
## Faculty of Electronics & Computer Technology and Engineering

# DEVELOPMENT OF WEB-BASED CLINIC'S PATIENT DATA MANAGEMENT SYSTEM USING ARDUINO AND MYSQL



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**Bachelor of Computer Engineering Technology (Computer Systems) with Honours**

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# DEVELOPMENT OF WEB-BASED CLINIC'S PATIENT DATA MANAGEMENT SYSTEM USING ARDUINO AND MYSQL

**NABLAH AMIRAH BINTI AZHA**

**A project report submitted**
**in partial fulfillment of the requirements for the degree of**
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Tajuk Projek : Development Of Web-Based Clinic's Patient Data Management System Using Arduino And MySQL

Sesi Pengajian : 2023/2024

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I declare that this project report entitled “Development Of Web-Based Clinic’s Patient Data Management System Using Arduino And MySQL” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

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Date : 15/2/24

Signature :

Co-Supervisor :

Name (if any)

Date :

## DEDICATION

*To my beloved mother, Noralisa, and father, Azha, who have been the source of inspiration and strength when I'm feeling down and giving up, who continually provide their moral, spiritual, emotional, and financial support*

*and*

*To dearest families, Izzati, Afiq and Afiif who shared their words of advice and encouragement to finish this project*

*and*

*To my friends, Allya Maisara, Farah Nabihah, Nurbalqis Bahirah and Nur Aini Solehah whose has contributed and guide me in completing BDP2, giving their thoughts, idea and solution that greatly help me in solving all the problems that occur in my journey to finish this project.*

*And lastly,*

*To the Almighty God, thank you for the guidance, strength, power of mind, protection and skills and for giving me a healthy life. It is because of your mighty power, I was able to finish this project successfully.*

## ABSTRACT

In the era of post-covid 19 where lots of thing still be done contactless as the habit to prevent the spreading of the virus still hard to die, the RFID technologies bloom rapidly as it seen as the solution to the problems to remain social distancing. RFID technologies that are seen as one of the most effective ways of conveying data from a distance swiftly and easily, even in the healthcare industry, in addition to helping to solve contactless problems. The increasing number of the patient registered everyday can no longer be handle manually as it seen not only not efficient but also cost lot of time and money in handling it. To overcome the problems that raised, the clinic's data management system with the implementation of the RFID technology is presented. The clinic's data management system is implemented by using the RFID cards and commonly used microcontroller, the Arduino UNO along with MySQL database for data storing. The RFID cards will be given to all of the clinic's patients to be used as their identification card on the clinic. They will be used to register the patients daily by tagging to the RFID module that connected to the microcontroller where data transmission from the module will be transmitted to the system's database which is the MySQL database. All the entries tagged by the RFID cards will be stored in the database and displayed on the clinic's management system. Through the system, the staffs and the doctors of the clinic will be able to view, change or update their patients data quickly and easily. By using the technology of the RFID for registering their patients, the staffs and doctors of the clinic will be able to focus on their work in managing their patient's data and at the same time, effectively help in caring for their patient's health. The usage of the papers as their documentation also can be reduce significantly and at the same time, more efficient in managing hundreds of data of the clinic's patients. The advancing technologies that keep blooming bring great changes to the sector of medical and health and the implementation of the RFID in it is one of them.

