ALTERNATIVE KEYLESS SYSTEM USING RADIO_FREQUENCY IDENTIFICATION (RFID) FOR QAIWAN UNIVERSITY (QAIWAN_ASK)

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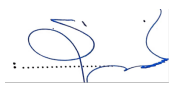

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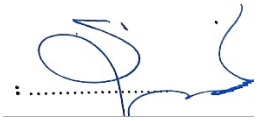
Signature : 

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ALTERNATIVE KEYLESS SYSTEM USING RADIO_FREQUENCY IDENTIFICATION (RFID) FOR QAIWAN UNIVERSITY (QAIWAN_AKS)

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A thesis submitted in fulfilment of the
requirements for the award of the degree of
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School of Computing
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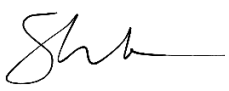
DECLARATION

I declare that this thesis entitled *"ALTERNATIVE KEYLESS SYSTEM USING RADIO_FREQUENCY IDENTIFICATION (RFID) FOR QAIWAN UNIVERSITY (QAIWAN_ASK)"* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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DEDICATION

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have been that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time.

ACKNOWLEDGEMENT

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main thesis supervisor, Dr. Mustafa Khaleel, for encouragement, guidance, critics and friendship. I am also very thankful to my co-supervisor Dr. Siti Hajar Othman for their guidance, advices and motivation. Without their continued support and interest, this thesis would not have been the same as presented here.

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ABSTRACT

Nowadays RFID system is popular among identification technologies because of the low-cost, light weight, reduced size and inexpensive maintenance and high security. RFID Commonly used for Digital locks systems to avoid using traditional locks, the proposed system implements a protected electronic lock for unlocking system that can be used to access the rooms that are consider as sensitive rooms like Server room, President room etc. This system intend is to provides a great security by using two factor of security and each one of these two factors give especial type of security to the system. The system uses RFID tag which can be read it by RFID reader as first factor of security, and Passcode send to each authorized user as factor of security. All these operations controlled via Microcontroller such as Arduino. The factors of security that followed is to achieve the aim of this project which is high security with high performance of the system. This system will provide an idea about the design and installation of a relatively security system which is suitable in the perspective of a developing country like Iraq. The result is show that developing of this system based on the two factors of security with, study the literature review, Agile methodology and the requirements can run effectively.

ABSTRAK

Pada masa kini sistem RFID popular di kalangan teknologi pengenalan kerana kos yang rendah, ringan, saiz yang lebih kecil dan penyelenggaraan yang murah serta keselamatan yang tinggi. RFID Lazimnya digunakan untuk sistem kunci Digital untuk mengelak daripada menggunakan kunci tradisional, sistem yang dicadangkan melaksanakan kunci elektronik yang dilindungi untuk sistem membuka kunci yang boleh digunakan untuk mengakses bilik yang dianggap sebagai bilik sensitif seperti Bilik Pelayan, Bilik Presiden dll. Sistem ini bertujuan untuk menyediakan keselamatan yang hebat dengan menggunakan dua faktor keselamatan dan setiap satu daripada dua faktor ini memberikan jenis keselamatan yang istimewa kepada sistem. Sistem ini menggunakan tag RFID yang boleh dibaca oleh pembaca RFID sebagai faktor keselamatan pertama, dan Kod Laluan dihantar kepada setiap pengguna yang dibenarkan sebagai faktor keselamatan. Semua operasi ini dikawal melalui Pengawal Mikro seperti Arduino. Faktor keselamatan yang diikuti adalah untuk mencapai matlamat projek ini iaitu keselamatan yang tinggi dengan prestasi sistem yang tinggi. Sistem ini akan memberikan idea tentang reka bentuk dan pemasangan sistem yang agak keselamatan yang sesuai dalam perspektif negara membangun seperti Iraq. Hasilnya menunjukkan bahawa pembangunan sistem ini berdasarkan dua faktor keselamatan dengan, mengkaji kajian literatur, metodologi Agile dan keperluan boleh berjalan dengan berkesan.

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LIST OF ABBREVIATIONS

ASK	-	Alternative Keyless System
RFID	-	Radio Frequency Identification
PIN	-	Personal identification number
UTM	-	University Technology Malaysia
IoT	-	Internet of Things
SDLC	-	Software development life cycle
LAN	-	Local area network

CHAPTER 1

INTRODUCTION

1.1 Introduction

Technologies have advanced our life in many ways; keyless lock system is one of those technologies that have been improving day by day. Nowadays in Iraq some of Organizations still uses a manual system for their lock systems and some other organizations uses Alternative system for their lock system. Using modern Alternative keyless Lock system is one of the priorities for any organization to make sure their organizations are secure and safe. In Qaiwan group caring about security is one of their priorities of the company and to make sure their departments and their places like Qaiwan university, is secured against any un authorized person.

Entering any department with using manual lock system by using a key it cause problems, for some of an authorize persons their keys might get lost or broke or some an unauthorize person want to enter any department by having a copy of a key or the entrance of that particular department is unlock, because its manual system sometimes the administrator conflict an authorize person with unauthorize person so that make entering any department is possible for anyone, so Alternative keyless lock system is needed by using RFID for it. The process of this projects is by using RFID to scan RFID tag to RFID scanner and entering the passcode on Mobile phone, these steps it will give a strong security to this system and it will help the administrator by letting admins to record who has right to enter and who has not, also it will help the user to use Alternative RFID to enter the particular department as an authorize user.

Expectation about this Project is to help the users to no longer use a traditional key for opening and closing, no need paper to write the detail of any user and for admins no more caring about security of locks system, these factors will give this project availability, efficiently, integrity and security.

1.2 Problem Background

Property and organizational security have become a major public issue. For this reason, many companies and organizations make security research and development one of their top priorities. The security system needs to be safe and stable without causing many annoying problems to the protected object. A successful security system must consist of three basic elements: authentication, authorization, and access control. Authentication is the process of verifying an individual's identity. This usually includes a username and password, but it can also include identification, RFID cards, voice recognition, or other methods of fingerprinting. Authorization is the process of giving an entity permission to get a particular resource. This is usually determined by determining whether the person is part of a particular group or has a particular level of security. Finally, access control is the ability to control access to restricted resources.

During the working time at QAIWAN_UTM university the staffs of Qaiwan can enter any of the department inside the university without previous permission, so any unauthorize person can show himself or herself as an authorized one to enter even sensitive department like Server room, or Coordinator room etc.

Keyless Alternative lock system will handle those problem because it will have RFID tag instead of traditional key, also the security of the system is highly recommended and its priority by providing two factors of security, first, using particular RFID tag by each user, second, each authorized user will have his or her PIN, these two factors will make this Alternative system secure and trusted system.

1.3 Problem Statement

Traditional locks and keys are the simplest and the cheapest way to secure a place. In the eye of security experts, it is being considered as a very poor security method that many disadvantages. The following are some of disadvantages for Traditional lock system:

A. Key duplication is simple by providing the original keys to a locksmith, an illegal person can simply duplicate conventional keys for a very low cost and in less than a minute.
B. B. Without the owner's permission, an unauthorized user can simply gain enter to a building.
C. C. A key loss caused the owner to replace the locks Traditional keys and locks are created to custom, and each lock only comes with a small number of key sets so if a user lost the traditional key, the only way to maintain security is to change all the locks that it can access, this method will cost a lot of money if a ring of key is lost.
D. D. The problem with heavy key rings comes when users use traditional keys to get access to several department.

To overcome these problems, Alternative key access is being introduced. Digital access control system is a modern system that commonly used to protect organizations. This new method had brought a revolution to the security. It effectively reduces the managing cost of remote sites by lowered down the human supervision needed. Access control systems come in many different varieties nowadays, including bar code system, biometric system, proximity card system, pin system and etc.., the following are some advantages of using a digital access control system:

A. Duplicating a digital key is difficult and requires a much higher level of duplication of a digital key. This makes the access system much more secure than a physical key.
B. Just authorized users have permission to access because their key tag (RFID tag) has been verified.
C. B. Never need to change locks because whenever the digital key lost it can be uninstalled on the system by the system controller. This greatly reduce the overall exposure to risk.
D. A single key for each user that grants access into multiple access points with digital access, a single key or access code grants user access to multiple access points that they are eligible to access. This significantly reduce users‟ burden

by avoiding users to carry heavy key rings when trying to access different department.

E. Flexible additional access makes it easy to update verified keys in an emergency.

1.4 Project Aim

This project seeks to help organizations in understanding the risks of using traditional lock system and defining disadvantages of that system. Alternative lock system as a new technology it can be used to avoid security risks. It provides practical, real-world advice on a way to initiate, design, implement and operate RFID systems during a manner that mitigates security and privacy risks. This project primarily focuses on asset management, process control to control the system by using Arduino, also utilized in contactless Alternative cards that support personal identification that each authorized user has own card as his or her identity. The aim of this project is to develop a system that engage with demands of users to have efficiency which make sure this system work without any error or lags, for integrity is to make sure just authorized user can used it, for security is to define the factors of security that have been used for this system, and availability is to make sure the system run 24/7 which means twenty four hour for all the days of the week. All these points is to make the users feels comfort about this system.

1.5 Project Objectives

The objectives of the project are:

(a) To elicit requirement of Alternative keyless lock system.
(b) To develop Alternative keyless system using RFID for QAIWAN university.
(c) To control Alternative keyless system via micro controller (Arduino)
(d) To create pin number for each authorize user as identity.
(e) To test and evaluate the security and efficiency of the system.

1.6 Project Scope

The scopes of the project are:

(a) The system will focus on development for QAIWAN_UTM university.
(b) The Arduino will be used to create this system, Arduino is more efficient than other microcomputer and it will give better result.
(c) RFID reader and RFID tag will be use as first factor of authentication it is easy to use and safe.
(d) Passcode number will be used as second factor of security.
(e) One keyless Alternative lock system will be created for testing at university.

