at the workplace. Therefore, this project is proposed due to the obvious behaviour of some worker who have come late but are asking their co-workers to punch their cards early or called as "buddy punching", so that their boss would not notice if they had been late. Other than that, the problem is difficulty in order to track back employee's attendance as the admin or person-in charge did not have a proper system. Next, there is no database to store attendance for traditional attendance method. The traditional method stores the attendance physically and easy to get tampered. After that, the high-rate time cheating among employees. This biometric fingerprint scanner for attendance can reduce the number of "buddy punching" in the company as each fingerprint unique for every person in this world. So, employees will not be able to trick or cheat their selves out of problems by using a biometric fingerprint scanner. From using this attendance method, the rate of attendance cheating will also be minimised and reduced since a fingerprint would be used to mark and record the exact arrival time at the workplace. From some research that I have made, the fingerprint device is by far the most price efficient and simple to use, without any negative health consequences. As a result, this fingerprint attendance system may be used to track and monitor the attendance of employees more accurate.

ABSTRAK

Projek ini adalah skema kehadiran pekerja yang menggunakan pengimbas cap jari biometrik untuk memantau waktu ketibaan mereka di tempat kerja. Oleh itu, projek ini diusulkan kerana tingkah laku yang jelas dari beberapa pekerja yang datang lewat tetapi meminta rakan sekerja mereka untuk menebuk kad mereka lebih awal atau disebut sebagai "rakan meninju", sehingga bos mereka tidak mengetahui jika mereka terlambat . Selain itu, permasalahan yang timbul adalah kesukaran untuk mengesan kehadiran pekerja kerana pentadbir atau orang yang bertanggungjawab tidak mempunyai sistem yang sesuai. Seterusnya, tidak ada pangkalan data untuk menyimpan kehadiran untuk kaedah kehadiran tradisional. Kaedah tradisional menyimpan kehadiran secara fizikal dan mudah diubahsuai. Selepas itu, penipuan masa yang tinggi di kalangan pekerja. Pengimbas cap jari biometrik untuk kehadiran ini dapat mengurangkan jumlah "teman meninju" di syarikat kerana setiap cap jari unik untuk setiap orang di dunia ini. Oleh itu, pekerja tidak akan dapat menipu masa atau menipu diri sendiri dengan menggunakan pengimbas cap jari biometrik. Dengan menggunakan kaedah kehadiran ini, kadar kecurangan kehadiran juga akan diminimumkan dan dikurangkan kerana cap jari akan digunakan untuk menandakan dan mencatat waktu kedatangan yang tepat di tempat kerja. Dari beberapa kajian yang telah saya buat, alat cap jari ini adalah harga yang paling efisien dan mudah digunakan, tanpa kesan kesihatan yang negatif. Hasilnya, sistem kehadiran cap jari ini dapat digunakan untuk mengesan dan memantau kehadiran pekerja dengan lebih tepat.

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FYP   **-**   **Final Year Project**

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Nowadays, every company or workplace have their own attendance system. This attendance system is very important for employers to know or check whether their staffs or employees coming up as scheduled. Due to technology advancement, the traditional pen-paper attendance or punch card attendance system have become more and more crucial. The traditional method for attendance system has many weaknesses and flaws. For example, pen-paper attendance needs to do or check calculation manually and any absent employee hard to track on the specific date and time. Other than that, for punch card attendance system has critical flaws to detect any time cheating such as "buddy punching" among employees. Along with the time cheating among employees, companies should improve their attendance system by using biometric attendance system.

Biometric authentication is an effective way to secure identity data nowadays. This biometric method also has been used for attendance systems. There are several types of biometric attendance systems, such as using facial recognition, iris recognition and fingerprint authentication. Fingerprint has widely used because fingerprint itself is unique and different for every person in this world even though they are twins. Of all biometric systems, the fingerprint device is by far the most price efficient and simple to use, without any negative health consequences (Abioye 2018). Using fingerprint also much more accurate and user friendly for all employees. Fingerprint attendance system will use fingerprint scanner to track or record attendance using accurate time and it will notify admin or manager if late present. Fingerprint scanner using solid state sensors give the most reliable and accuracy to use.

Therefore, the purpose of this proposed project an employee attendance scheme that uses a biometric fingerprint scanner to monitor the timing of their arrival at the workplace using Arduino with fingerprint scanner module. This project will help to track and monitor each of the employee's attendance and view history of the existing attendance.

1.2   Problem Statement

The main problem is difficulty in order to track back employee's attendance as the admin or person-in charge did not have a proper system. Next, there is no database to store attendance for traditional attendance method. The traditional method stores the attendance physically and easy to get tampered. After that, the high-rate time cheating among employees.

Table 1.1: Summary of Problem Statement

PS	Problem Statement
PS1	Difficult to track back and monitor employee's attendance.
PS2	Does not have proper database to store attendance.
PS3	High rate on time cheating among employees

1.3 Project Research Question

Project research question is used to define methods of ensuring attendance tracking among employee, the ways to reduce time cheating, and the solution in order to handle this particular problem, reason to use biometric fingerprint scanner module. Table 1.1 shows the summary of project research question.

Table 1.2: Summary of Project Research Question

PS	PRQ	Project Research Question
PS1	PRQ1	How to handle time cheating attendance?
PS2	PRQ2	How to track and monitor the attendance of employee?
PS3	PRQ3	What is the global solution to handle time cheating?

1.4   Project Objective

Project Objective define clear results or outcomes and achievable deliverables which the project would develop. The improvement about project is based on the stated problem statement and the project question. Table below shows the project objectives.

Table 1.3: Summary of Project Objective

PS	PRQ	PO	Project Objective
PS1	PRQ1	PO1	To analyse various forms of biometric technology systems and how they have been used in attendance system in various organizations.
PS2	PRQ2	PO2	To identify various factors that are to be considered to recommend a fingerprint biometric attendance system which traditional method have more flaws.
PS3	PRQ3	PO3	To implement a reliable fingerprint attendance system using Arduino.
		PO4	To evaluate the performance and reliability of the proposed system

1.5   Project Scope

Project scope is a detailed record of all that focuses on creating a project a success and fully functions. The project scope will also give an overview of entire project. For this project, the project scope will describe the targeted user and modules related to biometric fingerprint attendance system.

1.5.1   User

The target user for this project is the admin or person-in-charge who want to track and monitor employee attendance.

1.5.2   Modules/Functions

Since a module or function is a component of a program in software, it may help the system succeed. There are some modules that related for this project such as:

    i.   Search

    This module give permission to admin to search specific employee their attendance history.

    ii.   Update

    The update module allows the admin to edit or alter a worker's records or history. Only the ID, name, and department may be altered.

    iii.   Save

    This module allows the admin to save every new employee to the database.

    iv.   Fingerprint scanner module

    This module allows employees to register their attendance using their fingerprints, which is then stored in the database.

1.6 Project Contribution

The term "Project Contribution" refers to the expected successful outcome of the project. This section may be related to as the project's objectives. The table below shows the project contribution.

Table 1.4: Project Contribution

PS	PRQ	PO	PC	Project Contribution
PS1	PRQ1	PO1	PC1	The expected outcome of this project to make the rate of attendance cheating will also be minimised and reduced since a fingerprint would be used to mark and record the arrival time at the workplace
PS2	PRQ2	PO2		
PS3	PRQ3	PO3		
		PO4		

1.7 Report Organisation

For this section explain about report organization which a summary of each chapter within this report and shows the report arrangement of this project.

 I.   Chapter 1: Introduction

Explain more precisely the project's background as well as the previous research and study issues or problems that should be solved. This chapter also outline the project objectives, scope, and the expected outcome for this project.

 II.   Chapter 2: Literature Review

Review any research that related to Fingerprint Attendance System. In this chapter explains related works, proposed solution, and critical review of the current or existing problem.

III.   Chapter 3: Methodology

Project analysis been developed in this chapter. Methodology has to describe in detail each phase or stages and must relate to the project. Project milestones also explained and created to monitor project's progress.

IV.   Chapter 4: Design

This chapter describe the implementation of project including design overall project and system. The design including high-level design and database design.

V.   Chapter 5: Implementation

This chapter explain in detail on software development environment setup and the expected result of the system using software code and logical procedure.

VI.   Chapter 6: Testing

This chapter describe on the testing of the project software development. The developer and end user will test the project.

VII.   Chapter 7: Conclusion

For this final chapter is to make a summarization about the project, explain the project limitation and the future works to improve the system.

1.8   Conclusion

In conclusion, this propose Fingerprint Attendance System is to track and monitor attendance among employee using Arduino and Fingerprint scanner module and to view history of attendance in order to minimized and reduce the rate of attendance.

CHAPTER 2: LITERATURE REVIEW

2.1   Introduction

The proposed project is to create or develop a Fingerprint Attendance System with an Arduino and a fingerprint scanner module. This project necessitated some research and fact-finding to help the project and to review some of the problems and solutions for a deeper understanding of the methods that could be used. As a result, when carrying out a project, a literature review is necessary.

Throughout this chapter, facts and findings, as well as a summary of the literature on related projects and studies on this system, will be reviewed and discussed. The main goal of a literature review is to compile and analyze all possible references regarding a research article.

This chapter introduces the domain of the project and to provide information about the existing system and how it functions. This chapter will also discuss the methodology used in the development of the project, requirements either software or hardware, and comparison about parameter or attributes about this project.

2.2   Related Work/ Previous Work

The domain of this project is a service category of project in which the system offers a service to the user by storing employee records and their arrival time at the office or workplace. This project is an improvement from traditional method or way to check employee's attendance.

The issues related to domain problem are there is no proper system or database that used before to store worker attendance details. The company only using traditional method such as punch card system that have more flaws. Next, person-in-charge or admin who have the biggest role to supervise employee, does not have proper system to track back employees' attendance. Proper system can help to detect any late or absent employee in each day. It is difficult to spot any time cheating employee during working hours if there is no proper system in the company.

Time cheating or buddy punching is already well-known and widespread. Buddy punching happens when obvious behavior of some worker who have come late but are asking their co-workers to punch their cards early. Although they are late, but their boss or supervisor on duty would not notice if they had been late because of this bad buddy punching behavior. This buddy punching also not only for late punching, but to claim extra overtime payroll. According to the most recent data from the U.S. Bureau of Labor Statistics, there are many more than 78 million hourly staffs or employees in the American labor force. If 16% of them contributed 15 minutes to a coworker's time clock by buddy hitting, the yearly payroll bill will increase by more than $373 million.

2.3 Critical review of current problem and justification

Critical review is an evaluation or analysis of an academic research or article. It is an overall critical assessment that relies on the research's reliability, validity, capabilities, and weaknesses rather than the research's flaws or weaknesses. It asked for constructive or negative judgments on the document based on a variety of factors.

2.3.1 Methodologies previous research

According to Rahman (2018), the biometric identification system more reliable and timesaving as the traditional method more time consuming and hassle on handling process of the attendance. The biometric system itself much more secure as it uses verification and identification method. Figure 2.1 shows the methodological steps of the system.
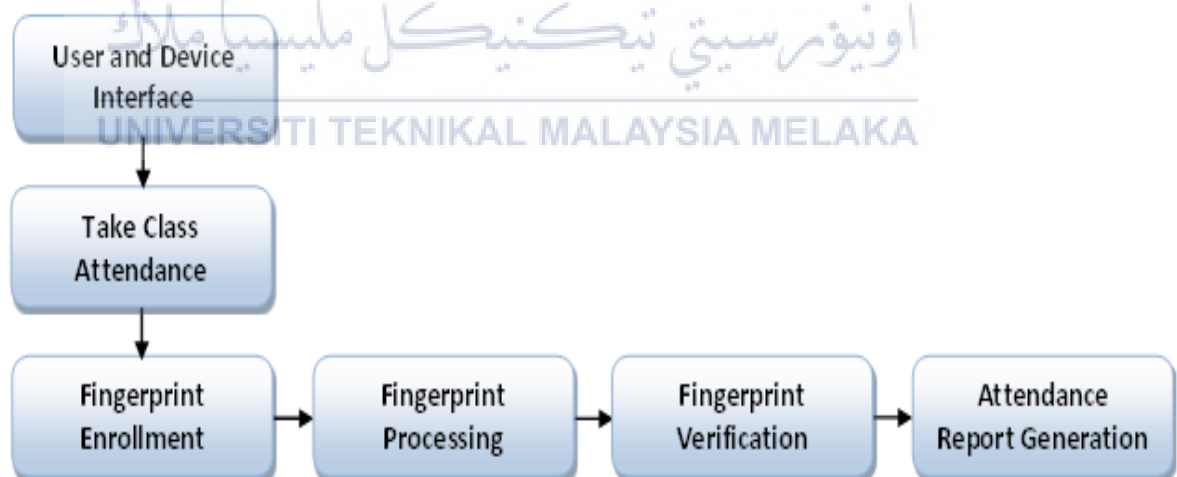
Figure 2.1: Methodological steps of fingerprint attendance

User and device interface is the medium to communicate between the system and user that used this system. Through the interface, admin can add student's information, courses and view report or view all student's or teacher's information.