## *ABSTRAK*

Dalam era pasca pandemik COVID-19 di mana banyak perkara masih boleh dilakukan tanpa sentuhan kerana kebiasaan untuk mencegah penyebaran virus masih sukar untuk ditinggalkan, teknologi RFID mekar dengan cepat kerana ia dilihat sebagai penyelesaian kepada masalah untuk kekal penjarakan sosial. Teknologi RFID yang dilihat sebagai salah satu cara paling berkesan untuk menyampaikan data dari jarak jauh dengan pantas dan mudah, walaupun dalam industri penjagaan kesihatan, selain membantu menyelesaikan masalah tanpa sentuhan. Peningkatan jumlah pesakit yang mendaftar setiap hari tidak lagi boleh dikendalikan secara manual kerana ia dilihat bukan sahaja tidak cekap tetapi juga memerlukan banyak masa dan wang dalam mengendalikannya. Bagi mengatasi masalah yang dibangkitkan, sistem pengurusan data klinik dengan pelaksanaan teknologi RFID dibentangkan. Sistem pengurusan data klinik dilaksanakan dengan menggunakan kad RFID dan mikropengawal yang biasa digunakan, Arduino UNO bersama-sama dengan pangkalan data MySQL untuk penyimpanan data. Kad RFID akan diberikan kepada semua pesakit klinik untuk digunakan sebagai kad pengenalan mereka di klinik. Mereka akan digunakan untuk mendaftarkan pesakit setiap hari dengan menandakan modul RFID yang disambungkan ke mikropengawal di mana penghantaran data dari modul akan dihantar ke pangkalan data sistem yang merupakan pangkalan data MySQL. Semua penyertaan yang ditandakan oleh kad RFID akan disimpan dalam pangkalan data dan dipaparkan pada sistem pengurusan klinik. Melalui sistem ini, kakitangan dan doktor klinik akan dapat melihat, mengubah atau mengemas kini data pesakit mereka dengan cepat dan mudah. Dengan menggunakan teknologi RFID untuk mendaftarkan pesakit mereka, kakitangan dan doktor klinik akan dapat memberi tumpuan kepada kerja mereka dalam menguruskan data pesakit mereka dan pada masa yang sama, berkesan membantu dalam menjaga kesihatan pesakit mereka. Penggunaan kertas kerja sebagai dokumentasi mereka juga dapat dikurangkan dengan ketara dan pada masa yang sama, lebih cekap dalam menguruskan beratus-ratus data pesakit klinik. Teknologi maju yang terus mekar membawa perubahan besar kepada sektor perubatan dan kesihatan dan pelaksanaan RFID di dalamnya adalah salah satu daripadanya.

**ACKNOWLEDGEMENTS**

First and foremost, I would like to express my gratitude to my supervisor, Ma Tien Choon for his precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my parents for the financial support through BPD 1 and BDP 2 which enables me to accomplish the project. Not forgetting my fellow colleague, Allya Maisara, Farah Nabihah, Nurbalqis Bahirah and Nur Aini Solehah for the willingness of sharing their thoughts and ideas regarding the project.

My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Patient's information system is seen as the most important thing in the healthcare sector as it is the information that will be refer to by the medical staffs when handling the patient. Slight error can cause grave danger not only to the patient's health but also to the career of the medical staffs. Due to rapid increase in patient registration daily, the management of the clinic is seeking the system that can counter this problem efficiently and effectively with the expectation of being reliable, safe, and secured. The development of a system that can withstand the large amount of data daily, have a large capacity to withhold the said data that might gone through changes frequently and also have a quick enough response might help the rises problems of data management system. Although some doctors' offices and clinics continue to rely on paper records rather than digital copies of the same paperwork, there is no denying that digital copies are more convenient to use than hard copies. Both ways have their own benefits but if the uses of the paper can be reduced by implementing the RFID technology on the clinic's system, it is a better way in managing the patient's data and information for the clinics.



## 1.2 Addressing the Data Management of Patients That Raise Daily.

Illness is something that cannot be avoided and prevented all the time. With the aid of medicine and health consultation with the medical's staffs like the doctor, medical assistant and pharmacist, the rate in getting the illness can be lower but only with the right

information and care. It is important to be given a truthful and detail information to prevent grave danger from befalling the patient cause by misleading and untruthful information both by wrong medical history given and prescription of medicines taken in the past. To address this issue, it is important to understand the any new or change information conducted must be update immediately so that the patient wellbeing can be maintained. This is why the project of clinic patient's management system is conducted. By keep tracking and monitoring the patient's medical records, the consultation with the doctor or medical assistant and prescription of medicine for them using the RFID technology, a clinic patient's management system project can provide updated information that can help the medical consultation go smoothly and most importantly, towards error free.

## 1.3 Problem Statement

Patient's medical information consist of important information like the past consultation, the doctor incharged that gave the consultation, the medicine distribute from the consultation, the health check up done for the consultation, for every new medical consultation that will be conduct. All of these information poses great challenges to be maintained, displayed and updated from time to time to ensure the consistancy and reliability of the system for a long period. The doctors and medical staffs job are to taking care the patients solely but unfortunately, they are abandoned with other stuffs such as fill up all the documentation and paper work needed after the consultancy as those are also important for the future usage. All these medical staffs needs a system that can help reducing the current workload to allow them more focus on the patients. A system with the features that can help them updating their patients information quickly, have the availability of resources needed and at the same time simple and easy to understand can help tremendously even for the local clinics that didn't even have the rush that most big and local hospital have.