1.7 Project Importance

This project will help staff of any organization to unlock the lock system in easy way without needing for key. It will secure organization from unauthorized person who has intend to unlock the lock system because it has some security factor steps that need to be followed.

1.8 Report Organization

This chapter contain introduction of the project to give a description about this project, process of this system and some problems that need to be solved via this system also the goal of this system with some important objective, scope and why this project is important.

Next chapter which is Chapter 2, it is about writing the literature review skills and referencing techniques. The following chapter which is Chapter 3 are project methodology and data collection and User/system requirements analysis. After that we have Chapter 4 which is about projects design.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter comprises of the literature review and theoretical background of the project provides an introduction to QAIWAN_ASK technology. It begins with understanding the source of the problem for the system and what are the requirement need it, structure of the system, the place that we want to provide this system for it, analyzing some similar existing system available and finding the advantage and disadvantage of those system. Then comparing between existing system to find strengths and weaknesses of these system to pick the good points for this system, then technologies that used for these systems and why these technologies have been used. It then reviews the basic components of keyless Alternative lock RFID systems and provides background information needed to understand later material in the document.

2.2 Current System of Alternative Lock system

This part figures out the problems regarding lock system that Qaiwan university has it and show some advantages of the Alternative lock system. Finding solutions for problems by making their locks as a smart lock to make sure their lock system under control and just an authorized person can enter their organization and the latching of the system is controlled by authorized person via hardware and software tools that will be used.

2.2.1 Manual Operation

- Qaiwan University used manual system for locking, this manual system is no longer available at many places so this can cause many problems like losing the key, unauthorized entering, person who is in charge cannot monitor everyone who entered.
- Because its manual lock losing of the key will appear many times resulting of that each one of the staff need to has his or her own key and any losing of the key cause latency of the work for staff, authorized person can show himself or herself as authorizes user so there is not any guarantee of security for the locks.
- These problems will affect the University security and integrity by attacking the security from entering any of rooms by Invalid staff so there is not any way to detect that invalid user, any document inside university rooms like president room can be changed and modified since there is no system to monitor entering any sensitive room inside the university, or the server room which can be entered by unauthorized person to shut down the server or make changes to the server.

2.2.2 Alternative Lock Operation

- Solution for manual locks is to change it to Alternative lock system by using RFID keyless Alternative lock system to be conformance with the need of the University.
- RFID system can be alternative for traditional key, by using RFID tag, each user has its own digital key, this make losing key problem be solved.
- Since this Alternative lock door work with RFID, RFID reader will read RFID tag so no one can enter as unauthorized person because system will use different factor of security like using passcode.
- The stakeholder of the system is staff as the user of the system, the authorized staff like president can enter his/her room via tag and pin number as passcode.
- Lower cost needed because it can reprogram RFID tags and monitoring of the system can be handled by one or two Controller.

2.2.3 Using RFID tag instead of Fingerprint for the system

The system will use RFID tag instead of using Fingerprint because RFID tag has more advantages than Fingerprint.

RFID Tag advantages over Fingerprint:

- RFID tag is Easy to use, because it has small size and reading of RFID is very easy just putting it on scanner will automatically read it by RFID reader. For the fingerprint there is sometimes an error appear when the user used the finger because for the finger print the finger that used on fingerprint scanner must be clean and no scratch on it.
- RFID tag has High security equipped with digital sign identifiers that make it extremely difficult to copy card. For Fingerprint there are some unauthorized users that can make a copy of fingerprint.
- Maintaining RFID need low cost, can be reprogrammed, so instead of replacing credentials can simply reconfigure them as needed. For fingerprint maintaining, the cost is higher than RFID tag because it needs to be upgrade too often.
- Convenience, only takes a fraction of a second to put your RFID key in the proximity of the reader to open the lock. For Fingerprint it takes longer time than RFID tag because sometime Fingerprint scanner not read the fingerprint that make the users to retry it.

2.3 Existing System analysis

This part analyst the survey of different technology that has been used in different researches for making secure locking systems.

2.3.1 The Automatic Door Lock to Enhance Security in RFID System

The most common way to use RFID for lock system is to create RFID reader, LCD screen for display the process and control all the function via Microcontroller, the RFID reader will read the RFID tag for authorized user and it will display it on LCD to tell the user that the lock unlocked or not, this way focuses on availability because the system needs to be available 24/7, the cost of the system is low since there is on much to do with maintenance and coding, (Yordan Hasan et al. 2020).

2.3.2 Development of an RFID Based Access Control System in the Context of Bangladesh

One of the modern ways for digitalization locking system is the password used as verification factor with using RFID. in (Md. Kishwar shafin and Kazi lutful Kabir. 2015) the working of lock system by using RFID cards for each user and the user has to type their password which is given by controller of the system and controller check the validation then the lock system will be unlock and at the same time the data is recorded of the user, these summaries the working of RFID system is where RFID tag and reader are the main components.

2.3.3 A Digital Security System with Door Lock System Using RFID Technology

The system by (Verma and Tripathi. 2010) summarize the implement of RFID for digital lock system, that RFID control the lock and unlock of the system, Passive RFID used for entering through RFID reader with recording the check-in and check-out of the user that stored in Database.

2.3.4 High Security Door Lock System by Using Android Mobile with Bluetooth

Instead of using RFID for lock system, some lock system uses mobile phone as tool for locking and unlocking while integrity, security and availability are discussable, in this paper (Putluru Sravani et al. 2017) analyses the way of using smartphone for locking and unlocking system through an application connected to microcontroller to not use any type of key for unlocking, this gives the system low cost with time decreasing and easy to use.

2.3.5 Password Protected Electronic Lock System for Smart Home Security

There is other type of digital lock system to protect electronic lock system by implementing a password-based locking system, using keypad for to give the correct password and LCD to display function of inserting the password. The microcontroller used to control processing of System work with using LCD for user interface and keypad for inserting the password, this makes functions easy and fast with low cost for the users (Md. Maksudur Rahman, 2018).

2.3.6 RFID and Finger Print Based Dual Security System: A Robust Secured Control to Access Through Door Lock Operation

Biometric lock system nowadays used commonly like fingerprint, eye and voice also it can be used with RFID system this Technique used with IOT commonly, a security lock system can work sequentially with Fingerprint sensor and RFID reader to achieve strong security, a user needs to add RFID tag and then press fingerprint, this way of unlocking system is to make satisfaction and secure system for the user as it describes in (Mostafizur Rahman Komol, 2018).

2.4 Comparison between existing systems

Table 2.1 A comparison of existing RFID methods on its security and design

Tittle	Security	Design
The Automatic Door Lock to Enhance Security in RFID System	One factor security which is using just RFID tag for unlocking.	Flexible can be used with every lock.
Development of an RFID Based Access Control System in the Context of Bangladesh	Two factors security used which is Using RFID and password for unlocking.	There is no design for the system.
A Digital Security System with Door Lock System Using RFID Technology	One factor for security which is using just RFID tag for unlocking.	There is no design for the system.
High Security Door Lock System by Using Android Mobile with Bluetooth	One factor of security used.	Flexible can be used with every lock.
Password Protected Electronic Lock System for Smart Home Security	One factors of security used which is Using password for unlocking.	Microcontroller is control unit
RFID and Finger Print Based Dual Security System: A Robust Secured Control to Access Through Door Lock Operation	Two factors of security: both RFID card tagging system and fingerprint sensing biometric security system.	A prototype of the security system is designed.

Table 2.2 A comparison of a strength and weaknesses of RFID methods

Tittle	Strengths	Weaknesses
The Automatic Door Lock to Enhance Security in RFID System	▪ Low cost. ▪ Easy to use. ▪ Functions take lees time it needs around 3 second. ▪ RFID tag is detecting the RFID reader around 3,5 cm this make the system more secure.	▪ There is no alert for the system to give more feature to the system. ▪ Weak security because just using RFID tag for entering not enough.
Development of an RFID Based Access Control System in the Context of Bangladesh	▪ Passive RFID used. ▪ Easy to use. ▪ LCD display has been used. ▪ the door closed automatically. ▪ There is database system to monitor all entering. ▪ For entering need RFID tag and password which make the system more secure. ▪ High Security	▪ There is no design for control unit system, how is work, how it connected, no information mentioned.
A Digital Security System with Door Lock System Using RFID Technology	▪ Passive RFID used. ▪ Easy to use. ▪ Low cost. ▪ Used for three RFID space. ▪ There is database system to monitor check- in. ▪ Battery life: More than 4,000 times open/close of door.	▪ Weak security because just using RFID tag for entering not enough. ▪ There is no alert for the user.

High Security Door Lock System by Using Android Mobile with Bluetooth	▪ Smartphone used. ▪ Application created. ▪ Java Language used for creating an application. ▪ the maximum ▪ distance that receiver can detect the RF signal from the smartphone is around 15 meters in house. for outdoor area, the maximum distance is 20 meters. ▪ LCD used	▪ There is no warning alarm on application when unauthorizes entered happen. ▪ Vulnerability for coding part. ▪ Vulnerability for the application that used because security not mentioned.
Password Protected Electronic Lock System for Smart Home Security	▪ Easy to use. ▪ LCD screen used. ▪ Keypad used. ▪ User can change current password through keypad.	▪ One factor for security used which is written password without confirmation of password from the system which make security of this ▪ system very weak
RFID and Finger Print Based Dual Security System: A Robust Secured Control to Access Through Door Lock Operation	▪ Easy to use. ▪ LED blink used to indicate the sensor is working. ▪ The door will be automatically closed. ▪ Info. of the user and fingerprint save through database system. ▪ High security since two factors of security used: Fingerprint and RFID.	▪ High cost.

2.5 Literature Review of Technology Used

There are some technologies that have been used in literature review, describe the software and hardware requirements for developing these systems.

2.5.1 Arduino

Arduino is a microcontroller used to control the functions of the system, its open-source electronic platform and consist of a programmable physical circuit called microcontroller. Its support C and C++ languages.