Next, fingerprint scanner will scan the edge and ridge of fingers and will capture or capable of reading fingerprints from any fingers and the fundamental data was saved in database. Then, for verification and identification process, the system scans and examines all the templates in database to matching with any stored template. Lastly, the attendance table was used to produce or generate a student attendance report.

2.3.2 Face Recognition based Attendance Management System

According to Smitha, Pavithra S. H. and Afshin (2020), traditional ways in marking attendance give an additional load on faculty who must call each of the student's name manually, so that session takes a long time. There seems to be a possibility of surrogate attendance. Many institutes have been implemented other techniques to change the traditional method. Face recognition may be obtained and unobtrusive. Face recognition systems are generally unaffected by diverse face expressions. Face recognition classified into two types which are verification and identification. Face verification uses 1:1 matching technique in order to checks and matches a face image to a set of template face images that have been stored and captured in the dataset.

The recognized and detected faces will be differentiated and compare from live streaming video of classroom to image in the dataset. If a match is found, then the student's attendance will be recorded. A list of absentees will be mailed to academic member in charge by the end of each session. Figure 2.2 show the system architecture of face recognition based attendance management system.
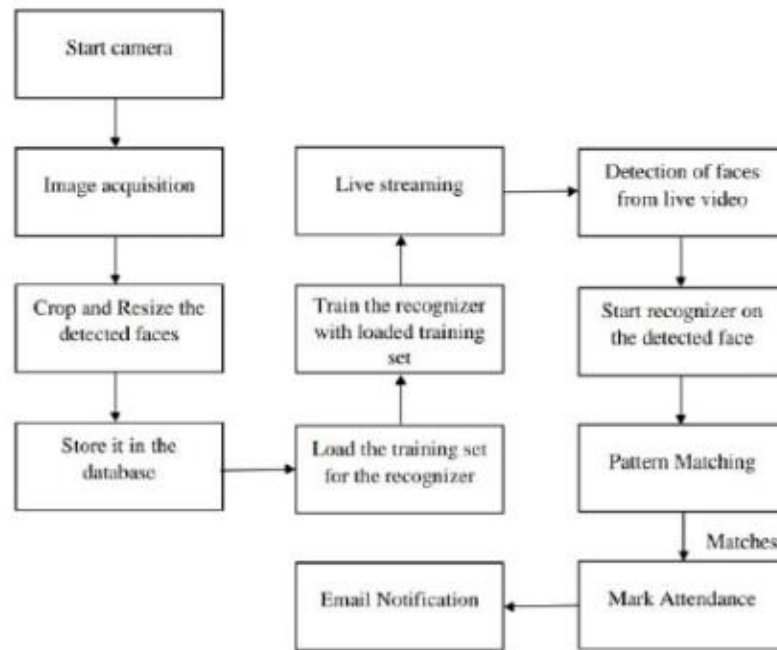
Figure 2.2: System Architecture

2.3.3 Attendance Management System Using Fingerprint and Iris Biometric

According to A. Adamu (2019), every higher institution required a modern or biometric attendance system to monitoring of student punctuality. Attendance is one method for evaluating a student's punctuality in class. Traditional method such as writing names and signatures is insufficient, and one may use another's identity or even help their buddies in writing attendance. This approach is time-consuming it can result in the entering of incorrect information. As a result, an effective, efficient, and reliable system of recording, tracking, and monitoring attendance is required.

A. Adamu also mentioned that iris recognition is a biometric technique of identification that uses a mathematical pattern of recognition on imagery of an individual's eyes' iris, where the complicated pattern is stable, unique, and can be caught from a particular distance. A technique is applied to capture a student's iris using an iris scanner, which uses a near field infrared visible light to illuminate and

capture the iris, picking up a distinctive pattern that is not apparent to human eyes. The scanner identifies and eliminates eyelids, eyelashes, and specula reflections that are obscured by iris parts. Figure 2.3 shows the three stages that involved in this attendance system, which are enrolment stage, identification stage and verification stage.
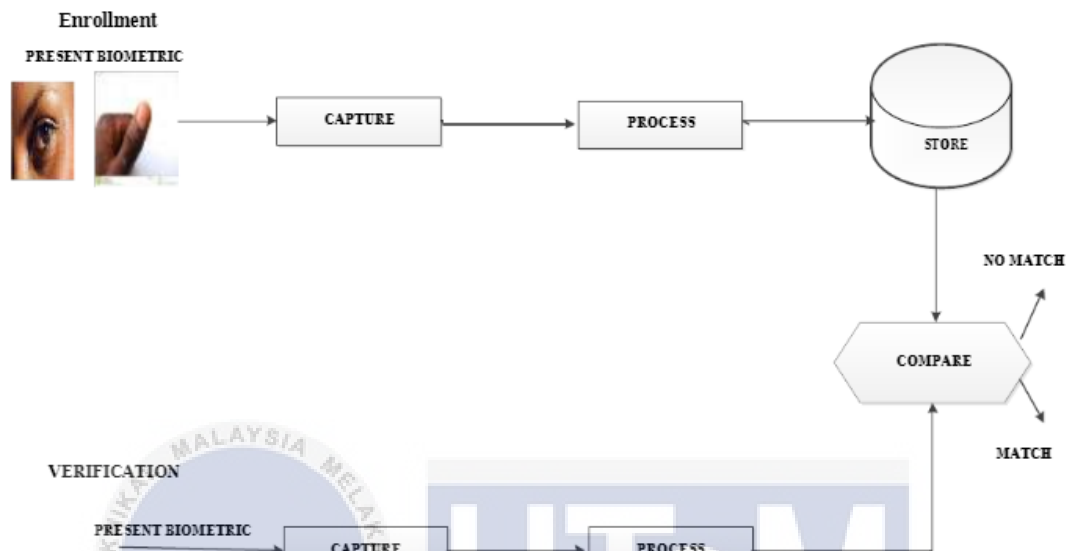
Figure 2.3: System Diagram

2.3.4 Fingerprint Based Attendance Using GSM

According to S. Gowthami, R. Kokila, M. Vasumathi & G. Senthilrajan (2018), the most basic method of monitoring student attendance is to have each student manually sign the attendance sheet that is distributed around the class. The downside of this approach is that certain students can inadvertently or deliberately sign the name of another student. Following that, the attendance sheet will be misplaced, making it more difficult for the teacher to track the students' attendance. The new technology will help solve this because it employs a fingerprint reader, and parents can receive SMS notifications regarding their children's attendance.

They then mentioned that a wireless fingerprint attendance system would solve the drawbacks of a magnetic card attendance system, such as card damage. Global System for Mobile communication or called as GSM is used to deliver SMS notifications to students' faculties about their attendance and called as 2G or Second-Generation technology. The GSM messages are sent back and forth in a store-and-forward process.

2.3.5 Attendance Fingerprint Identification System Using Arduino and Single Board Computer

According to M A Muchtar, Seniman, D Arisandi & S Hasanah (2017), every or each humans or people in the world have something unique about them that no one else does. This uniqueness helps in identify each people identity precisely and accurately. Thus, every person's fingerprint is unique, including twins. Some other benefit of fingerprints is their pragmatism and reliability. This kind of biometrics is widely employed due of its high accuracy and uniqueness. Other than that, fingerprints are unchanging. And as people get older, their fingerprints remain the same as before.

Nowadays, the most advanced technology has developed fingerprint recognition that used fingerprint sensor. A fingerprint sensor is a device that uses an optical method to identify a person's fingerprint. Figure 2.4 shows the general architecture or methodology of the system.
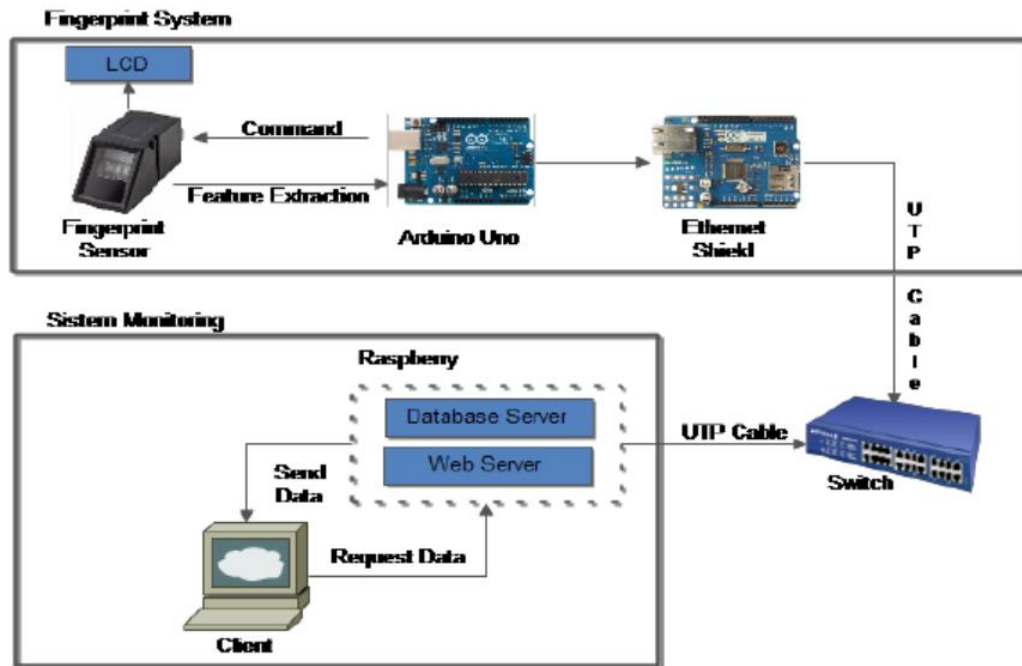
Figure 2.4: General Architecture using Arduino and Single Board Computer

2.3.6 Fingerprint Based Attendance System Using Arduino

According to Myint K. S. & Nyein C. M. M., time wastage happens during lecture time because teachers need to call every student's name to mark all attendance in educational system. This become worst if the number of students in class is bigger. If the teachers pass the attendance sheet to the student, it is possible that any student will help their absent friends in signing for them. Therefore, proper attendance system is needed to encounter the problem. Biometric technique such as fingerprint verification system is need for automated identification and verification. This fingerprint-based methodology stores or records and verifies or authenticates fingerprints on a computer. Figure 2.5 shows overall block diagram using Arduino Uno and fingerprint module.
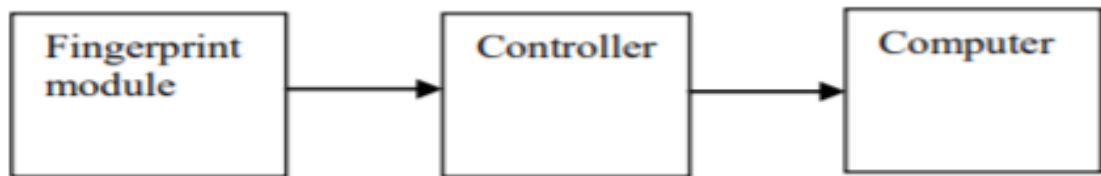
Figure 2.5: Overall Block Diagram using Arduino Uno and Fingerprint Module