## 1.4 Project Objective

For this project, the main aim is to propose a systematic and effective methodology to handle and manage the clinic's patient's data with efficiency and have a good response's time. Specifically, the objectives are as follows:

a) To develop a clinic's patient data management system based on the RFID technology.

b) To store the clinic's patient data to the database using MySQL.

## 1.5 Scope of Project

The scope of this project are as follows:

a) The use of Arduino UNO in controlling the transmission of the data of the card reader to the linked database, blocking unwanted data or allowing the repetitive entries of the data.

b) The usage of RFID technology in card reader system to trasmit the ID of the patient to the linked database of the clinic's system.



c) Developing the MySQL database for the clinic's management system to store all the necessary information of the patients such as the doctors consultation, prescription of medicines and the total payments of the consultation.

d) Creating a web-based system for the clinic's management system that linked to the MySQL database as the interface for the staffs of the clinic to makes changes and updating the information of the patients.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

There is a lot of project had been developed in the past in order to help reducing the burden of the doctors and medical officers along with the intent of improving the qualities of the medical and health care. Some of it are successful but some did not cause by the complexity of the system or the refusal of the medical officers in changing their work habits. Habits is one of the things that hard to be changes but not impossible especially in desperate time or the constant pressing from other people and changes is need in the medical and health care sector. Lots of past project had proven that their system should be implemented for the betterment of the sector but without insistences, it would not be able to be done as overall. But insistences and pressing are not the only thing that can make changes from happening, a simple but user-friendly system can also be the encouragement for the people to start change their way of works. Which is why the developer of these system keep researching for a way to make a system even more simple but at the same time full of features that can benefit the users and more importantly, user-friendly.



## 2.2 Understanding the Problems Rises from the Current Lifestyle Habits

Now days, the habits of current lifestyles also contribute to the drastic rise of the healthcare problem. The lavish lifestyles where sweet and sugary foods and drinks that most of the people takes daily not only effecting the body but also exposing them to lots of diseases. Intake of medications also can contribute to the problems of health care as too many drugs taken by the body can harm the immune system. Though it is quite hard to

change the peoples thought, the changes in qualities of medical and health care can easily be made with new implementation of system to the sector, starting from the local clinics. As the people usually go the clinics first before the hospital to get medical treatments, the improvement needs to be started from here as the improvement from clinic will indirectly also improve the qualities and performance of the doctors of the hospitals. The doctors' job can never be reduced entirely as diseases is something unavoidable in this world but, with the improvement done to the local clinics, it can help the doctors of the hospitals greatly.

## 2.3 Literature Review

### 2.3.1 An Attendance System Design Based On RFID Technology

Attandance system design by [1] is an attandenace system that used the mobile interconnection technology, RFID technology and Wi-Fi technology in storing the data of their employees arrival and departure time into their database. The system that used the card reader shall be able to transmitting the information needed after the employees swipe it. The information such as the arrival time, the attandance status, the number of the employees and other nessecary information transmitted through the existing computer network and saving them into the database allow the enteprise in decreasing the burden and uneffiient past attandance system as it is low cost, simple operation, simple interface and easy maintenance. Hence, the system must be able to quickly read the card and get all the information needed and transmit it immediately into the system, also able to allow the modification to be done on the employees' information on the background and allowing the cancellation and activation of the cards.

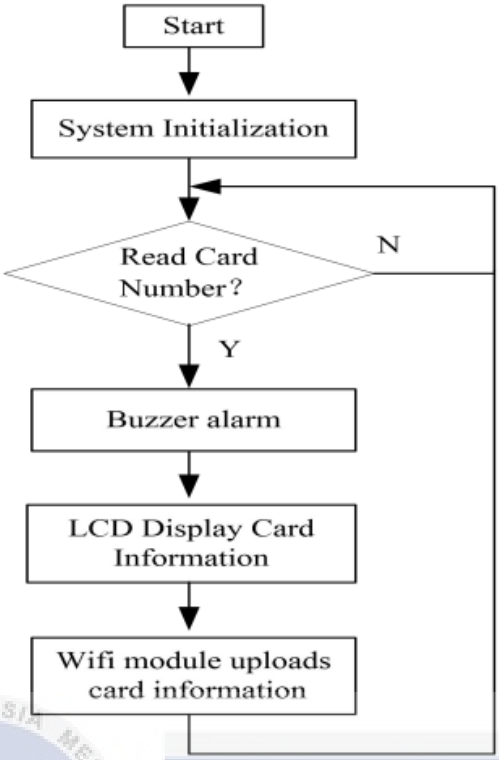


Figure 2.1 Card reader software flowchart [1]