2.5.2 Raspberry PI

Raspberry PI is a series of small single-board computers used to control the system functions. Raspberry Pi supports phyton and other programming languages.

Table 2.3 A comparison of existing Technology used

Hardware	Advantages	Disadvantages
Raspberry PI	▪ Higher Speed ▪ Can do multitasking. ▪ RAM 1GB to 8GB. ▪ While it consumes less power. ▪ Use python for programming language.	▪ Expansive. ▪ Only used Linux operating system.
Arduino	▪ Cheaper than Raspberry. ▪ Can use all kinds of operating system.	▪ It consumes more power. ▪ Sketches and shields can be hard to change

2.5.3 Active RFID

Active RFID tag is continuously operating, battery-powered sensors that combine and transmit data to a reading device. It's a wireless, automatic identification method.

2.5.4 Passive RFID

Passive RFID tag is a tag with not having internal power source, it's powered by the electromagnetic energy transmitted from an RFID reader.

Table 2.4 A comparison of existing Technology used

Hardware	Advantages	Disadvantages
Active RFID	▪ Used for longer range than passive RFID	▪ Increase data storage ▪ Expensive ▪ Life limited by battery
Passive RFID	▪ Reduce data storage ▪ Unlimited life of battery ▪ Smaller size	▪ Can collect data from sensor only when in range of reader.

2.6 Chapter Summary

This chapter discuss the system importance for Qaiwan university and why the university need this project, it gives the problems faced by Qaiwan university since the university used manual lock system and it gives the proper solution for the problem and the necessary of this project for Qaiwan International University. The discussion about the current systems research that relates to this system to give brief analyze about this research and analyze the Strengths and weakness of these research by performance, security, integrity and design and picking strengths points to be used in this project. Display some Hardware and software electronic devices that used in this project to describe the Devices and give description about performance of these tools and why they need to be used in this system.

CHAPTER 3

SYSTEM DEVELOPMENT METHODOLOGY

3.1 Introduction

Methodology means is the procedures or techniques used to identify, process, and analyze information about it to implementing the system development life cycle. It is a series of steps to perform and deliverable to produce. This chapter will discuss the methodology used for this system and there are five phases for software development life cycle (SDLC) which are i) Analysis, ii) Design, iii) Implementation, iv) Testing and v) Evaluation as shown on Figure 1.

The system presents a lock security system which provides security that can be used for many institutes and various organizations etc. The system will use three factor authentication which are using RFID keyfob, entering unique pin, unique passcode.

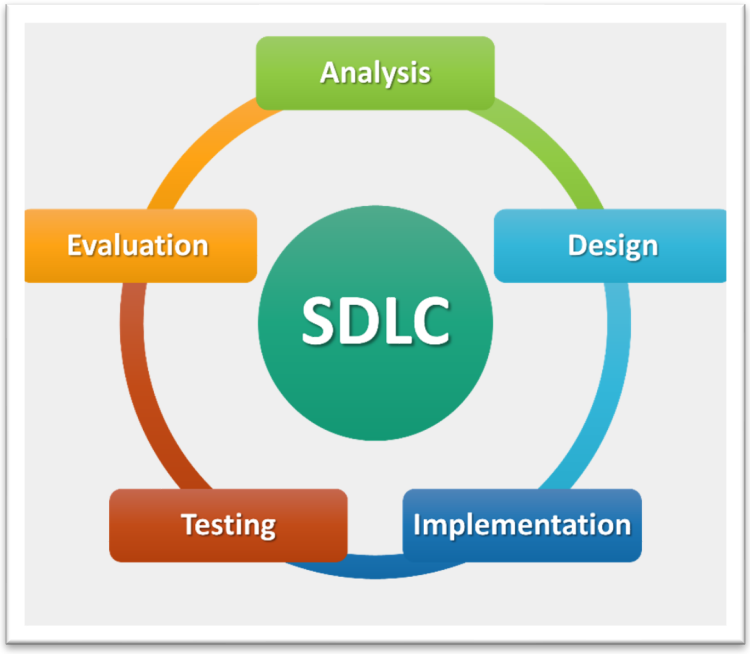


Figure 3.1 Software development life cycle (Bzfar.org, 2020)

Analysis it means collecting information from customers, stakeholder then these information's used to plan the approach project, next phase is design it is to come out with the best architecture for the project, after that implementation phase is to generate coding base on the design for the system, then testing is to test the application before be available to users and finally evaluating is to discover any bug and any changes base on client requirement.

3.2 Methodology Choice and Justification

There are several types of methodologies that are used to develop a system the most used methodologies are Waterfall, rapid application development, agile and devops deployment, each one of these methodologies has Strengths and weaknesses and its base on the developer to use suitable methodology (Synopsys Editorial Team, 2019).

This system will use Agile methodology, because nowadays agile methodology is favorable methodology for developer and its modern methodology, agile methodology can be used for small and medium project so that is one of the reasons that this project used agile, another reason is working on this project is weekly and agile support that, in agile methodology developer can make changes even late changes so for this project any changes later can be added to this project to improve the efficiency and fix defects. the term of agile stands for 'Moving quickly' which means quick testing of the system.

3.3 Agile Methodology product backlog

Product backlog is the list of requirements for the system that will satisfy end user needs, adding new features, changes to existing features, bug fixes, infrastructure changes or other activities that a developer may deliver in order to achieve a specific outcome. For this system there are some changes added to the system based on the

user requirements and all these changes have been done properly as shown on figure 3.2.

PRODUCT BACKLOG

User Story ID	User Story	Story point	Priority	Sprint	Status
US001	As a user I need this system to have an alert to notify the authorized user to know if our card is valid or not.	2	Must	3	Done
US002	As a user I need from the System to send random number of passcodes each time to avoid duplication, confliction and to make sure unauthorize user cannot know the passcode numbers.	5	Should	4	Done
US003	As a user I need from this system to close the door automatically after each entering so this will make it easier to use	8	Could	8	Done

Figure 3.2 Agile methodology Product backlog

3.4 Phases of the Chosen Methodology

Since this project used Agile methodology there are has some phases related to agile methodology that need to be follow.

The Agile methodology has six phases which are concept, inception, iteration, release, production, retirement.

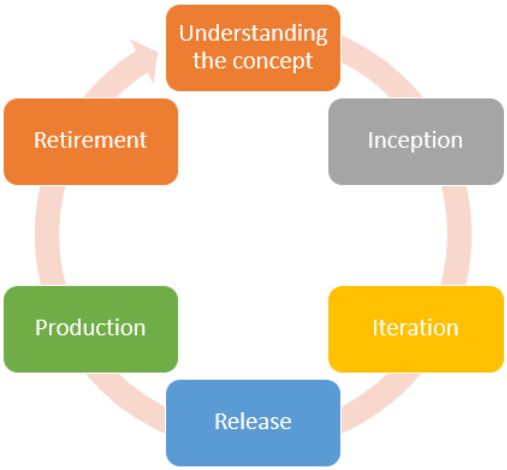


Figure 3.3 Agile methodology phases (Chaitra, 2021)

3.4.1 Phase 1 Concept

In the concept phase, the project done a scope to create a secure lock system for the Qaiwan_UTM university, and given a description about the project, the problem background that are discussed the problems that faced by Qaiwan university regarding the lock system and give a proper solution by applying Alternative lock system. The requirement has been discussed to check them and their futures to know the requirement that are need it for the project and estimating the cost and the time that it will take to make this project.

3.4.2 Phase 2 Inception

This phase is to understand the system and how it works to have better view about the system. it discusses the necessary tools and the design of the system with using diagram to analysis the architecture of this system, to give declaration about the users and how the project is going to work.

The intend to do design modeling that are need it for this project, they are two types of UML diagram which are structure diagram and behavioral diagram.

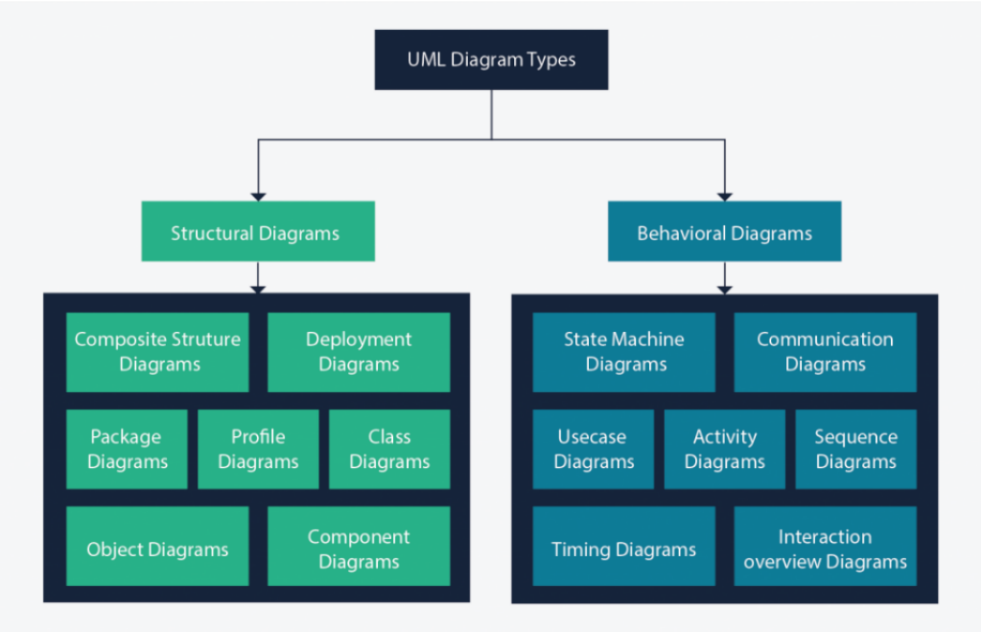


Figure 3.4 UML diagram types_ (nishadha, 2012)

This project needs structural diagrams such Use Case diagram to show who is in role for this system also to display the user's responsibility and actions, sequence diagram to display how the group of objects work together. Activity diagram is need it also to show the steps of the process that this system follows last diagram is database diagram to show relations between database objects in the system, it describes how data can be store, how they interact with each other. The design tool for that will used in this system is Lucid chart because it free and all the tools thar are need it can be found it in this application.