They also mentioned that this system begins with the connection of an Arduino and a fingerprint sensor to a computer for enrollment. This system is divided into three sections: enrolling, searching, and viewing attendance. Figure 2.6 illustrates circuit diagram between devices.
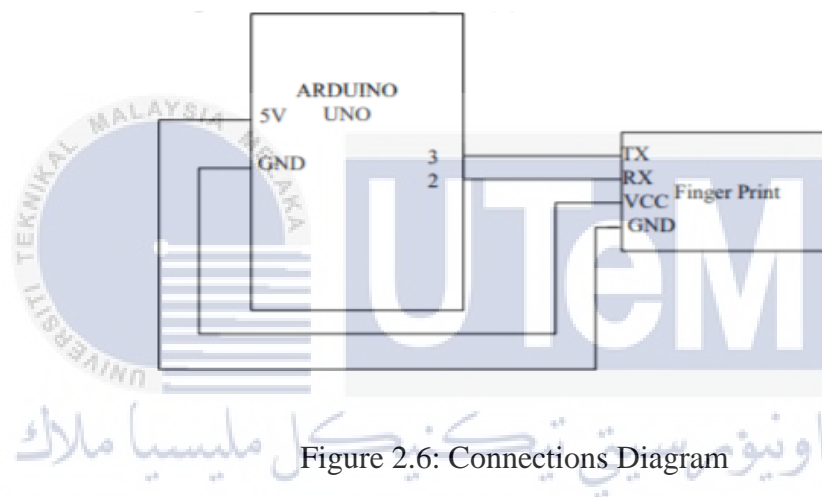
Figure 2.6: Connections Diagram

2.3.7   Staff Attendance System Using RFID

According to Muhammad Thariq Abdul Razak & Chuah Chai Wen, the Radio Frequency Identification or RFID system has drawback such as the administrator cannot trace if private data has been altered or modified. RFID systems are made up of different components that are linked together by a specific communication route. Each part is embedded into the device to enhance the benefits of the RFID solution. Figure 2.7 shows the architecture of RFID system.
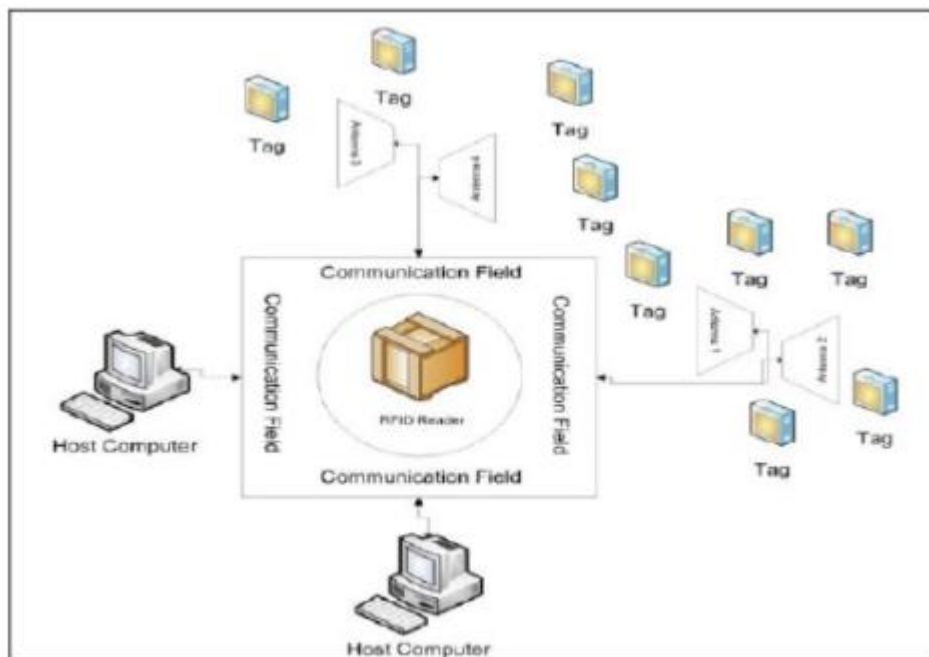
Figure 2.7: Architecture of RFID system

There are three components in RFID system such as tag, reader, and database. The tag is a device that are applied to products that detect radio waves using a unique sequence and made up of a microchip that holds a particularly unique sequence identifier in RFID memory that can be used to recognize individual objects. The reader has to interact with tag by transmit a beam of impulse. Next, the database is used to collect data and it can be conveniently accessed, managed, and updated.

According to Mshelia D. E., Alkali A. H., Isuwa S., Dibal D. E. and Onogwu C. (2017), even though RFID technology that use RFID reader and RFID tag that have been deploy, it was unable to resolve the issue of impersonation. Despite the fact that it eliminates the problem of traditional manual attendance taking. Fingerprint recognition been adopted to make the process of identifying students for facilities management more reliable and safer. RFID and fingerprint-based attendance management systems were created to give a quicker, more secure, and more accessible ways of user verification than passwords and tokens provide for trustworthy personal identity. Figure 2.8 illustrate idea the composition of the design RFID and fingerprint automated attendance system.
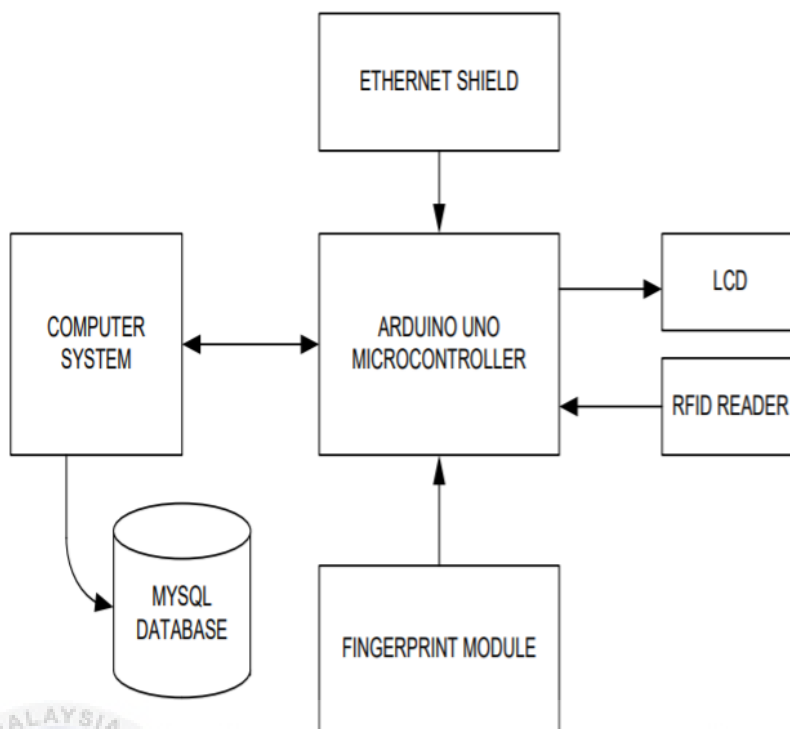
Figure 2.8: Block Diagram of RFID and Fingerprint Attendance System

2.3.8   Comparison Analysis

According to the previous studies, there are several different ways of development and approaches that are used. An overview of the various types of attendance systems has been created as a conclusion. in table 2.1.

METHOD	SPEED	SECURITY LEVEL	PORTABLE	COST
Paper based attendance system	Very low	Low	Yes	Low

Punch card attendance system	Low	Low	No	High
Face Recognition based Attendance Management System	High	High	No	High
Attendance Management System Using Fingerprint and Iris Biometric	High	High	No	High
Fingerprint Based Attendance Using GSM	High	Moderate	Yes	Moderate
Fingerprint Based Attendance System Using Arduino	High	High	Yes	Low
Staff Attendance System Using RFID	High	Moderate	No	High

Table 2.1: Comparison between Existing Systems

Those stated factors measured by the effectiveness and efficiency of the systems. The existing attendance systems are evaluated and compared based on their speed in capturing and recording and also retaining attendance, power usage of multiple device units, cost of the system to deploy, security level of systems, and the portability and functionality of different systems. For example, using fingerprint scanner is more reliable and low cost than other biometrics attendance system such as face recognition and iris recognition. In speed and security factors, some modern attendance system have high speed and security features than traditional methods.

2.4   Propose Solution

The approach to the proposed project system is identified by researching the fact finding of previous existing related systems. It is recommended that a fingerprint attendance scheme be implemented and developed in order to address the user's problem. Based on Fingerprint Based Attendance System Using Arduino (Myint K. S. & Nyein C. M. M., 2018), some of the design and ideas mentioned previously would be included in this proposed project. For the hardware used, this propose project will use the Arduino as the microcontroller and the fingerprint module needs to implement with Arduino that need to be use at the company. The cost for this development project may be cheaper than any microcontroller device in the market. For software requirement I will using Arduino IDE to implement programming codes into Arduino and XAMPP as database. Apart of that, this proposes project going to use a website as a platform to connect with the hardware device. Thus, the website uses to store and search or display real-time employee's attendance record and history. This can make admin or person in charge to track and monitor each or every employee's attendance record.

2.5 Conclusion

To sum up, this literature review is an important part and chapter in developing a project definition or concept and comparing the existing system with the project proposed. The review and research would make the project's progress clearer and more understandable. After that, the literature review also assists in understanding the system's existing functionality and features and obtaining clear facts in order to incorporate the system.

CHAPTER 3: PROJECT METHODOLOGY

3.1   Introduction

The methodology approaches that will be utilized or employed to effectively complete this project will be discussed in this chapter. Methodology consists of theoretical and methodical analysis of procedures used in the part of the research study. This methodology also is a process that decide how to effectively plan, develop, and deliver a project until the project successful. System Development Life Cycle (SDLC), Object-Oriented Analysis and Design (OOAD), Top Down design approach, Agile, Rapid Application Development (RAD) and Waterfall are some of the methodologies used and applied in various types of development. Different software development methodologies have different scopes, phases or stages and advantages.

For this project will use SDLC methodologies. According to Barjtya S., Sharma A., and Rani U. (2017), Software Development Life Cycle (SDLC) is a combination of numerous stages that are taken to ensure that all user requirements are met with the smallest amount of resource consumption during the methodical development, design, and maintenance of software projects. They also stated that SDLC more suitable for specific project that have different requirement. SDLC is more suitable software development methodology for this project and give minimal expenditure.

3.2   Methodology

During the development of Fingerprint Attendance System, System Development Life Cycle (SDLC) methodology will be implemented. SDLC is also known as Waterfall model even though Waterfall is traditional model of SDLC and has five phases or stages such as Planning, Analysis, Design, Implementation and Maintenance. The Waterfall model, which is commonly used by all sorts of software developer, guides developers through each phase of the project.

The first phase of the SDLC is planning. During this phase and process, we must first negotiate the progress of this project with the supervisor. The developer considers how to solve the problems that have arisen as a result of the project's development. The developer must also decide the system's sources and scope, as well as create a specific plan and milestones for this project. A literature review was conducted to determine if a fingerprint attendance system is functional, and the results demonstrated that this technique is functional. At that stage, the system's feasibility for usage is assessed.

The second phase is analysis. In this phase, the developer must gather requirement for this project by gathering any useful information and details. After gathering the requirement, the developer need to analyze, compare and evaluate what the suitable device or technique to be used. Next, developer also need to study and examine the system's requirements and structure, as well as compare any suitable software and hardware for use in this system.

The third phase is design. The developer converts the project description into logical and the physical specification during this phase. This phase also will develop a storyboard of the product. The developer also needs to design all aspects of the system, including the input and output process which become an outline of the system. After that, create and produce a module and a prototype for the project system.

The fourth phase is implementation. Throughout this phase where to turn and convert the system specifications and requirement into a working system that is tested to make sure that the system had fulfilled all the requirement and then the prototype can put into use. During this implementation stage, which including coding, testing and installation.