### 2.3.2 Design Of Attendance Monitoring System Using RFID

Attandance monitoring system using RFID by [2] is design to maximize the technology of RFID and expressing certain concerns regarding it. As the issues regarding the attandance of the employees had become one of the most important issues on the companies as it closely enterwine with the payment of the employees' salary, a system of monitoring the employees' attandance by using RFID had been developed. RFID technology which is wireless equipment and able to move the data from the tag via radio waves is seen as an innovative idea in solving the issue arised. A RFID tags developed allows the administration in keep tracking their employee as the systems shall maintains the history and improve the safety of the company as the system shall ensure only accredit employee had access to the company. The developement of the attandance monitoring system also able to reduce the cost of the company as data storing of the attandance of the employee shall require less storage space compare to the previous.

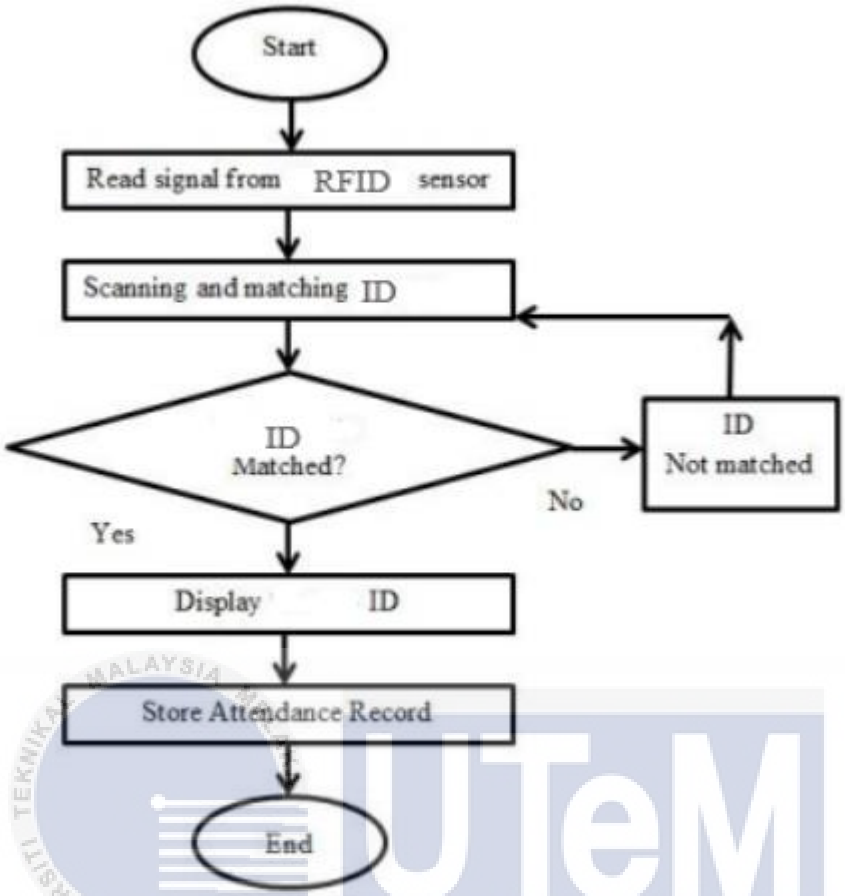


Figure 2.2 Flowchart of attandance monitoring system using RFID [2]



### 2.3.3 Smart Attendance System Using RFID and Face ID

Smart attandance system using RFID and face ID by [3] is an attandance system that used the face recognition and RFID tag corresponding with each other and the database to ensure the credebility and the user of it is the same one. The RFID tag that get in contact with the receiver module will connect to the database via the internet, transmitting both the RFID tag's information and also the image captured. All the information shall be processed and if all the information matched, the attandace shall be noted in the system and the LED on the hardware shall turn into GREEN light, informing the user of the success key-in attandance. If the opposite happen, the LED of the hardware will turn to RED light, indicating the failure of the attandance key-in and the user need to tag in again. After the

successful of the data key-in, the attandance shall be noted with nessecary informations such as the name, date, time entry, the department and roll number. The same process shall repeat again for the time of exit, the RFID tag need to be in contact with the receiver module and the face of the user shall be captured again. If all of the information matched, the same information shall be noted into the database but with the time of exit instead.