3.4.3 Phase 3 Iteration

In this phase which is about the UX design and combining the requirements with feedback of the users, is physically developing the system to generate coding part, and connecting all the tools of the system together. The project in this phase will create the UX for the system based on the architecture design of the system, then generating coding for the system to work as a quick first draft to check the efficiency of the system.

3.4.4 Phase 4 Release

In the Release phase which is testing of the system, it is one of the important phases because it's for monitor the real system to find bugs and vulnerability of the system that can be fixed before real time which means before publishing the system.

3.4.5 Phase 5 Production

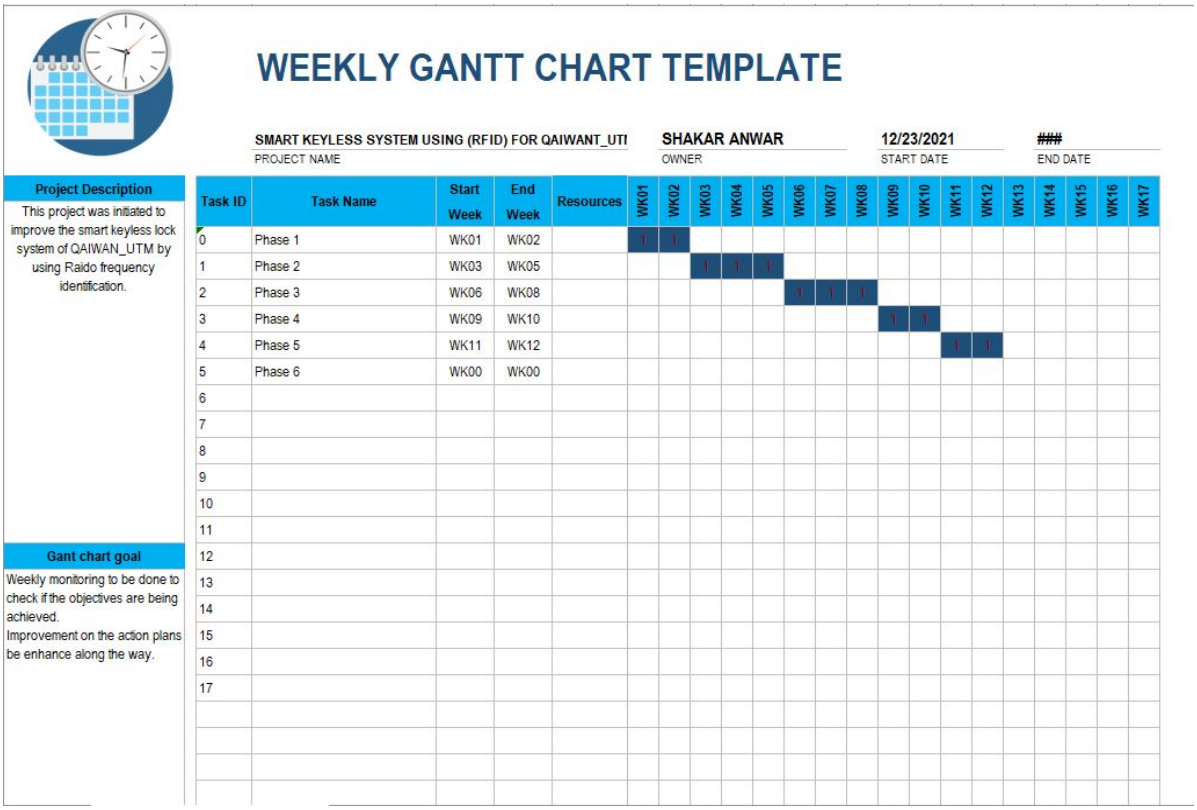
This phase is reached when the system is fully available and published, in this project for this phase it will handle by developer to check the system if it running without any problem for Qaiwan university and give training to the staff and system controller to make sure that they know how to used it.

3.4.6 Phase 6 Retirement

In the retirement phase, this project can reach this phase when there is another system better than this to replaced and if retirement happen the developer will remove the existing system and no more supported.

3.4.7 Gantt chart

This Gantt chart is for defining how long each phase will take to be done in a period of time.



WEEKLY GANTT CHART TEMPLATE

SMART KEYLESS SYSTEM USING (RFID) FOR QAIWANT_UTI — PROJECT NAME
SHAKAR ANWAR — OWNER
12/23/2021 — START DATE
— END DATE

Project Description

This project was initiated to improve the smart keyless lock system of QAIWAN_UTM by using Raido frequency identification.

Gant chart goal

Weekly monitoring to be done to check if the objectives are being achieved.
Improvement on the action plans be enhance along the way.

Task ID	Task Name	Start Week	End Week	Resources	WK01	WK02	WK03	WK04	WK05	WK06	WK07	WK08	WK09	WK10	WK11	WK12	WK13	WK14	WK15	WK16	WK17
0	Phase 1	WK01	WK02		1	1															
1	Phase 2	WK03	WK05				1	1	1												
2	Phase 3	WK06	WK08							1	1	1									
3	Phase 4	WK09	WK10										1	1							
4	Phase 5	WK11	WK12												1	1					
5	Phase 6	WK00	WK00																		
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					

Figure 3.5 Gantt Chart

3.5 Technology Used Description

This part discusses the technology and tools that will be used to create this Alternative lock security system.

3.5.1 Arduino Nano

The Arduino Nano is Arduino's classic breadboard friendly designed board with the smallest dimensions. The Arduino Nano comes with pin headers that allow for an easy attachment onto a breadboard and features a Mini-B USB connector.

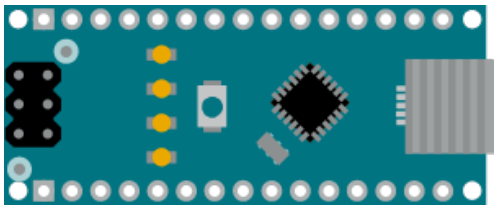


Figure 3.6 Arduino Nano_ (Ltd, n.d.)

3.5.2 USB RFID Reader 125KHZ EM4100 / TK4100 Card Tag ID Reader With 5pcs Keyfobs

Passive RFID will be use because it has more features than Active RFID like, life unlimited and reduce the storage size and used for less range which is better for this project to be read near to the reader, it also Support for EM4100 / TK4100 ID card.

This one is only a RFID reader, cannot be used to duplicate other cards and write Fast in reading the RFID Tags. The USB powered, no external power supply 125khz RFID reader with USB interface, do not need a driver, Reading Distance: Up to 8cm. it will be connected to the Raspberry pi.

Figure 3.7 USB RFID Reader 125KHZ EM4100 / Tag ID Reader with Keyfobs_ (www.amazon.co.uk, n.d.)

3.5.3 GSM

The Arduino GSM Shield V1 allows an Arduino board to connect to the internet, make/receive voice calls and send/receive SMS.

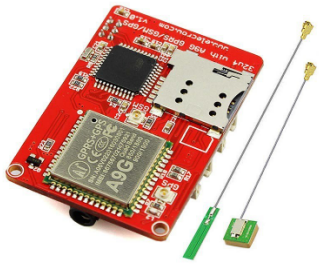


Figure 3.8 GSM_ (UrukTech, n.d.)

3.5.4 DC step down

A buck converter down to 5V from 24V will be mainly immune to voltage dropouts and droop on the 24V rail so it's a reasonable approach.

Figure 3.9 DC step down_ (Industries, n.d.)

3.5.5 Breadboard

This Breadboard include a lot of small holes in it to allow you to place different components to build an electronic circuit is known as a breadboard. The connection on the breadboard is not permanent but they can be connected without soldering the components.

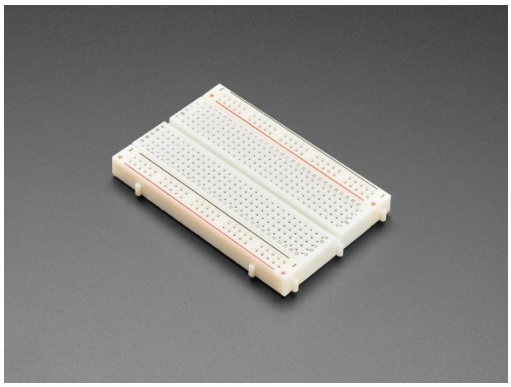


Figure 3.10 Breadboard

3.5.6 C++

C++ language will use to implement the Arduino, that help the developer to make change to enhance the system. there are a couple of small differences designed to make Arduinos as easy to use as possible.

3.6 System Requirement Analysis

System requirements for this project are two type, hardware and software, the hardware is physical tools that are needed for the system to use it by users and software requirements is the programming part that will be installed to the system via Arduino nano.

3.6.1 Hardware requirement

Hardware requirements are physical peripheral hardware which are required to complete each part of the system.

3.6.1.1 Arduino nano

The Arduino Nano is Arduino's classic breadboard friendly designed board with the smallest dimensions. The Arduino Nano comes with pin headers that allow for an easy attachment onto a breadboard and features a Mini-B USB connector.

Table 3.1 Hardware requirement / Arduino nano

Features	
MICROCONTROLLER	ATmega328
FLASH MEMORY	32 KB
ANALOG IN PINS	8

3.6.1.2 Passive RFID / USB RFID Reader 125KHZ EM4100 / TK4100 Card Tag ID Reader With 5pcs Keyfob

This is passive RFID, cannot be used to duplicate other cards and write. Fast in reading the RFID Tags, direct need from the USB-powered, no external power supply.

Table 3.2 Hardware requirement / Passive RFID / USB RFID Reader

Features	
Hard disc interface	USB 1.1
Connectivity technology	USB
Form factor	Portable

3.6.2 Software requirements

Software requirement is software that is required to build the system. The software which is used is defined as below.