The fifth and last phase of SDLC methodology is maintenance. Maintenance is the longest and most time-consuming phase in SDLC. It has four main activities during this phase. Firstly, obtain maintenance request that is receiving request for any change in the system. Secondly, transform the request into what the changes are. Thirdly, design the new changes and lastly implement the changes that will be tested. Figure 3.1 illustrate idea of Waterfall phases.

Figure 3.1: Block Diagram of Waterfall phases

3.3   Project Milestones

Project milestones are specific tasks or activities that must be completed and run smoothly and perfectly for the project within certain given timeframe. This project milestones also used to measure the project's progress to achieve the successful system and need in order to get updated and monitor the project progresses. Gantt chart will track the time of every progression of the chapter to ensure that all tasks can be completed on the given time. Figure 3.2 below shows the Gantt chart and milestones

Activities	Weeks																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Proposal • Discuss proposal with Supervisor • Proposal assessment & verification • Proposal improvement or Correction • Proposal submission via email • Proposal Approval and submission via PSM in Ulearn	X	X	X																			
2. Chapter 1 • Introduction • Problem Statement • Objectives • Scope of the Project • Expected Outcome				X																		
3. Chapter 2 • Introduction • Related Work • Critical review of current problem and justification • Proposed Solution					X	X																
4. Chapter 3 • Study on previous methodology research • Project milestones							X	X														

Task	Timeline
5. Chapter 4 • Problem and Requirement Analysis • Design the project deliverable • Hardware and software requirement	
6. Presentation PSM 1 • Presentation and evaluation of the project	
7. Chapter 5 • Starting to develop system • Software configuration management	
8. Chapter 6 • Testing the system • Identify problems and fix any error • Test Plan, Test design and test results	
9. Chapter 7 • Project Limitation • Future Works	
10. Presentation PSM 2 • Presentation and evaluation of the project	

Figure 3.2: Gantt chart and Milestone

3.4 Conclusion
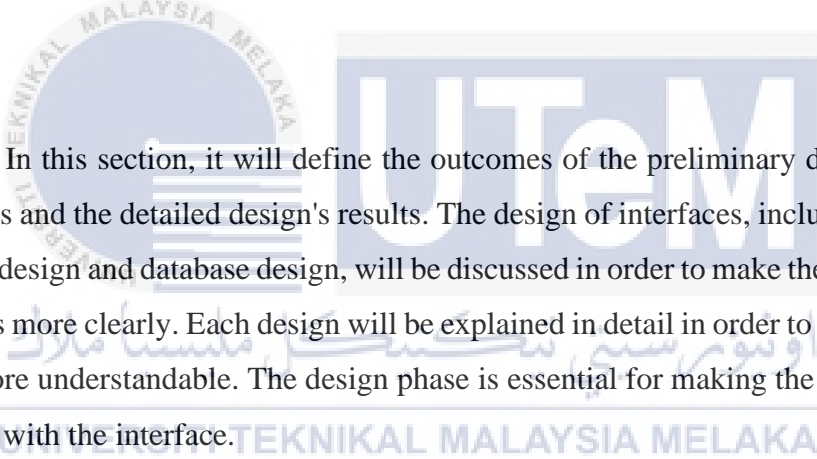
In conclusion, this chapter explain briefly what the suitable methodology used in this project. This project will use and implement SDLC methodology because this methodology is straight model which make an easy to utilize and each stage is refined in indicated timeframe before moving to next stage. The project milestone is to set the timeline to finish the project in an accurate time.

CHAPTER 4: ANALYSIS AND DESIGN

4.1   Introduction

In this section, it will define the outcomes of the preliminary design's system analysis and the detailed design's results. The design of interfaces, including input and output design and database design, will be discussed in order to make the whole system process more clearly. Each design will be explained in detail in order to make it clearer and more understandable. The design phase is essential for making the user feel more at ease with the interface.

Analysis and design are the part of System Development Life Cycle, and that are an important and critical phase in development of a system. It specifies how the project will be accomplished. The software and hardware required to develop the project are within requirements. For the design phase is concerned with methodically planning the project so that the system fits the requirements.

4.2   Problem Analysis

For this Fingerprint Attendance System project, the main problem is difficulty in order to track back employee's attendance as the admin or person-in charge did not have a proper system. Furthermore, the company used a physical type of card for each employee. When employees arrive at the workplace, they must punch their cards into the punch card machine, and the machine automatically stamp their arrival time to record their attendance. The issue with this technique is that the traditional method stores the attendance physically is easily to get tampered, and time-cheating occurs among employees. Therefore, this project will be implemented for a system development that will create based on Arduino Uno with Fingerprint module to ease the admin to track back and monitor all the employee's attendance. Besides, this project also helps the company to view history of existing attendance.

4.3   Requirement Analysis

Requirement analysis is the concentrates on the processes that set the requirements or conditions for the new or modified product or project. The success or failure of a system or software project is dependent on requirements analysis. In requirement analysis also will be discuss about the data requirement, functional requirement, and other requirement that will be involved in this project.

4.3.1   Data Requirement

For this project, the Fingerprint module will be connected with Arduino Uno to capture and detect fingerprint image to get the employees information. The command will be program in the Arduino IDE that been used to input programming codes into respective Arduino Uno board and the fingerprint module. Then, database will use to store each employee's information and will be retrieved to the Fingerprint Attendance System interface. Figure 4.1 illustrate the data flow of the Fingerprint Attendance System and for table 4.1 shows the data dictionary for Fingerprint Attendance System database.
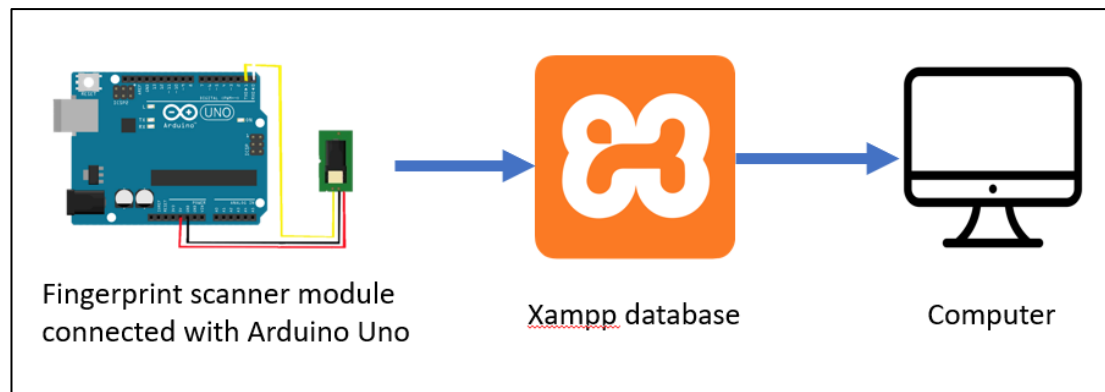
Figure 4.1: Data Flow for Fingerprint Attendance System

DATA DICTIONARY				
Fingerprint Attendance System				
ATTENDANCE				
Attribute	Description	Data type and size	PK	Constraint
rollNo	ID number	Integer (20)	PK	UNIQUE, NOT NULL
name	Staff name	Varchar (30)		NOT NULL
department	Staff department	Varchar (50)		NOT NULL
present	Early staff	Varchar (10)		NOT NULL
late	Late Staff	Varchar (10)		NOT NULL
absent	Absent Staff	Varchar (10)		NOT NULL

Table 4.1: Data Dictionary for Fingerprint Attendance System

4.3.2 Functional Requirement

This project will be separated into several blocks, including input or output, fingerprint scanner module, and development. The figure 4.2 shows the details of block diagram for this project system.
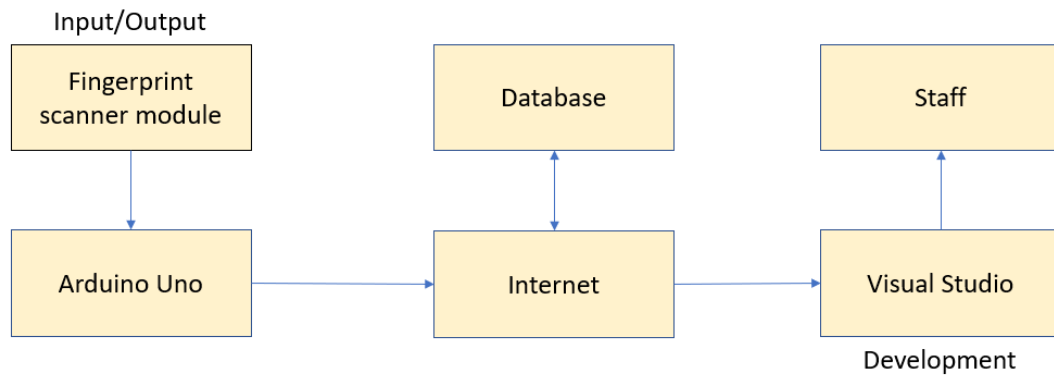
Figure 4.2: Block Diagram

- Input/Output block

  The Arduino Uno will connect with Fingerprint scanner module to run the device, then the fingerprint scanner module will read and store fingerprint data.

- Fingerprint scanner module block

  The fingerprint scanner module will read and send the fingerprint data to the Arduino Uno, where it will be stored and enrolled. The Arduino Uno will be used to program all of the code, which will be done with the Arduino IDE.

- Development block

  The main function will be located at the development block. The function consists of produce windows application by using Visual Studio which can make the administrator to monitor and store employee's information.

4.4 High-Level Design

High-level design describes how the project defines the architecture that will be utilized to develop a software product. This one will display the project's System Architecture, User Interface Design, and Database Design.

4.4.1 System Architecture

The conceptual model that specifies the structure, behavior, and additional perspectives of a system is known as system architecture. A system architecture can be made up of system modules and created sub-systems that will work together to accomplish the entire system. The flow of the project is conceptualized in the design. The fingerprint scanner device will be developed by using Arduino IDE to configure the device. An interface will be created by using Visual Studio to develop Fingerprint Attendance System windows application. Figure 4.3 shows system architecture for Fingerprint Attendance System.
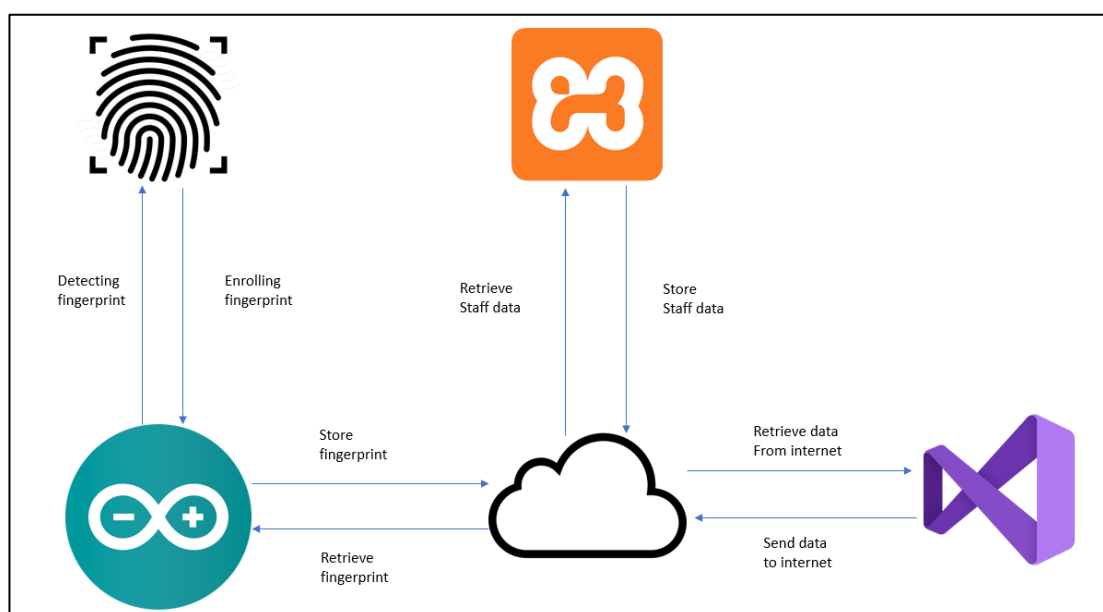

Figure 4.3: System Architecture

4.4.2 User Interface Design

User interface design for this project system allow the admin to have some basic idea on how the system's flow works. Figure below shows the interface of the project.