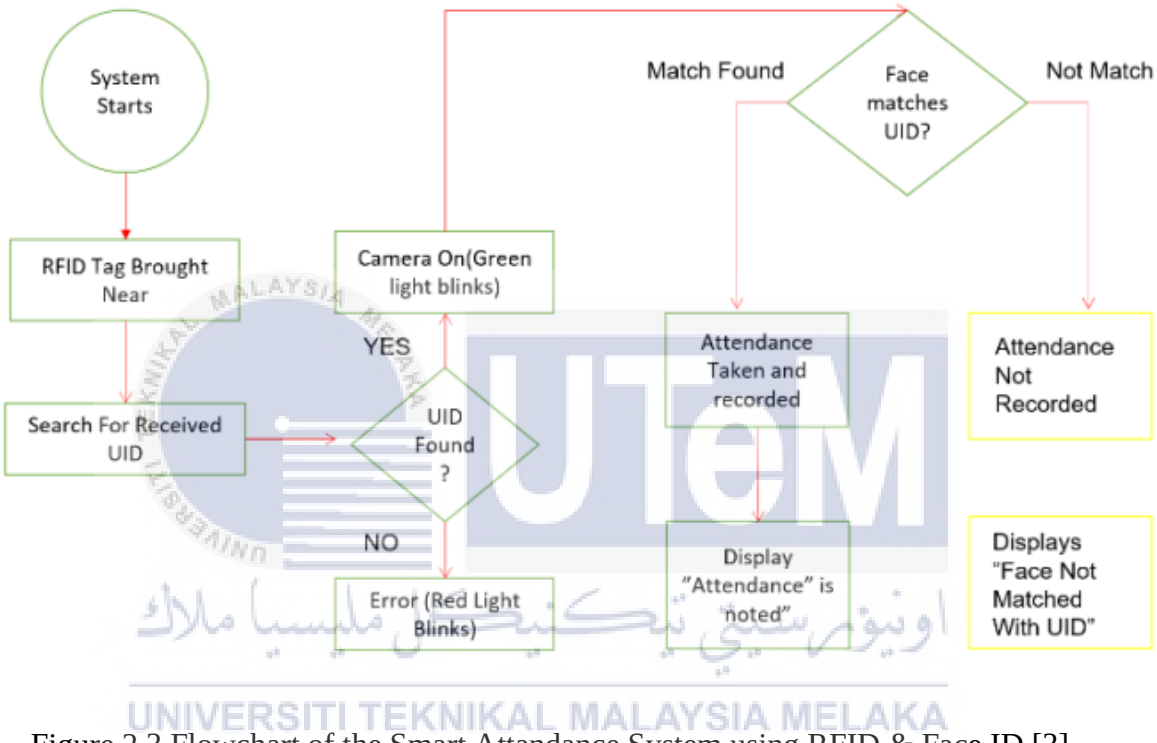




Figure 2.3 Flowchart of the Smart Attandance System using RFID & Face ID [3]

### 2.3.4 JomRFID Attandance Management System

JomRFID attandance management system according to [4] is a system designed for the use of university students which is simple and efficient, replacing the past traditional attandance system. The advance technologi of RFID shall be implemented by placing the chip on the student's matric card that shall be used in taking their attandance. It is not only an efficient way in taking the student's attandance, it is also save up the instructor's or lecturer's time and actively encounter the student's attandance problems where some of them signing up for their absent friends. The JomRFID attandance system shall have two specific

purpose which is to scan the student's chip and read the information that shall be connected to the database of the university and shall take note of the new information transmitted. The attandance system developed with the initiative to counter the problems regarding attandance of the students caused by the traditional and unreliable system of the past and to teach the students to be more hardworking and taking their attandance to the classes more seriously.