3.6.2.1 C++ operating system

C++ is a general-purpose programming language that used in this project for coding part.

3.7 Chapter Summary

In this chapter explained the methodology that used to develop this system which is agile methodology and why this methodology suits for this project. Phase of agile methodology applied for this project and explained in detail. Software and hardware tools ordered and explained and analysis these tools why they are important for this project. In Chapter 4, the system will be designed and diagrams will be used to analysis the project step by step and give clear illustration about it.

CHAPTER 4

REQUIREMENT ANALYSIS AND DESIGN

4.1 Introduction

This chapter is about how the Alternative keyless system by using RFID works, how it designed by analyzing the steps in diagrams like use case to tell who are involved in this system, Sequence diagram to tell how objects interacts and activity diagram to analysis the process of the system.

4.2 Requirement Analysis

Requirement's analysis or is a process used to determine the needs and expectations of a new product. The requirements users in this system involve two actors which are system Controller and Staff.

System controller it is the admin of the system to control the system and make sure it works properly.

- System Controller can manage the detail of the users list
- System Controller can verify the data

This system it is for the authenticated Staff in Qaiwan university, the functions for Staff as user are:

- Staff can use RFID tag for the system
- Staff can get passcode from the system

4.2.1 Use Case Diagram

A use case is a written description of how users will perform tasks on the system and telling the role of each actor as shown on Figure 4.1.

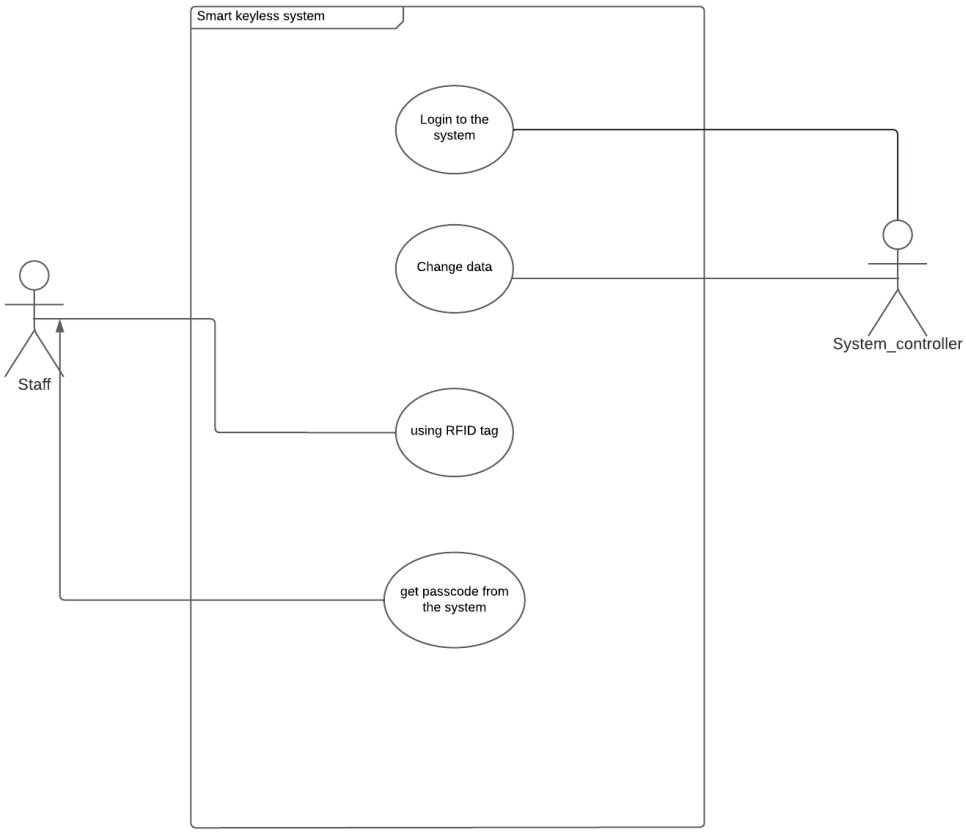


Figure 4.1 Alternative Keyless System Using (RFID) Use case Diagram

This Use case diagram describe the role of the two actors that this system has which are System Controller and Staff, system Controller has some sensitive functions to do like changing the data and login to the system. For the staff which is the user of this system as an authorized user their functions are using RFID tag and get passcode that they will get form the system.

4.2.1.1 System Controller Use Case

System controller which is the admin of the system, based on Figure 4.1 has some functions to do, on Table 4.1 shown the way of each function.

Table 4.1 Use Case Functions for System Controller

Use Case		Description
Login to the Database System		Only system controller as admin can login to the system and to the database system by using PIN.
Manage user data	*RFID_Code*	The System controller can controller the functions and manage it, also change and modify the RFID Code of any authorized user.
	Passcode No	The System controller will send Specific Passcode Number for each authorized user to be used for unlocking the lock system.

4.2.1.2 Staff Use Case

Staff which is the user of the system, based on Figure 4.1 has some functions to do, on Table 4.2 shown the way of each function

Table 4.2 Use Case Functions for Staff

Use Case	Descriptions
Using RFID tag	The Authorized Staff as user can have his or her particular RFID tag to scanned to RFID reader as first factor of security that used in this system.
Getting Passcode from the System	Each Authorized staff as user can get passcode from the system and sending back to the system.

4.2.2 Sequence Diagram

Sequence diagram is a type of interaction diagram because it used to describe how and in what order a group of objects works together.

4.2.2.1 System controller Sequence diagram

This sequence diagram is to explain the System controller function while login to the system, to Manage the Data of the System as admin, because only admin can login to the system.

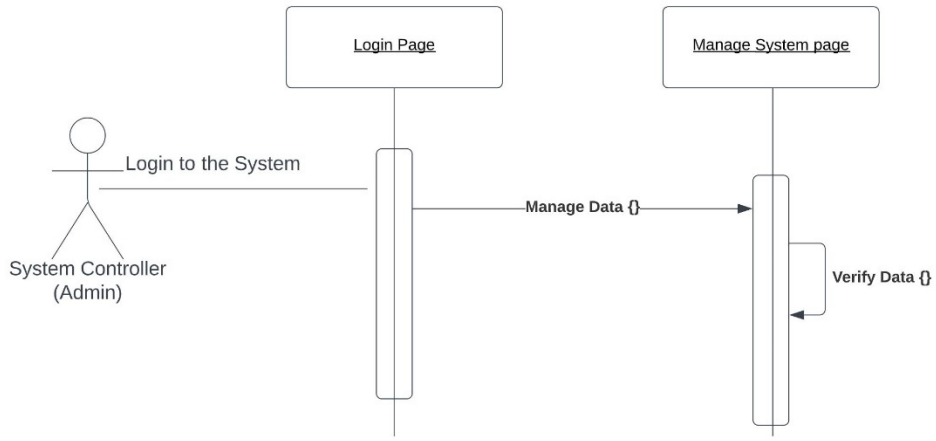


Figure 4.2 Login function Sequence diagram for System controller (Admin)

This sequence diagram is to explain the System controller function while managing the data of the user, to add user information like RFID Code and Phone number etc.

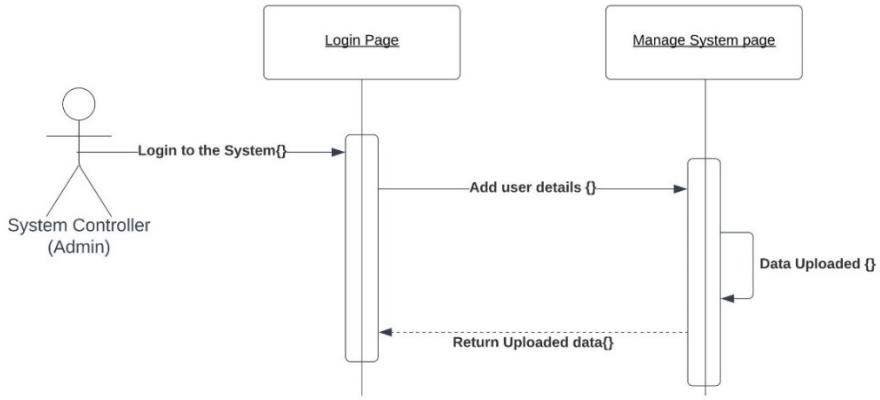


Figure 4.3 Manage data function Sequence diagram for System controller (Admin)

4.2.2.2 Staff Sequence diagram

This sequence diagram is to explain the Staff function while using RFID tag as the first step to unlock the system, if the RFID is authorized the user is verified, if not the system will deny reading that tag.

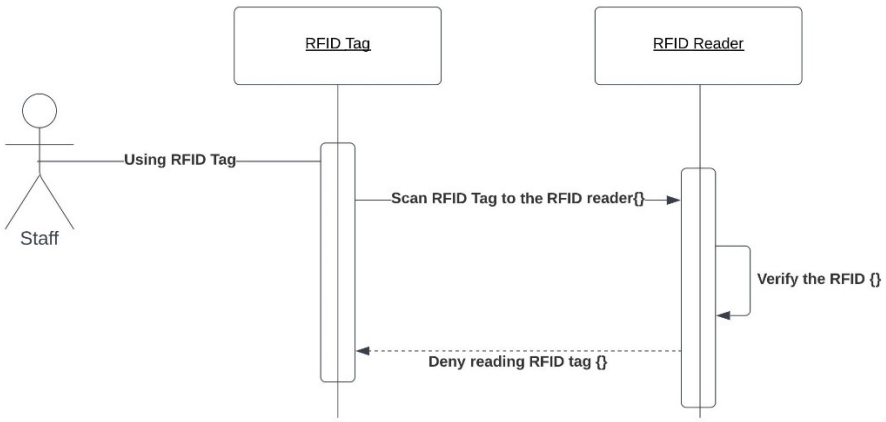


Figure 4.4 RFID tag function Sequence diagram for Staff (User)

This sequence diagram is to explain the Staff function while using RFID tag and getting the passcode from the system the sending back the passcode to the system to unlock the lock.