Figure 4.4: Main Interface

Figure 4.5: Save new staff as Amirul

Figure 4.6: New staff successfully added

Figure 4.7: Search staff in database

4.4.3   Database Design

A database is an essential component of every system. Databases are what distinguishes an information system from a physical system. Almost all physical and traditional attendance systems use paper to record important data and information, such as punch card. An administrator may simply search for and update employee information by using a database.

4.4.3.1   Conceptual and Logical Database Design

The Entity Relationship Diagram (ERD) is used to show database information by displaying all tables and their relationships. However, because the database will just record the name, department, and the status of their arrival such as present, late, or absent, this system will only need one table for the database. Figure 4.7 show the ERD for Fingerprint Attendance System.

attendance	
PK	rollNo
	name
	department
	present
	late
	absent
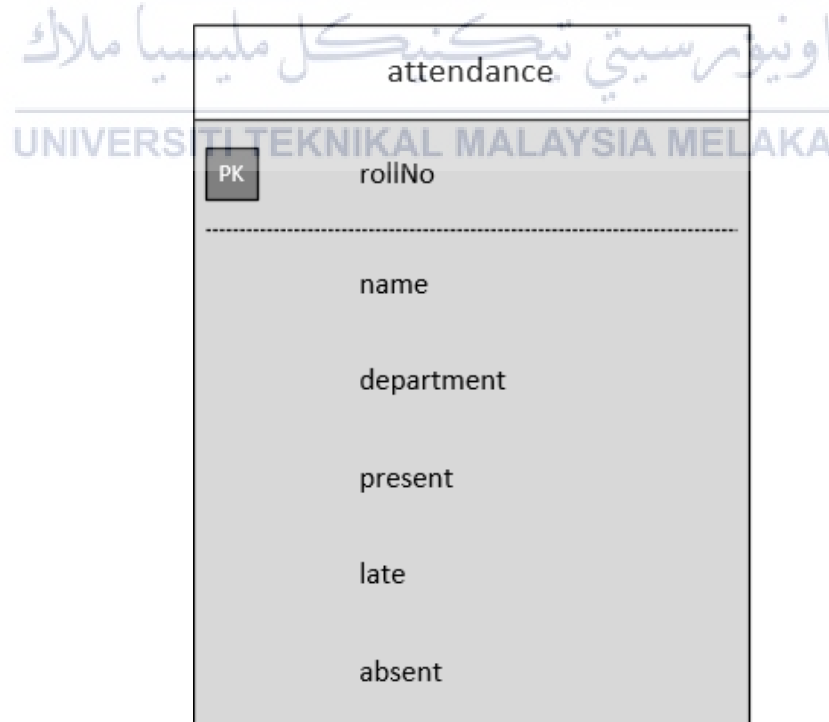
Figure 4.8: Entity Relationship Diagram

4.5   Detailed Design

The detailed design phase involves the refinement of the design as well as the creation of blueprints, specifications, and estimates. Specification and diagrams may be expanded upon in this part. The emphasis should be on the system design rationale or logic and the method to meeting and fulfilling the requirements.

4.5.1   Software Design

The use case diagram can describe in detail of the project system and its users' functions in a very straightforward and more understandable way. As a result, I decided to create a use case diagram to represent just about all the users and what else they can do throughout this Fingerprint Attendance System. Figure 4.8 illustrate the use case diagram for Fingerprint Attendance System.
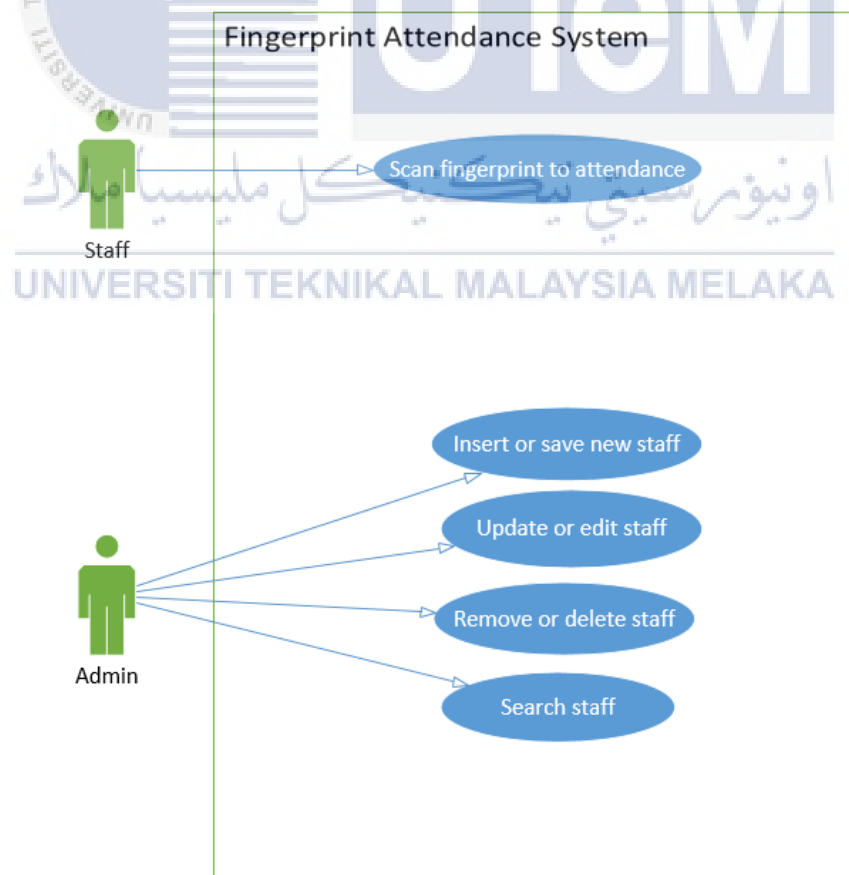
Figure 4.9: Use Case Diagram

4.6   Conclusion

To summarize, analysis and design are important phases or parts of project implementation or development. Before beginning a project, all software and hardware must be identified and evaluated. This chapter is the pre-implementation stage, and it also includes the entire system flow for a better knowledge before implementing it. The next chapter is Implementation, which will go through in depth how the project will be implemented and developed as well as the expected results

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

This chapter will discuss more on how to implement the Fingerprint Attendance System within hardware and software development. Throughout this phase where to turn and convert the system specifications and requirement into a working system that is tested to make sure that the system had fulfilled all the requirement and then the prototype can put into use. During this implementation stage, which including coding, testing, and installation. This section will go through how to configure and develop an interface for a Windows application form. This chapter is necessary for future reference in order to make the system development phase more understandable for system maintenance and support.

5.2   Software Development Environment setup

This section will mostly cover the software development environment that will be created on Fingerprint Attendance System. To begin, XAMPP is used as a localhost database to record employee information such as ID number, name, department, and attendance status. The XAMPP database, however, cannot retain user fingerprint data, therefore it will match an ID of a fingerprint with a specific user from the database.

The Arduino IDE is then used to program and configure the Arduino Uno board and the fingerprint module. The Arduino Uno board holds and stores each or an employee's fingerprint information, and the fingerprint module is also used to authenticate and verify the employee's ID in the database.

Next, Microsoft Visual Studio 2012 is utilized to create the system's interface. This is due to the fact that this software can assist in the development of a Windows application that can interface with the Arduino board and the database. Microsoft Visual Basic 2012 includes a drag-and-drop feature that aids in the creation of a custom-made Windows application which can be quickly updated for new interface modifications.

5.3   Software Configuration Management

Software Configuration Management (SCM) goal is to provide a better procedure for dealing with, coordinating, and managing changes in requirements, codes, and other aspects throughout the software development life cycle. The SCM requires dealing with version selection, monitoring changes, and version control of software projects in order to maximize efficiency while minimizing mistake or risk.

5.3.1   Configuration environment setup

This part will go through how to set up the Arduino Board with the fingerprint sensor as well as how to connect the board to the Microsoft Visual Basic's Window application. First, an Arduino Uno board and a fingerprint module are required. On the fingerprint module, the outgoing wires are labeled with TX, RX, 3.3V and GND. Next, connect the TX wire with the pin 2 on the Arduino Uno board. The RX wire must be connected to pin 3 of Arduino board. Next, the 3.3V of the fingerprint module wire connects to the 3.3V pin of the Arduino board. Lastly, the GND wire from the fingerprint module goes to the GND pin on the Arduino Uno. The figure 5.1 below shows the connection of the Arduino Uno and the fingerprint module, while figure 5.2 shows hardware setup for this system.
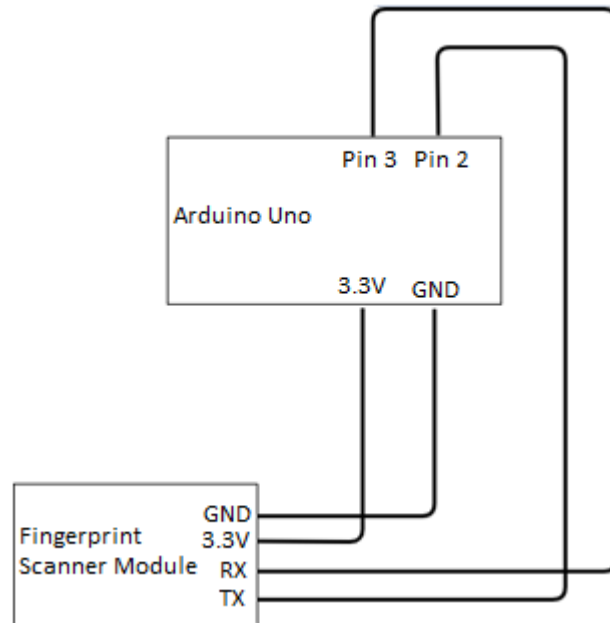
Figure 5.1: Arduino Uno and Fingerprint Module Connection
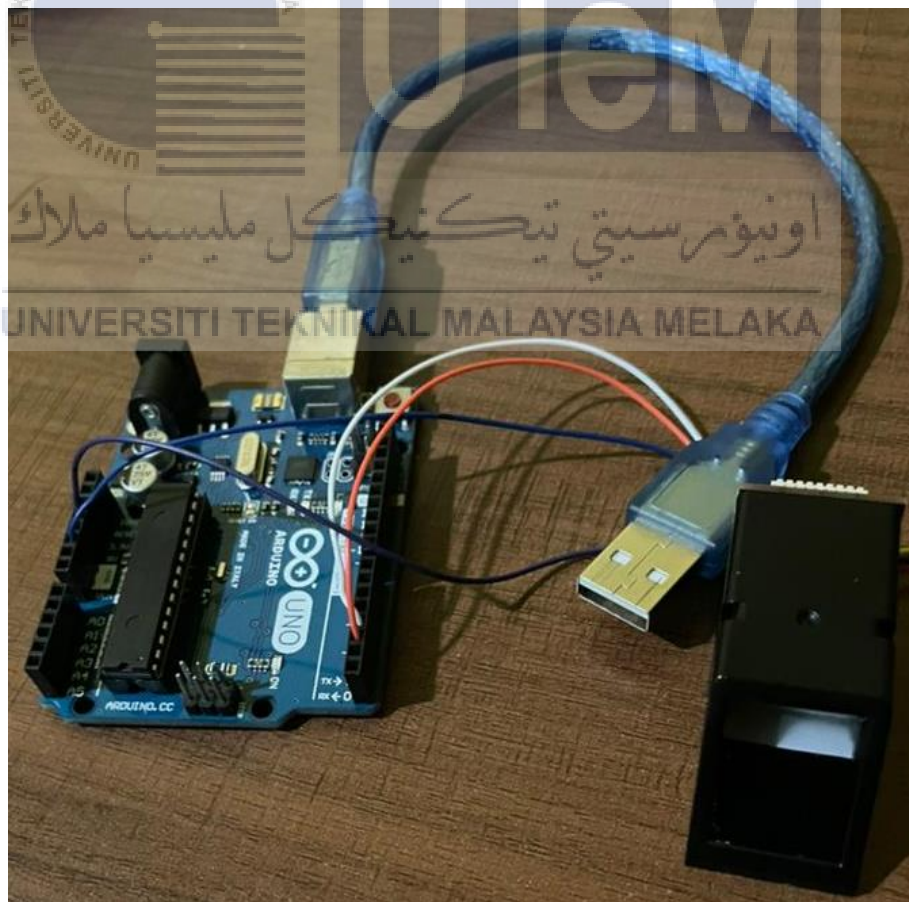
Figure 5.2: Hardware Configuration Setup