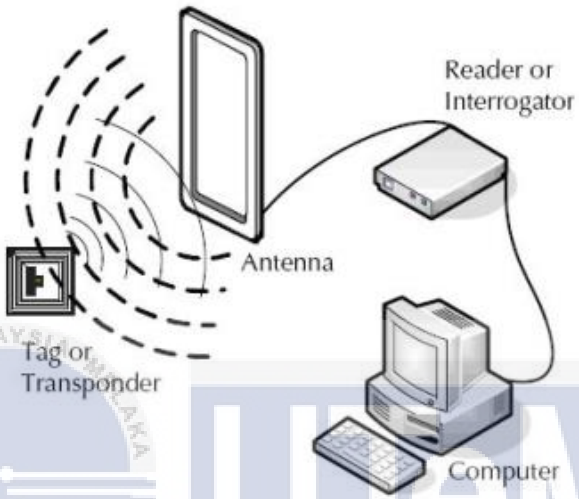


Figure 2.4 Overview of RFID attandance taking management system [4]

### 2.3.5 IoT Based Smart Attendance Monitoring System Using RFID

Based on [5], the process in taking the attandance that play very important role in any organization that are paper-based had the high chances of error that can easily be counter with IoT based smart attandance monitoring system using RFID. It seems as one of the most effective way in countering the problems most of the management of an organisation facing currently as several attemps had been made by several researchers of the field. Like most of the attandance's system that using the RFID technology, IoT based smart attandance monitoring system using RFID will implemented the ID card of the employee or students with RFID number in it where the system shall transmit the information when the card is swipe for the attandance taking processes. The card reader hardware shall be the intermidiate between the user and the system where the LED turn to GREEN light indicating the process

is succeed and into RED light should the process of taking the attandance fail where the user need to repeat the process again. The same process shall be done for the departure time, all the data gained from the process will be transmit to the database of the organisation for the records.

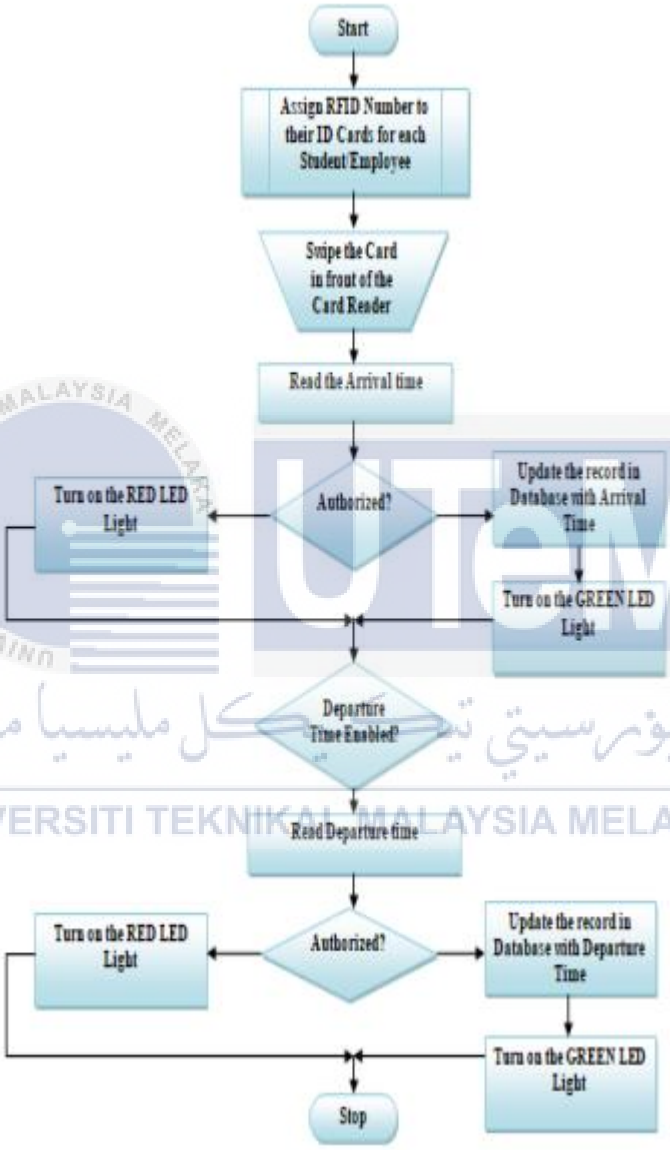


Figure 2.5 Process flow diagram of IoT based smart attandance monitoring system using RFID [5]

### 2.3.6 Smart School System With Single ID Based On RFID Through NFC Using FCM Notification

Smart school system with single ID based on RFID through NFC using FCM notification, based on [6], developed mainly for the purpose to be used for schools to overcome the problems that come from managing school's activities that being held daily. The system design based on the RFID technologies, will be using the single ID specifically for each students to identify them through the Near Field Communication (NFC) with smartcard reader applications installed on their mobile phone. Every school activities done by the students will be record by the smartcard reader applications with their ID and will automatically be updated to the database of the school's management system. With this smart school system, it will be easy for both the teachers, parents and also the administrator of the school to check the progress done by the students anytime and anywhere they wish to.