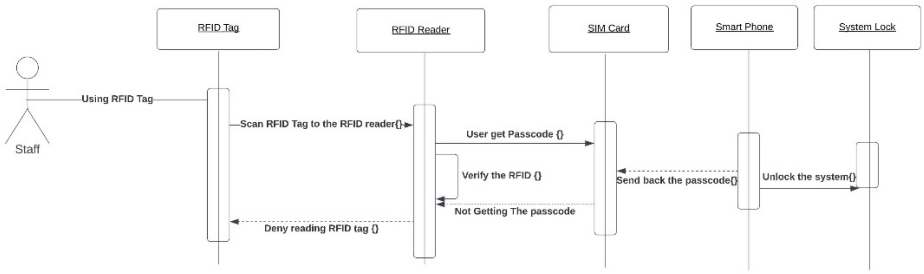


Figure 4.5 Getting passcode function Sequence diagram for Staff (User)

4.2.3 Activity diagram

Activity diagram is essentially an advanced version of flowchart that shows activities performed by a system, this part shows the activity diagram for each user of the system and explain dynamic aspects of the system.

4.2.3.1 System controller Activity Diagram

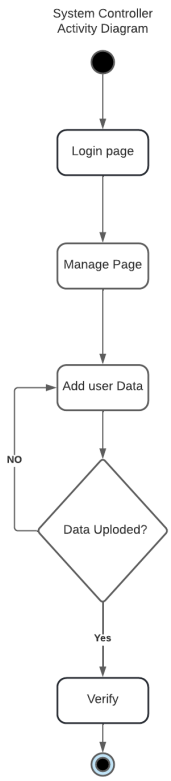


Figure 4.6 System Controller Activity diagram

As shown on Figure 4.8 activity diagram for System controller of the system, this figure explains the activities that can performed by admin, at the first step he or she need to login, after that going to manage page to add user detail if the Detail uploaded it will be verified if not it needs to re added again.

4.2.3.2 Staff Activity Diagram

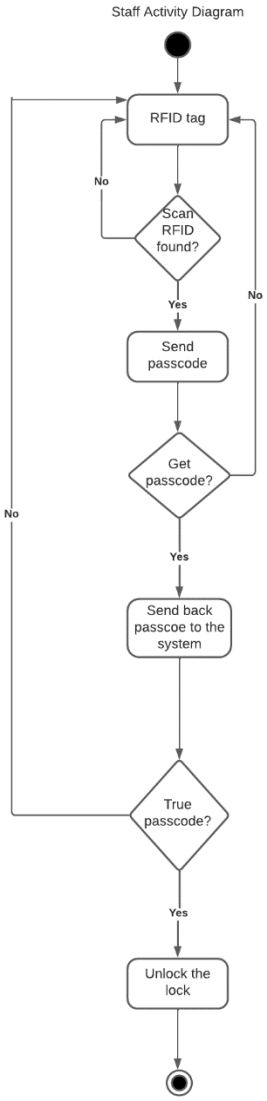


Figure 4.7 Staff Activity diagram

As shown on Figure 4.9 activity diagram for the Staff, this figure explains the activities that can performed by Staff, starting from RFID tag that each staff has own particular RFID tag to scanned to RFID scanner, if scan of RFID found its authorized the system will send passcode via SMS to the user, if not it needs to use RFID tag again, then if the user get passcode it will send back the same passcode to the system, but if the passcode is wrong it needs to use RFID tag again as first step.

4.3 Project Design

It's the set of structures needed to reason about the system, to show the relations among the software or hardware elements that are used in this system, to design based on combination of system and design.

The System used breadboard to connect the devices together, Arduino nano as a system controller connected with RFID reader on pin nine and ten, the servo is on pin seven, DC step down is used because the GSM need just four Voltage but the power is about nine voltages so DC step down will convert the nine voltages to four voltages for GSM serial, GSM serial is on pin two and three, capacitor is used also to protect the system from increasing and decreasing of voltages. The battery is used as power supply for the system. The Resistor used to lower the flow of current, divide voltages, block transmission signals as shown on figures 4.8, 4.9, 4.10, 4.11 how the system devices are connected.