After that, Microsoft Visual Basic is used to create the system's interface. By starting a new project and choosing Windows application form, the software generates a blank Windows application form that can be customized with drag and drop characteristics to allow for easy interface modification. The interface may be directly connected to the Arduino Uno board and the fingerprint module by utilizing the serial port from the software's toolbox. The Arduino Uno board is connected to the Port named as COM3 on my PC. This varies from computer to computer according to where the Arduino board is connected with USB type B to a USB type A on the PC. The system interface is represented in the figure 5.3 below.
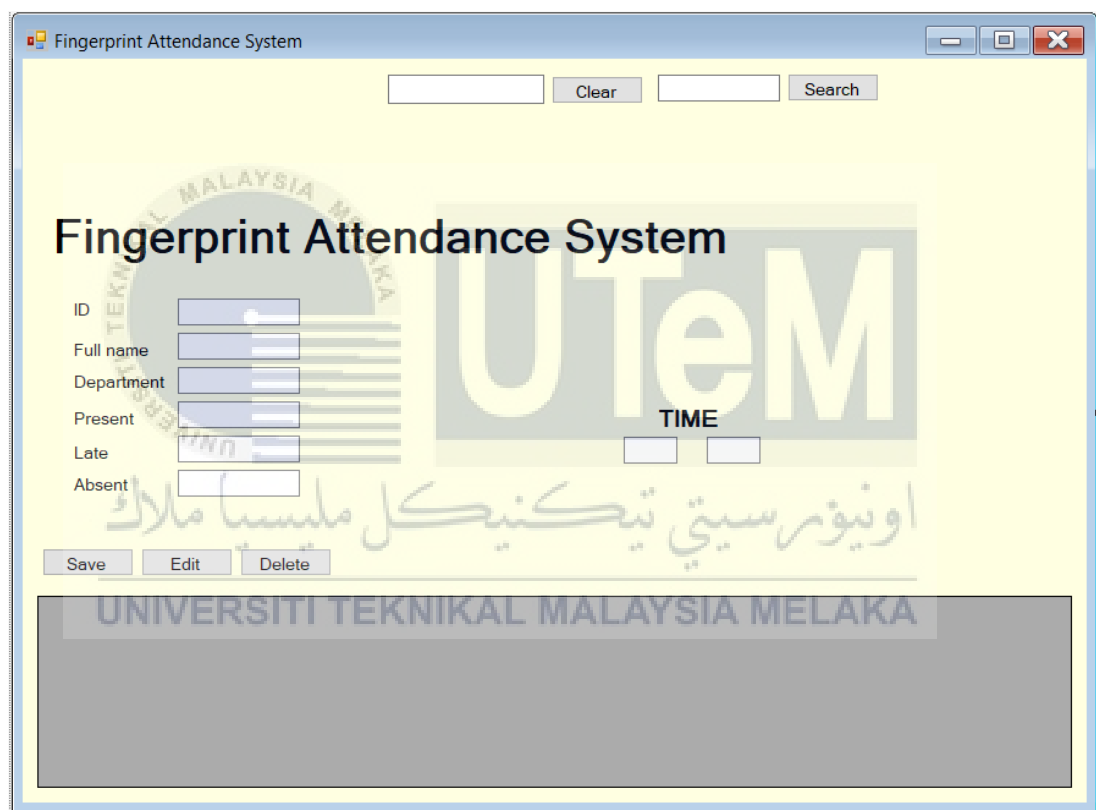
Figure 5.3: System Interface

5.3.2 Version Control Procedure

This Fingerprint Attendance System is being implemented, documented, and developed for the first time. As a result, the final product system will have a version number of 1.0.

5.4 Implementation Status

This part will bring attention to the system's programming codes. The Fingerprint Attendance System employs two types of programming since it relies on two software programs to effectively build the system: Microsoft Visual Studio 2012 and the Arduino IDE.

5.4.1 Microsoft Visual Basic 2012

The coding below shows how the Microsoft Visual Basic 2012 connected to the Xampp database. This connection used to send and retrieve data between Microsoft Visual Studio 2012 and Xampp by using MySqlConnection command.

```
Form1                                                              ▾  (Declarations)
    Imports System.IO
    Imports System.IO.Ports
    Imports System.Threading
    Imports MySql.Data.MySqlClient

Public Class Form1

    Dim interval As Integer
    Dim secs As Integer
    Dim mins As Integer
    Dim value2 As Decimal
    Dim mysqlcon As New MySqlConnection("SERVER=localhost;USERID=root;PASSWORD=;DATABASE=fingerprint;")
    Dim mysqlcommd As New MySqlCommand
    Dim da As New MySqlDataAdapter
    Dim dt As New DataTable
    Dim i As Integer
    Dim data As String
```

Figure 5.4: Connection between Visual Studio and Xampp

The coding shows the command to connect with Arduino Uno board by using Serial Port tool.

```
    SerialPort1.PortName = "COM3"
    SerialPort1.BaudRate = 9600
    SerialPort1.DataBits = 8
    SerialPort1.Parity = Parity.None
    SerialPort1.StopBits = StopBits.One
    SerialPort1.Handshake = Handshake.None
    SerialPort1.Encoding = System.Text.Encoding.Default
    SerialPort1.Open()
End Sub
```

Figure 5.5: Arduino Uno Board and Visual Studio Connection

The coding shows the showdata command that used to show data in the data grid view.

```
Private Sub showdata()
    mysqlcon.Open()
    With mysqlcommd
        .Connection = mysqlcon
        .CommandText = "SELECT * from attendance"

    End With

    da.SelectCommand = mysqlcommd
    dt.Clear()
    da.Fill(dt)
    DataGridView1.DataSource = dt
    mysqlcon.Close()




End Sub
```

Figure 5.6: Show Data Code

The coding shows the save button function that used to save employee's information such as roll number, name, and department. All the data will directly save to the database.

```vbnet
Private Sub btn_save_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btn_save.Click
    mysqlcon.Open()
    With mysqlcommd
        .Connection = mysqlcon
        .CommandText = "INSERT into attendance(rollNo,name,department) values('" & txt_roll.Text & "','" & txt_name.Text & "','" & txt_dept.Text & "')"
        i = .ExecuteNonQuery
    End With
    If i > 0 Then
        MsgBox("data saved: " & i & " rows")
        clear()

    End If
    mysqlcon.Close()
    showdata()


End Sub
```

Figure 5.7: Save Button Code

The coding shows the delete button function which used to delete employee's information by deleting the roll number.

```vbnet
Private Sub btn_delete_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btn_delete.Click
    mysqlcon.Open()
    With mysqlcommd
        .Connection = mysqlcon
        .CommandText = "DELETE from attendance WHERE rollNo=" & txt_roll.Text
        i = .ExecuteNonQuery
    End With
    If i > 0 Then

        MsgBox("Data Deleted")
        clear()
    End If
    mysqlcon.Close()
    showdata()
End Sub
```

Figure 5.8: Delete Button Code

The coding shows the edit button function which used to update employee's information such as name and department.

```vbnet
Private Sub btn_edit_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btn_edit.Click
    mysqlcon.Open()
    With mysqlcommd
        .Connection = mysqlcon
        .CommandText = "UPDATE attendance SET name='" & txt_name.Text & "',department='" & txt_dept.Text & "' where rollNo=" & txt_roll.Text
        i = .ExecuteNonQuery
    End With
    If i > 0 Then

        MsgBox("data Updated")
        clear()
    End If
    mysqlcon.Close()
    showdata()
End Sub
```

Figure 5.9: Edit Button Code

The coding shows the search button function which used to search employee's data based on roll number or ID.

```vb
Private Sub btn_search_Click(ByVal sender As System.Object, ByVal e As System.EventArgs) Handles btn_search.Click
    mysqlcon.Open()

    With mysqlcommd
        .Connection = mysqlcon
        .CommandText = "SELECT * from attendance WHERE rollNo like '%" & txt_search.Text & "%'"

    End With
    da.SelectCommand = mysqlcommd
    dt.Clear()
    da.Fill(dt)
    DataGridView1.DataSource = dt
    mysqlcon.Close()
End Sub
```

Figure 5.10: Search Button Code

The coding shows how Visual Studio connected with Arduino Uno and fingerprint scanner module.

```vb
Private Sub DataReceived(ByVal sender As Object, ByVal e As SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived
    Try

        Dim mydata As String = ""
        mydata = SerialPort1.ReadExisting()

        If TextBox1.InvokeRequired Then
            TextBox1.Invoke(DirectCast(Sub() TextBox1.Text &= mydata, MethodInvoker))

        Else
            TextBox1.Text &= mydata

        End If
    Catch ex As Exception
        MessageBox.Show(ex.Message)
    End Try
End Sub
```

Figure 5.11: Visual Studio and Fingerprint Scanner Connection

The coding shows how employee's fingerprint will determining attendance status such as present, late, or absent.

```vb
Private Sub CheckBox1_CheckedChanged(sender As System.Object, e As System.EventArgs)
    CheckBox1.Checked = False

    Try
        mysqlcon.Open()
        With mysqlcommd
            .Connection = mysqlcon
            .CommandText = "UPDATE attendance set present='" & txt_present.Text & "',late='" & txt_late.Text & "',absent='" & txt_absent.Text & "' where rollnu=" & DataGridView1.SelectedRows(0).Cells(0).Value
            i = .ExecuteNonQuery

        End With
        If i > 0 Then
            ' MsgBox("data Updated")
            clear()

        End If
        mysqlcon.Close()
        showdata()
        txt_absent.Text = ""
        txt_present.Text = ""
        txt_late.Text = ""

    Catch ex As Exception
        MessageBox.Show(ex.Message)

    End Try
End Sub
```

Figure 5.12: Attendance Status Code

The coding shows attendance status of each employee based on time of arrival.

```vb
Private Sub Timer5_Tick(sender As System.Object, e As System.EventArgs) Handles Timer5.Tick

    If ((mins <= 2) And (InStr(TextBox1.Text, "1001")) And (sflag1 = 0)) Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag1 = 1
    End If

    If mins <= 2 And InStr(TextBox1.Text, "1002") And sflag2 = 0 Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag2 = 1
    End If

    If mins <= 2 And InStr(TextBox1.Text, "1003") And sflag3 = 0 Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag3 = 1
    End If

    If mins <= 2 And InStr(TextBox1.Text, "1004") And sflag4 = 0 Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag4 = 1
    End If

    If mins <= 2 And InStr(TextBox1.Text, "1005") And sflag5 = 0 Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag5 = 1
    End If

    If mins <= 2 And InStr(TextBox1.Text, "1006") And sflag6 = 0 Then
        txt_present.Text = "present"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag6 = 1
    End If
```

Figure 5.13: Present Status Code

```vb
    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1001") And sflag1 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag1 = 1
    End If

    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1002") And sflag2 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag2 = 1
    End If

    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1003") And sflag3 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag3 = 1
    End If

    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1004") And sflag4 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag4 = 1
    End If

    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1005") And sflag5 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag5 = 1
    End If

    If mins > 3 And mins < 6 And InStr(TextBox1.Text, "1006") And sflag6 = 0 Then
        txt_late.Text = "late"
        CheckBox1.Checked = True
        TextBox1.Text = ""
        sflag6 = 1
    End If
```