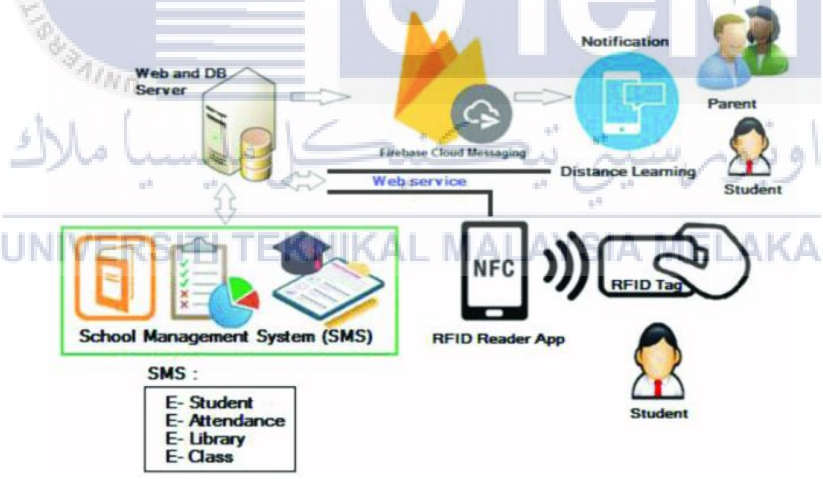


Figure 2.6 Smart School System Architecture [6]

### 2.3.7 Design Of An Efficient Authentication And Access Control System Using RFID

Design of an efficient authentication and access control system using RFID by [7] is seen as the effective way as the technology of the RFID had been used since the period of World War II in identifiying the military air crafts back from their missions. The current

RFID technology that had been enhanced with additional security features of digital signature system and can restricting the access of unauthorized person is seen as the solution of the current security problems that had rised. By using the Raspberry Pi, a secure communication between the clients and servers can be implemented by applying the cryptographic scheme on the client server based room access control system. A mutual authentication protocol based on hash algorithm which is applicable to mobile RFID, where the user's IDs are stored, is seen as the proposed solution for the problem regarding the authentication and authorization.

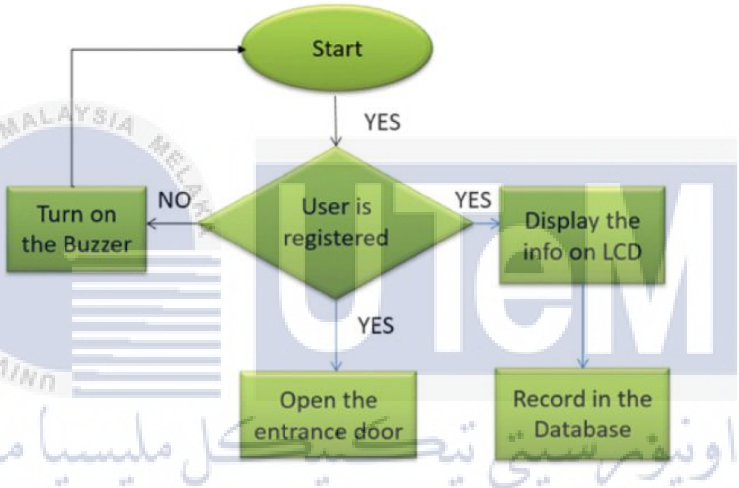


Figure 2.7 Architecture design flow of the efficient authentication and access control system using RFID [7]



### 2.3.8 Implementation On RFID Based Device Control And Authentication System

[8] developed a system with implementation on RFID based device control and authentication system as a suggested way in reforming the technology of access control systems, aligning with the latest technologies of Internet of Things (IoT) and smart gadgets that keep gaining popularity these days. The latest technology of RFID that had touched every aspect in the technology field, which makes it gain higher demand, not ony can be used for systems of data management but can also act as the security layer in protecting the asset of the organisation. RFID, which basically act with a tag that being put on a card reader

can become automatic identification technology that corresponding with the receiver and it's database. As it transmit the data to the database, the credentinality of the identification of the card can be checked and determine whether it is belong to authorize person or not. With this, the RFID technology become a security layer that help protecting the valuables assets of the organisation.