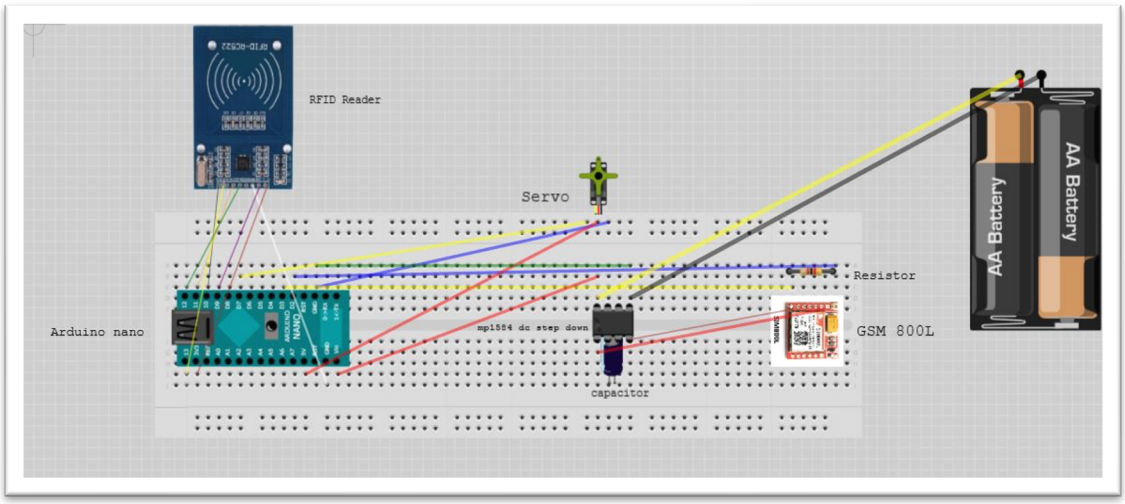


Figure 4.8 System virtual design

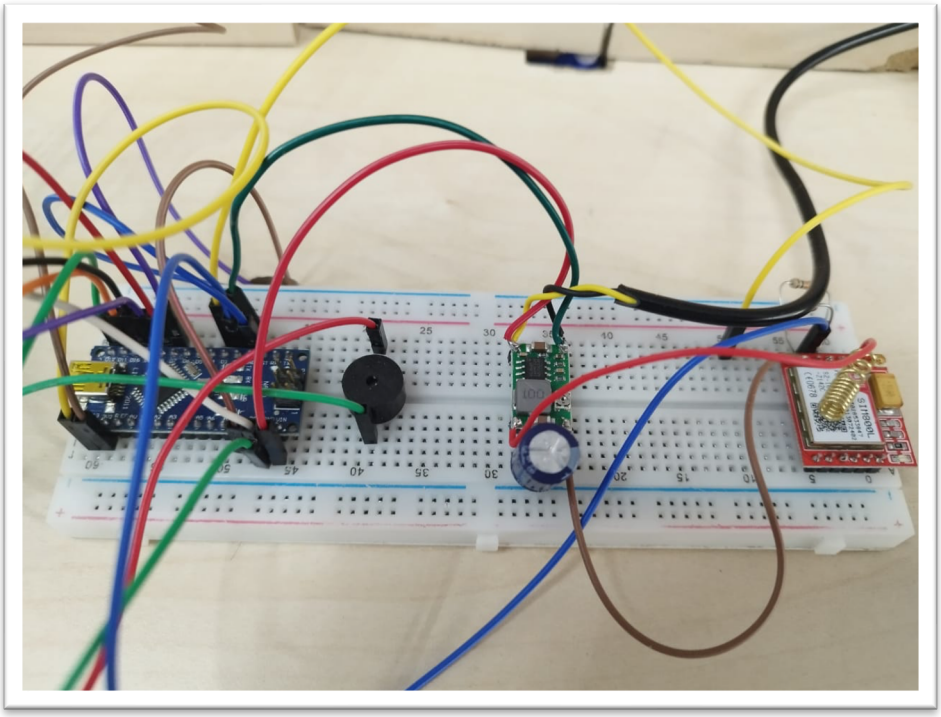


Figure 4.9 System architecture and design on breadboard

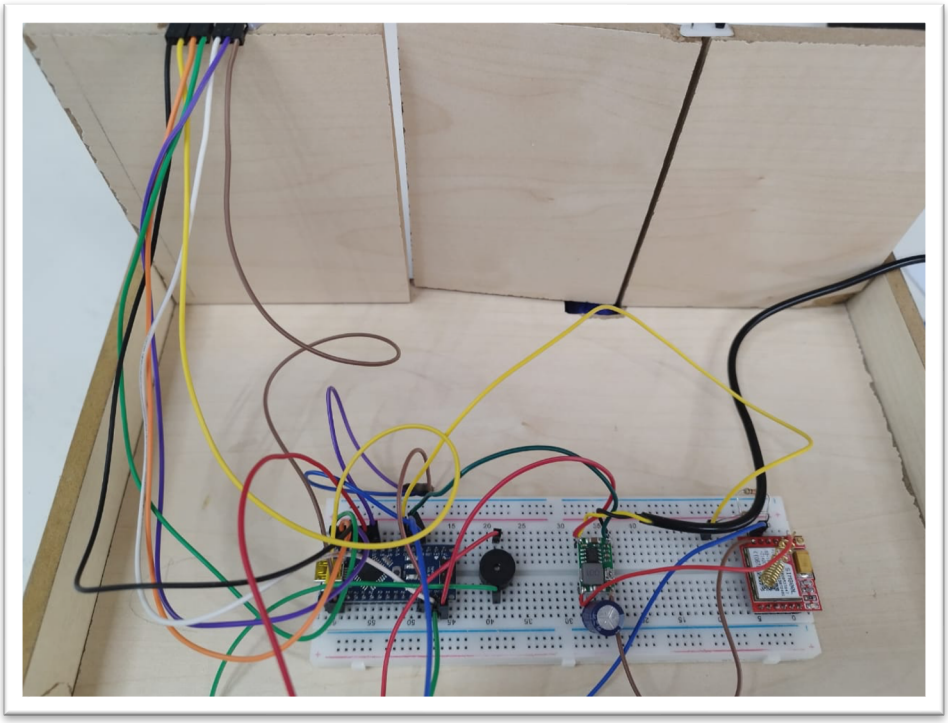


Figure 4.10 System architecture and design on breadboard

Figure 4.11 RFID on the system

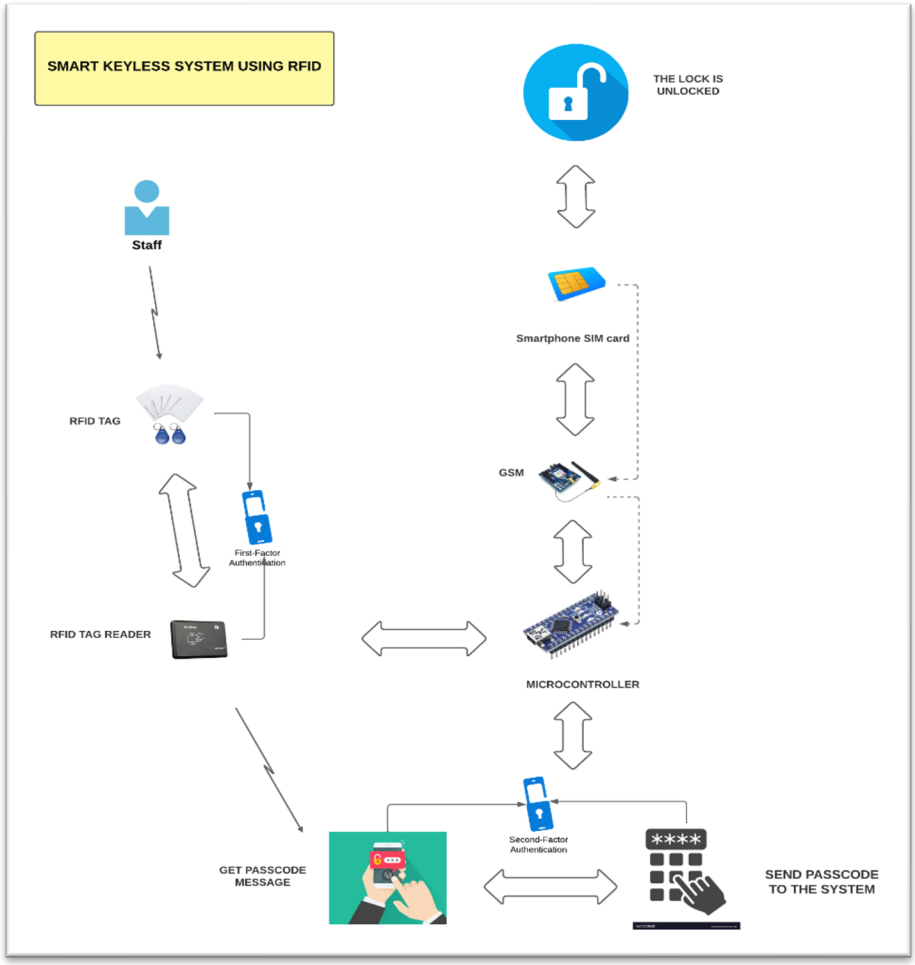


Figure 4.12 System architecture

As shown on Figure 4.12 the System architecture and design of the Alternative keyless system, this diagram explains the way of using the system in simple way to tell the reader how this system works. First, the user put RFID tag to the RFID reader if the system read that user RFID ID it means its verified, after that the user will get passcode number from the system to his or her smartphone and the user will send back the same passcode to the system as second factor of authentication, then the door will open automatically and it will close automatically after a few seconds.

4.4 Chapter Summary

This chapter was about the requirements and design for the system, for the requirements the use case diagram, sequence diagram, activity diagram applied, for the database design entity relationship used, and for design part the design of system database has been created for admin, but for Staff which is the user of the system there is no interface because the tasks of staff all should be done by the hardware tools of the system.

CHAPTER 5

IMPLEMENTATION AND TESTING

5.1 Introduction

In this chapter will be discussing the implementation and coding part for Alternative keyless system. According on the system development approach, requirements analysis, and design laid out in this paper's preceding chapters.

5.2 System Implementation

This part related to the coding part which has been done on the Arduino nano by using Arduino editor and the version is 1.8.19. This picture is just a sample of coding part, all the coding parts are put it on appendix page.

Figure 5.1 Coding part

5.3 System testing

System testing is a technique that used for the system to verify the end-to-end system specifications. After the system implementation process have been completed according to the specifications described in previous chapters, many testing have been conducted. The two types of testing are conducted which are Black box testing and User acceptance testing in order to validate the system.

5.3.1 Black box testing

Black box testing is a kind of software testing that looks just at the software's functioning without looking at its code or internal structure. A customer-stated requirement specification serves as the main source for black box testing.

Table 5.1 Black Box testing for Alternative keyless system

T.C ID	**TC01-1**	**TC01-2**	**TC01-3**	**TC01-4**
RFID tag	-	yes	no	yes
Passcode	-	1234	-	1234
User type	Staff	Staff	Staff	Admin
Expected result	**Actual result**			
RFID tag error	✓		✓	
RFID used		✓		✓
Get Passcode		✓		✓
Passcode not get it	✓		✓	
Test Results	Pass	Pass	Pass	Pass

5.3.2 User acceptance testing

The end user or client does a sort of testing known as user acceptance testing, or UAT. After functional, integration, and system testing are complete, UAT is carried out as the last stage of testing. Results from User Acceptance Testing, Table 5.2 shows the results obtained from the User Acceptance Testing:

Table 5.2 User Acceptance testing for Alternative keyless system

No	***Action***	***Expected result***	***Pass /Fail***
1	Using Tag	Alert that the Tag used	Pass
2	After using Tag	Waiting for sixty second Get authorized passcode SMS Resend the Passcode to the System	Pass

5.4 Chapter Summery

This entire testing procedure was carried out in accordance with the methodology, specifications, and design that were established. The project's end will be covered in the next chapter.

CHAPTER 6

CONCLUSION

6.1 Introduction

This chapter is recap of the Alternative keyless system, it will discuss the results and the achievement of the system and it will discuss the suggested plan for the project.

6.2 Achievement of Project Objectives

Chapter one of the project was about, the introduction of the project to give a description about this project, process of this system to explain how the process of the system has been done and some problems that identified to give proper solution via this system, also the goal of this system with some important objective, scope and why this project is important.

Chapter two discuss the system importance for Qaiwan university and why the university need this project, it gives the problems faced by Qaiwan university since the university used manual lock system and it gives the proper solution for the problem and the necessary of this project for Qaiwan university. The discussion about the current systems researches that relates to this system to give brief analyze about these researches and analyze the Strengths and weakness of these researches by performance, security, integrity and design and picking strengths points to be used in this project. Display some Hardware and software electronic devices that used in this project to describe the Devices and give description about performance of these tools and why they are need to be used in this system.

Chapter three explain the methodology that used to develop this system which is agile methodology and why this methodology suits for this project. Phase of agile methodology applied for this project and explained in detail. Software and hardware tools ordered and explained and analysis these tools why they are important for this project.

Chapter four was about the requirements and design for the system, for the requirements the use case diagram, sequence diagram, activity diagram applied, for the database design entity relationship used, and for design part the design of system database has been created for admin, but for Staff which is the user of the system there is no interface because the tasks of staff all should be done by the hardware tools of the system.

Chapter Five was about the implementation to tell the reader how this System has been implemented by applying some of the coding and clarify the test of the system that has been done in two ways as mentioned on chapter 5.

6.3 Suggestions for Future Improvement

Intent for the PSM 2 is to implement the system in proper way by using the methodologies that have been created on PSM1 which was agile methodology, it means the changes can be happen in the phases base on agile methodology.

The importance methods for this project are the three factor authentications this project has which are first factor using RFID tag, second factor is using PIN number for each authorized user and the third factor and the most important factor is Passcode that will be send through message to mobile phone, these factors will be add to the system in PSM 2.

Last point for PSM 2 will be testing of the system which is very important to find any problem that could be faced through implementing of the system.