Figure 5.14: Late Status Code

```
If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1001") And sflag1 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag1 = 1
End If

If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1002") And sflag2 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag2 = 1
End If

If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1003") And sflag3 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag3 = 1
End If

If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1004") And sflag4 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag4 = 1
End If

If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1005") And sflag5 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag5 = 1
End If

If mins >= 6 And mins <= 10 And InStr(TextBox1.Text, "1006") And sflag6 = 0 Then
    txt_absent.Text = "absent"
    CheckBox1.Checked = True
    TextBox1.Text = ""
    sflag6 = 1
End If
```
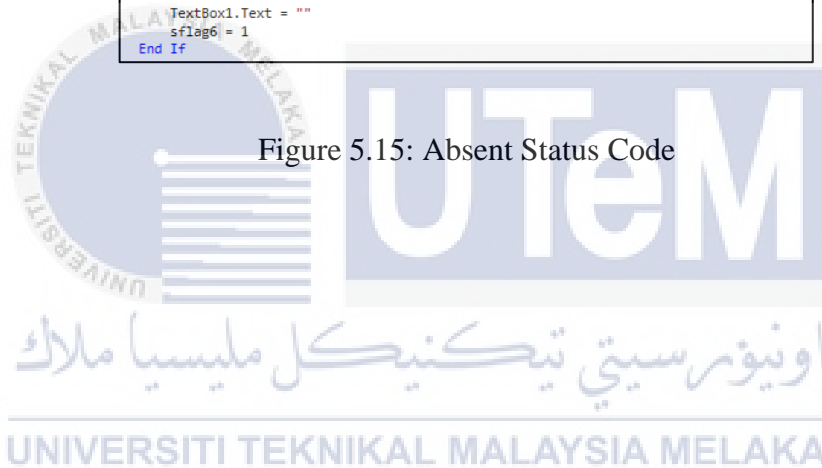
Figure 5.15: Absent Status Code

5.4.2   Arduino IDE

For Arduino IDE codes, there are two types of programs that are used: enrolling employee fingerprints and verifying the employee to record their attendance.

5.4.2.1   Enrolling New Employee Fingerprints

The coding shows the sequences in order to enrolling new employee. Firstly, need to connect Arduino Uno board with fingerprint scanner module. Next, key in ID that want to assign to new employee.

```
1  #include <Adafruit_Fingerprint.h>
2  #include <SoftwareSerial.h>
3  uint8_t id;
4
5  SoftwareSerial mySerial(2, 3);
6
7  Adafruit_Fingerprint finger = Adafruit_Fingerprint(&mySerial);
8  void setup()
9  {
10   Serial.begin(9600);
11   Serial.println("Fingerprint Attendance System");
12
13   finger.begin(57600);
14   if (finger.verifyPassword()) {
15     Serial.println("Found fingerprint sensor!");
16   } else {
17     Serial.println("Did not find fingerprint sensor :(");
18     while (1);
19   }
20  }
21  uint8_t readnumber(void) {
22   uint8_t num = 0;
23   while (num == 0) {
24     while (! Serial.available());
25     num = Serial.parseInt();
26   }
27   return num;
28  }
29  void loop()
30  {
31   Serial.println("Type in the ID # you want to save this finger as...");
32    Serial.println("Please type in the ID # (from 1 to 127) you want to save this finger as...");
33   id = readnumber();
34   if (id == 0) {// ID #0 not allowed, try again!
35     return;
36   }
37   Serial.print("Enrolling ID #");
38   Serial.println(id);
39   |
40   while (!  getFingerprintEnroll() );
41  }
```

Figure 5.16: Enrolling New Employee Code

The code shows how the image of fingerprint will be process. Firstly, image of fingerprint will be taken or else it will show some error message. Next, remove finger and place same finger again until it successfully stored the fingerprint.

```
Serial.println("Waiting for valid finger to enroll");
while (p != FINGERPRINT_OK) {
  p = finger.getImage();
  switch (p) {
  case FINGERPRINT_OK:
    Serial.println("Image taken");
    break;
  case FINGERPRINT_NOFINGER:
    Serial.println(".");
    break;
  case FINGERPRINT_PACKETRECIEVEERR:
    Serial.println("Communication error");
    break;
  case FINGERPRINT_IMAGEFAIL:
    Serial.println("Imaging error");
    break;
  default:
    Serial.println("Unknown error");
    break;
  }
}
```

Figure 5.17: Fingerprint Image is Taken

```
Serial.println("Remove finger");
delay(2000);
p = 0;
while (p != FINGERPRINT_NOFINGER) {
  p = finger.getImage();
}
p = -1;
Serial.println("Place same finger again");
while (p != FINGERPRINT_OK) {
  p = finger.getImage();
  switch (p) {
  case FINGERPRINT_OK:
    Serial.println("Image taken");
    break;
  case FINGERPRINT_NOFINGER:
    Serial.print(".");
    break;
  case FINGERPRINT_PACKETRECIEVEERR:
    Serial.println("Communication error");
    break;
  case FINGERPRINT_IMAGEFAIL:
    Serial.println("Imaging error");
    break;
  default:
    Serial.println("Unknown error");
    break;
  }
}

p = finger.createModel();
if (p == FINGERPRINT_OK) {
  Serial.println("Prints matched!");
} else if (p == FINGERPRINT_PACKETRECIEVEERR) {
  Serial.println("Communication error");
  return p;
} else if (p == FINGERPRINT_ENROLLMISMATCH) {
  Serial.println("Fingerprints did not match");
  return p;
} else {
  Serial.println("Unknown error");
  return p;
}

p = finger.storeModel(id);
if (p == FINGERPRINT_OK) {
  Serial.println("Stored!");
} else if (p == FINGERPRINT_PACKETRECIEVEERR) {
  Serial.println("Communication error");
  return p;
} else if (p == FINGERPRINT_BADLOCATION) {
  Serial.println("Could not store in that location");
  return p;
} else if (p == FINGERPRINT_FLASHERR) {
  Serial.println("Error writing to flash");
  return p;
} else {
  Serial.println("Unknown error");
  return p;
}
}
```

Figure 5.18: Fingerprint Successfully Stored

5.4.2.2 Verifying Employee to Record Their Attendance

The code explains how the existing employee's fingerprint will be linked to Visual Studio and Xampp. The ID assigned in the Arduino IDE must match the ID in the Xampp database which is roll number.

```
  Serial.print("Found ID #"); Serial.print(finger.fingerID);
  Serial.print(" with confidence of "); Serial.println(finger.confidence);
}

// returns -1 if failed, otherwise returns ID #
int getFingerprintIDez() {
  uint8_t p = finger.getImage();
  if (p != FINGERPRINT_OK)  return -1;
  p = finger.image2Tz();
  if (p != FINGERPRINT_OK)  return -1;
  p = finger.fingerFastSearch();
  if (p != FINGERPRINT_OK)  return -1;
  // found a match!
  Serial.print("Found ID #"); Serial.print(finger.fingerID);
  Serial.print(" with confidence of "); Serial.println(finger.confidence);

   if(finger.fingerID == 1)
   {
Serial.println("1001");
  delay(1000);
 }

   if(finger.fingerID == 2)
   {
Serial.println("1002");
  delay(1000);
 }

   if(finger.fingerID == 3)
   {
Serial.println("1003");
  delay(1000);
 }

 if(finger.fingerID == 4)
  {
Serial.println("1004");
  delay(1000);
 }

 if(finger.fingerID == 5)
  {
Serial.println("1005");
```

Figure 5.19: Verifying Existing Employee

5.5 Conclusion

Overall, this chapter covered the important software development, environment, and hardware setup of the Fingerprint Attendance System. The implemented coding is easy to manage and highly adaptable for future system upgrades. Next chapter is testing which a phase or process that will assist in order to improve any flaws of the system.

CHAPTER 6: TESTING

6.1   Introduction

In this chapter will go through the activities that take place during the testing phase of the Fingerprint Attendance System's development. End-to-End testing, which involves testing the entire project as well as the project's ability to connect to the database, is one of the system testing strategies. Another form of system testing is functionality testing, which is conducted by focusing on how much the system's output meets the project's requirements.

6.2   Test Plan

Test plan is a comprehensive process that outlines the system's overall testing strategy. Normally, a test plan specifies the sort of test, the test data that will be utilized, the expected results, and the actual outcome of the test. It is being used to test or evaluate the project's expected outcome.

6.2.1   Test Organization

The personnel involved in the testing for this Fingerprint Attendance System project are referred to as the test organization. Since this Fingerprint Attendance System employs a biometric fingerprint which would need other people's fingerprints to check or evaluate if the system successfully recognizes various fingerprints from other people, this project requires some friends and relatives to carry out testing. The personnel involved in testing the system are listed below.

- Muhammad Aimi bin Zainudin

- Syasya Hadirah binti Zainudin

- Hanez Sakinah binti Zainudin

- Zul Adli bin Zulkarnain

6.2.2 Test Environment

The system was mainly tested in two locations: the first at Taman Tasik Utama, Ayer Keroh, Melaka, which is a house that my friends and I rented and stayed there. Another place is in my hometown which at Rengit, Batu Pahat, Johor where my family stays and lives.

Some settings would need to be done before the system could be tested, such as enrolling the test individuals' fingerprints and storing them to the Arduino board. Some outdated data would also be removed from the database in order to minimize redundant data and to make it successful project. This development ensures the system can detect and verify attendance.

6.2.3 Test Schedule

The test schedule must be well planned. This procedure ensures that the testing process was completed effectively in order to find or detect any errors and make any necessary changes. It takes 2 weeks to testing this system including fix any errors.

6.3 Test Strategy

For this project, top-down testing, is a strategy used in system testing that can assist in evaluating the entire system, including the use of the database. The final outcome of this testing may be observed when the system is able to update the database when the user enters their fingerprint into the system's fingerprint module.

Functional testing is another approach that is utilized. This testing includes testing the system's specific modules, such as the enroll module and the fingerprint module. Individual module testing reveals any issues with that module and allows it to be changed to function properly.

6.3.1 Classes of Tests

There were no serious issues throughout the testing process. Every time the system is utilized, the result meets the project's requirements in terms of correctness and efficiency.
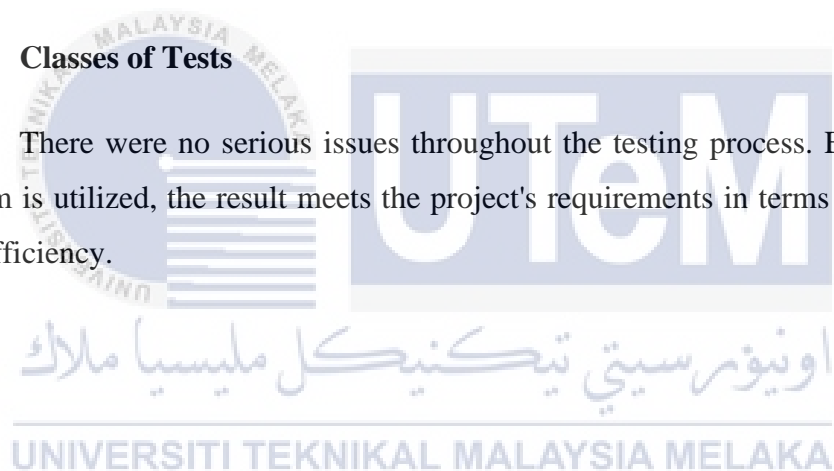
6.4   Test Design

Test design addresses the identification of test cases, test cases, and expected outcomes for each scenario that is developed and recorded.

6.4.1   Test Description

The test description goes over integration and functionality testing. The results of the tests are shown in Tables 6.1–6.5.