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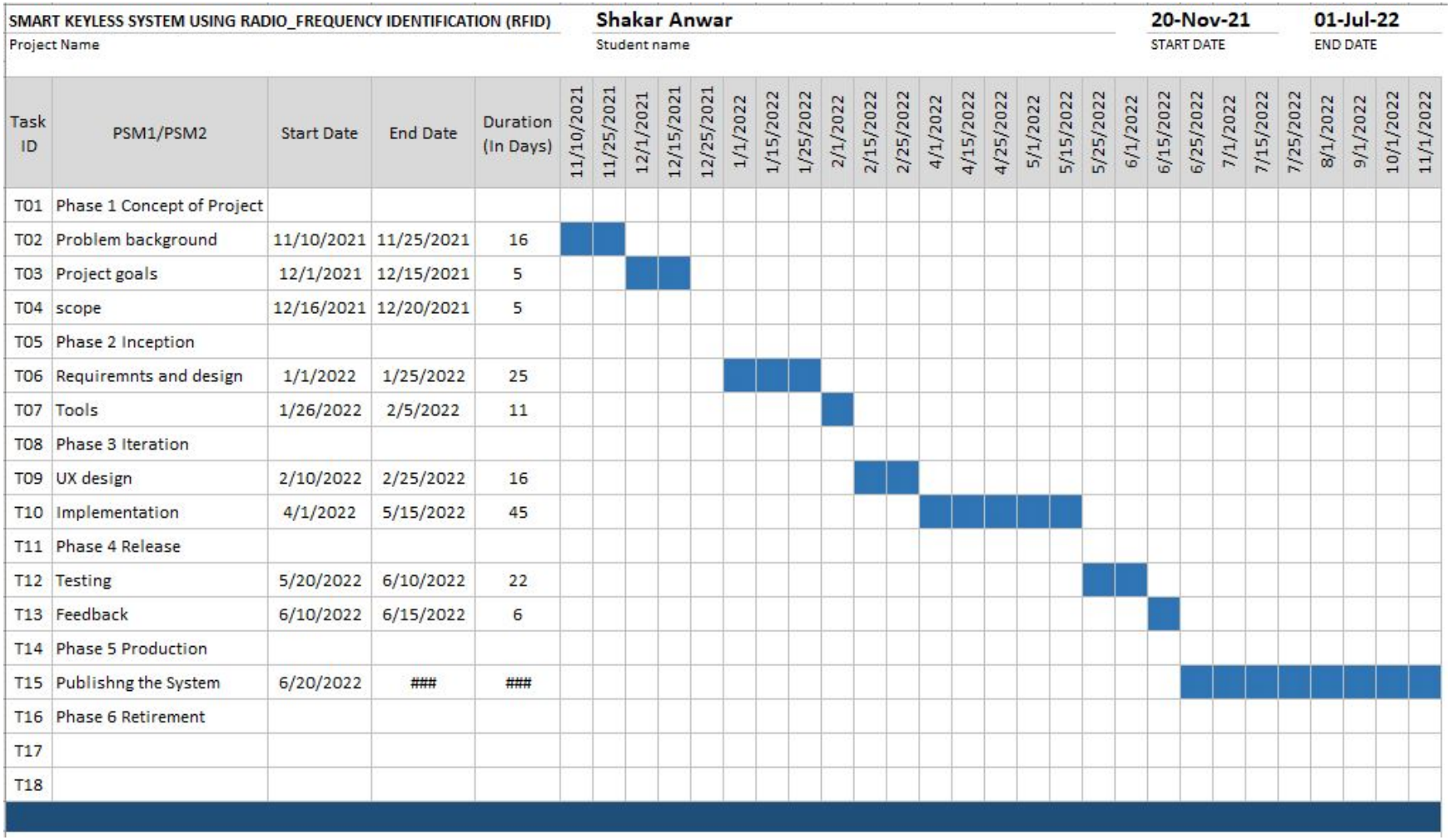
Appendix A Gantt Chart

SMART KEYLESS SYSTEM USING RADIO_FREQUENCY IDENTIFICATION (RFID)	Shakar Anwar	20-Nov-21	01-Jul-22
Project Name	Student name	START DATE	END DATE

Task ID	PSM1/PSM2	Start Date	End Date	Duration (In Days)
T01	Phase 1 Concept of Project			
T02	Problem background	11/10/2021	11/25/2021	16
T03	Project goals	12/1/2021	12/15/2021	5
T04	scope	12/16/2021	12/20/2021	5
T05	Phase 2 Inception			
T06	Requiremnts and design	1/1/2022	1/25/2022	25
T07	Tools	1/26/2022	2/5/2022	11
T08	Phase 3 Iteration			
T09	UX design	2/10/2022	2/25/2022	16
T10	Implementation	4/1/2022	5/15/2022	45
T11	Phase 4 Release			
T12	Testing	5/20/2022	6/10/2022	22
T13	Feedback	6/10/2022	6/15/2022	6
T14	Phase 5 Production			
T15	Publishng the System	6/20/2022	###	###
T16	Phase 6 Retirement			
T17				
T18				



Appendix B Coding Part

```
#include <SPI.h>
#include <MFRC522.h>
const byte SS_PIN = 10;
const byte RST_PIN = 9;
MFRC522 mfrc522(SS_PIN, RST_PIN);
String IDCard;
String IDCard_LAST;

const int rows = 3;
const int columns = 2;
String IDCard_List[rows][columns] = {{"77 4D B3 5F", "+9647701900991"}, {"43
8E 67 97", "+9647718962424"}, {"93 ED 81 97", "+9647701650195"}};
//String IDCard_List[rows][columns] = {{"77 4D B3 5F", "+9647700409503"},
{"43 8E 67 97", "+9647700409503"}, {"93 ED 81 97", "+9647700409503"}};
String NumberPhone = "";
String VerifyCode = "";
bool Verify = false;

long Timer = 0;
int Delay = 1;//ms
int TimeCalculation = 0;

#include <SoftwareSerial.h>
SoftwareSerial GSMSerial(2, 3); //SIM800L Tx & Rx is connected to Arduino #2 &
#3
String SMS = "";
int ResetCounter = 0;
int Duration = 60;

#include<Servo.h>
Servo myServo;
const byte Servo_PIN = 7;
const int OpenGate = 80;
const int CloseGate = 10;
int pos = OpenGate;

const byte Buzzer_PIN = 8;

void setup() {
  Serial.begin(9600);
  Serial.println("Start.");

  pinMode(Buzzer_PIN, OUTPUT);
//  GateOpen(OpenGate);
//  delay(2000);
//  GateClose(CloseGate);

  SPI.begin();
```

```
  mfrc522.PCD_Init();

  GSMSerial.begin(9600);
  GSMSerial.println("AT"); //Once the handshake test is successful, it will back to
OK
  UpdateSerial();
  GSMSerial.println("AT+CMGF=1"); // Configuring TEXT mode
  UpdateSerial();
  GSMSerial.println("AT+IPR=9600");//Tell the SIM900 not to autobaud
  UpdateSerial();
  GSMSerial.println("AT+CNMI=1,2,0,0,0");  //procedure, how receiving of new
messages from the network
  UpdateSerial();
  GSMSerial.println("AT+CMGDA=\"DEL ALL\"");
  UpdateSerial();
  GSMSerial.println("AT+CLIP=1"); //Calling Line Identification Number
  UpdateSerial();

  randomSeed(analogRead(A0));
}

void loop() {
  if(!Verify){
    IDScanner();
    TimeCalculation = 0;
  }
  else{
    TimeCalculation = 1000;
  }

  Timer++;
  if (Timer > TimeCalculation) {
    Timer = 0;
    if(IDCard != IDCard_LAST){
      IDCard_LAST = IDCard;
      Serial.print("ID Card: ");
      Serial.println(IDCard);
      for(int x = 0; x < rows; x++){
        //Serial.println(IDCard_List[x][0]);
        if(IDCard == IDCard_List[x][0]){
          Serial.println("Currect ID Card.");
          Tone(500, 500, 1);
          SendCode(IDCard_List[x][1]);
          break;
        }
      }
      if(!Verify){
        Serial.println("Wrrong ID Card!");
        Tone(1000, 100, 3);
        Reset();
```

```
    }
   }

   if(Verify){
    if(ResetCounter >= Duration){
     Serial.println("Failed.");
     Tone(1000, 100, 3);
     Reset();
    }
    else{
     GetCode();
    }
    ResetCounter++;
   }
  }
  delay(Delay);
}

void Reset(){
  ResetCounter = 0;
  Verify = false;
  IDCard = "";
  IDCard_LAST = "";
  NumberPhone = "";
  SMS = "";
  GSMSerial.println("AT+CMGDA=\"DEL ALL\"");
  UpdateSerial();
  Serial.println("Reset.");
}

void Tone(int Hz_, int Duration_, int Loop_){
  for(int x = 0; x < Loop_; x++){
   tone(Buzzer_PIN, Hz_, Duration_);
   delay(Duration_);
   noTone(Buzzer_PIN);
   delay(Duration_);
  }
}

void GateOpen(int Degree){
  Serial.println("Open Gate.");
  myServo.attach(Servo_PIN);
  Tone(200, 100, 1);
  for (pos; pos <= Degree; pos++) {
   myServo.write(pos);
   delay(2);
  }
  myServo.detach();
}
```

```
void GateClose(int Degree){
  Serial.println("Close Gate.");
  myServo.attach(Servo_PIN);
  Tone(200, 100, 1);
  for (pos; pos > Degree; pos--) {
    myServo.write(pos);
    delay(2);
  }
  myServo.detach();
}

void IDScanner(){
  if (!mfrc522.PICC_IsNewCardPresent() || !mfrc522.PICC_ReadCardSerial()) {
    return;
  }

  IDCard = "";
  byte letter;
  for (byte i = 0; i < mfrc522.uid.size; i++) {
     IDCard.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
     IDCard.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  IDCard.toUpperCase();
  IDCard.trim();
  //Serial.println(IDCard);
}

void UpdateSerial(){
  delay(500);
  while (Serial.available()) {
    GSMSerial.write(Serial.read());
  }
  while(GSMSerial.available()) {
    Serial.write(GSMSerial.read());
  }
}

void GetCode(){
  while(GSMSerial.available()) {
    SMS += (char)GSMSerial.read();
  }
  if(SMS.length() > 40){
    if(SMS.indexOf(NumberPhone) >= 0 && SMS.indexOf(VerifyCode) >= 0){
      Serial.println("Successful.");
      GateOpen(OpenGate);
      delay(5000);
      GateClose(CloseGate);
      Reset();
    }
    else{
```

```
      if(SMS.indexOf(VerifyCode) < 0){
        Serial.println("Wrrong Verify Code.");
      }
      if(SMS.indexOf(NumberPhone) < 0){
        Serial.println("Wrrong Phone Number.");
      }
      Tone(1000, 100, 3);
      Reset();
    }
  }
}

void SendCode(String PhoneNumber){
  Verify = true;
  NumberPhone = PhoneNumber;
  Serial.print("Phone Number: ");
  Serial.println(NumberPhone);
  GSMSerial.println("AT+CMGS=\"" + PhoneNumber + "\"");
  UpdateSerial();
  VerifyCode = CodeGenerate(5);
  Serial.print("Verify Code: ");
  Serial.println(VerifyCode);
  GSMSerial.print(VerifyCode);
  UpdateSerial();
  GSMSerial.write(26);
}

String CodeGenerate(byte Number){
  String Code = "";
  for(byte x = 0; x < Number; x++){
    Code += String(random(0, 10));
  }
  return Code;
}
```