Test Case ID	Test_Case1
Scenario	To add new employee in the department
Steps	1. Insert ID, name, and department 2. Press save.
Test Data	1. 1004 2. Abdul Hamid 3. IT
Expected Results	The pop-up message show "Data saved successfully: 1 row"
Result	Pass

Table 6.1: Test Case 1

Test Case ID	Test_Case2
Scenario	To update employee data in database
Steps	1. Choose any employee in the Data Grid View. 2. Update name and department. 3. Press edit.
Test Data	1. Ameer Hussin 2. IT
Expected Results	The pop-up message show "Data updated successfully"
Result	Pass

Table 6.2: Test Case 2

Test Case ID	Test_Case3
Scenario	To delete employee data in database
Steps	1. Choose any employee in the Data Grid View. 2. Press delete.
Test Data	
Expected Results	The pop-up message show "Data deleted successfully"
Result	Pass

Table 6.3: Test Case 3

Test Case ID	Test_Case4
Scenario	To search employee data in database
Steps	1. Insert ID number in search bar. 2. Press search.
Test Data	1. 1004
Expected Results	The Data Grid View will show employee data of ID 1004
Result	Pass

Table 6.4: Test Case 4

Test Case ID	Test_Case5
Scenario	To record employee attendance in database
Steps	1. Employee information must saved in ID 1003. 2. Input fingerprint of ID 1003.
Test Data	
Expected Results	The attendance status will be saved into database.
Result	Pass

Table 6.5: Test Case 5

6.5   Test Results and Analysis

This subchapter will go through the test results for each of the Test Case that was created or developed, as well as a comprehensive and detailed analysis of the system's success and failure.

For Test Case 1, the results are successful since the new employee's ID, name, and department are shown, and a popup stating, " Data saved successfully: 1 row ".
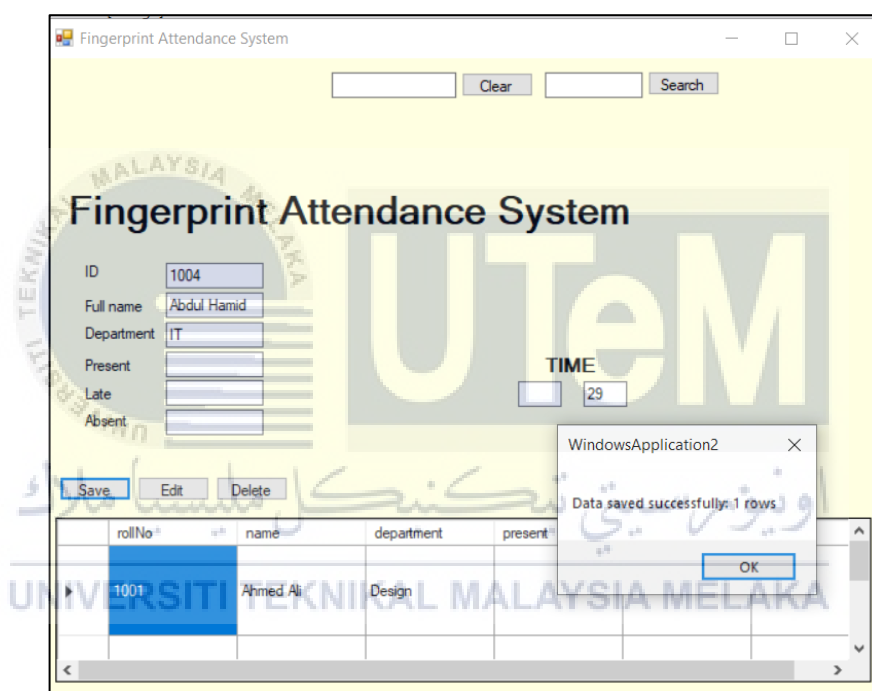

Figure 6.1: Test Case 1

Then, Test Case 2 will test involves updating the data of a saved user from the database. First, the user must choose the employee's data that needs to be updated and then modify the field that has to be changed. However, the ID of the selected employee member cannot be altered. When the admin clicks the Edit button, a message appears stating that "Data updated successfully".
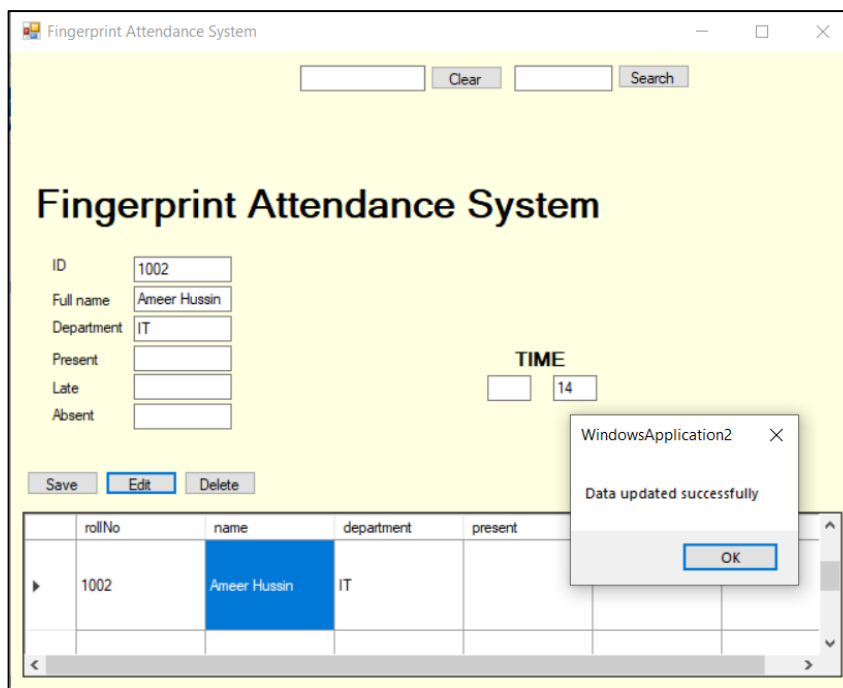
Figure 6.2: Test Case 2

Next, for Test Case 3, the system will remove all data about the admin chosen after deleting a selected employee from the Data Grid View. Aside from that, admin also can type any ID into the ID textbox and delete it.
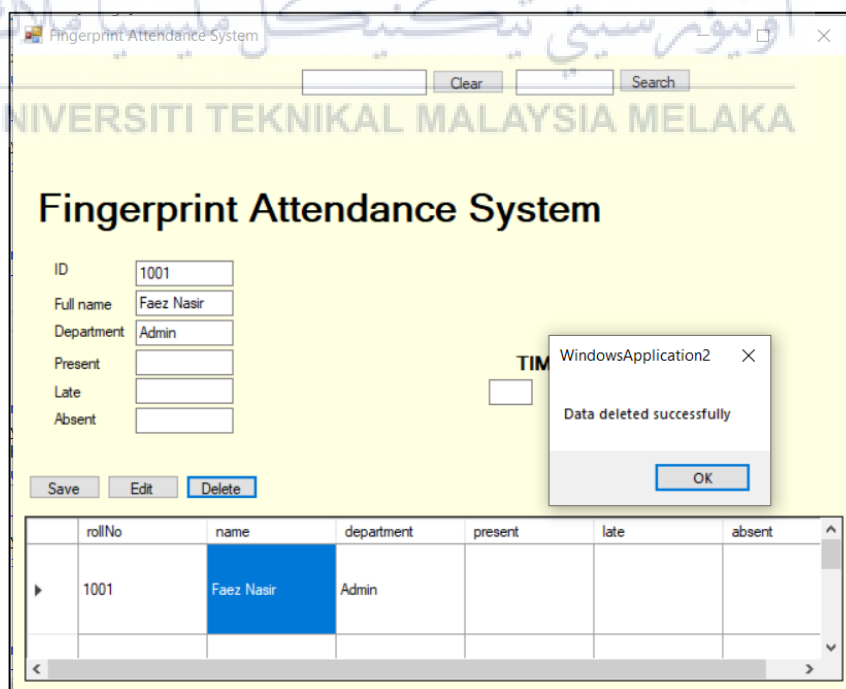

Figure 6.3: Test Case 3

The search function is the major focus of Test Case 4. When an admin searches for an ID, the Data Grid View displays the employee ID's information.

Figure 6.4: Test Case 4

Lastly, the Arduino Uno board and the fingerprint module are used in Test Case 5. When a user with saved data and ID interacts with the fingerprint module, the attendance status is logged in the database. However, if an invalid fingerprint is used, the hardware will merely idle and wait for a valid fingerprint.

Figure 6.5: Test Case 5

6.6   Conclusion

        To summarize, the testing process is an important element of every system. This is because the testing step assists in the detection of problems that may arise when using the system, allowing the system to meet or fulfill the Fingerprint Attendance System's requirements. Next chapter will discuss more on project limitations and future works.

CHAPTER 7: PROJECT CONCLUSION

7.1   Introduction

For this last chapter will be discussing on conclusion for Fingerprint Attendance System project. This part also explaining project summarization including this project strength and weakness, project limitation and future works.

7.2   Project Summarization

The project is an employee attendance scheme that uses a biometric fingerprint scanner to monitor the timing of their arrival at the workplace. Therefore, this project is proposed due to the obvious behaviour of some worker who have come late but are asking their co-workers to punch their cards early or called as "buddy punching", so that their boss would not notice if they had been late. Other than that, the problem is difficulty in order to track back employee's attendance as the admin or person-in charge did not have a proper system. Next, there is no database to store attendance for traditional attendance method. The traditional method stores the attendance physically and easy to get tampered. After that, the high-rate time cheating among employees. This biometric fingerprint scanner for attendance can reduce the number of "buddy punching" in the company as each fingerprint unique for every person in this world. So, employees will not be able to trick or cheat their selves out of problems by using a biometric fingerprint scanner.

a) **Project Weakness**

- There is no LCD panel to alert employees when they have successfully recorded their attendance.

- By using system would need a connection to the local host database, and if the database is down, the system will be unable to record attendance.

b) **Project Strength**

- The usage of a database system allows the administrator to monitor employee attendance.

- Admin can search up an individual employee's attendance in the department.

- Because of the deployment of a biometric fingerprint scanner, employees are unable to assist late-arriving colleagues.

7.3   Project Contribution

Fingerprint Attendance System goal is to provide attendance tracking and monitoring system. This can assist and help boss or admin to track employee's attendance every day. Other than that, this project can help to make the rate of attendance cheating will also be minimised and reduced since a fingerprint would be used to mark and record the attendance status at the workplace.

7.4   Project Limitation

This project has several limitations, such as:

- **Accuracy of detecting fingerprint images**

  Fingerprint scanner needs to detect a perfect image that this process consumes much time to record attendance.

- **Alert message**

  Alert message used to give alert if any employee arrives late more than 3 times in a week or absent.

7.5   Future Work

There are various future works that may be done in system development to overcome weaknesses that can aid to provide greater improvement in future work.

Firstly, the system may be greatly improved by providing the database online so that the administrator or manager can view the attendance of the employees from any computer. This allows the administrator to view the system's database without connecting to the system's network.

After that, an LCD monitor might well be connected to the system's hardware to let the employee who connects with the fingerprint module to know if their attendance has been successfully stored in the database. Using this approach, employees may easily check whether or not they have logged their attendance.

Next, additional improvement to the current system would also be the development of a mobile application that links to the database, allowing the administrator and manager to view the employee attendance record anywhere not only in the office. Using this technique, the administrator may access the database and check any employee record using their phone and the mobile application.

7.6   Conclusion

As a conclusion, the project system is complete after passing through all of the chapters, which include planning, analysis, implementation, and testing. Therefore, the Fingerprint Attendance System has satisfied all of the requirements that were previously stated. Although most of the testing outcomes have been positive, there is still much more that can be done to improve the system.

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APPENDIX

Appendix A: Arduino Uno Board Specifications

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Voltage	5 V
Input Voltage	6-20 V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (6 gives PWM output)
DC Current on I/O Pins	40 mA
Flash Memory	32 KB (0.5 KB used for Bootloader)
Clock Speed Frequency	16 MHZ

Appendix B: Fingerprint Scanner Specifications

Model	JW-101B 2103L
Voltage	3.3V
Peak Current	60 mA
Resolution	500 dpi
Fingerprint Read Time	< 1.0 Second
Backlight colour	Blue
Interface	TTL Serial