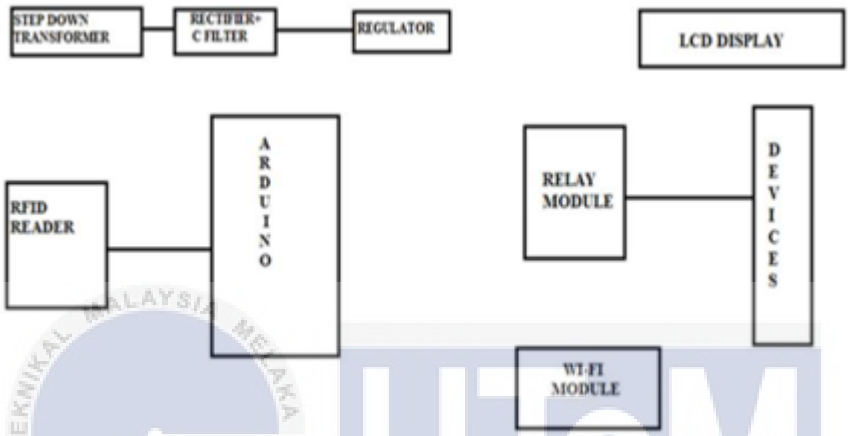


Figure 2.8 Overview of Device Control and Authentication System [8]

### 2.3.9 RFID Based Smart Ticketing System

RFID based smart ticketing system by [9] is a system developed to overcome the deforestation problems which the paper-printed tickets contribute to. RFID based smart ticketing system works by using the unique ID the user get when registering their own RFID card. The unique ID then shall be used when they registering into the system, making their seat's booking and other system's purposes such as displaying the fee of the ticket. The RFID's unique ID will automatically corresponding with the ticketing system's database that shall update every new action done by their registered user. With these, the deforestation problems that had become prevalent can be decrease with the RFID based smart ticketing system.

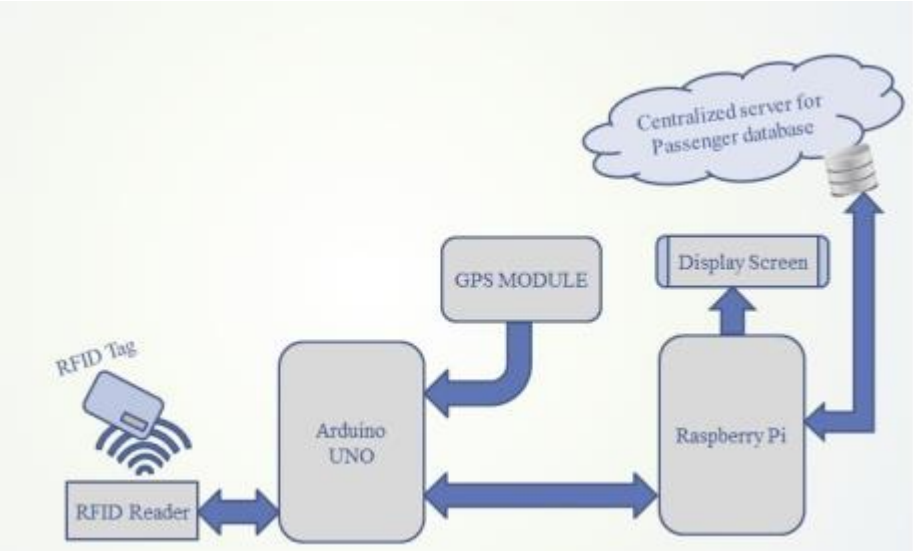


Figure 2.9 Block Diagram Of RFID based smart ticketing system [9]

### 2.3.10 Automated Toll Collection System Based On RFID Sensor

Automated toll collection system based on RFID sensor by [10] is a proposed solution for the traffic problems occur in Bangladesh caused by the time taken for the vehicles to get through the tolls. Automated toll collection system based on RFID sensor that can transmit data quickly is seen as the best solution to encounter the traffic's problem as the data and payment will be processes automatically and less time consuming, preventing vehicles being stuck on the toll's lane. RFID reader with tag on it with their unique ID will be used in tracking the vehicle's journey and receiver module will be put on the toll to receiving the necessary data and information also to recognize only the registered vehicles, allowing them to get through. With the system implemented fully for the tolls, all the transaction will be cashless and less time taken, reducing the traffic's congestion occur on the toll's lane significantly.

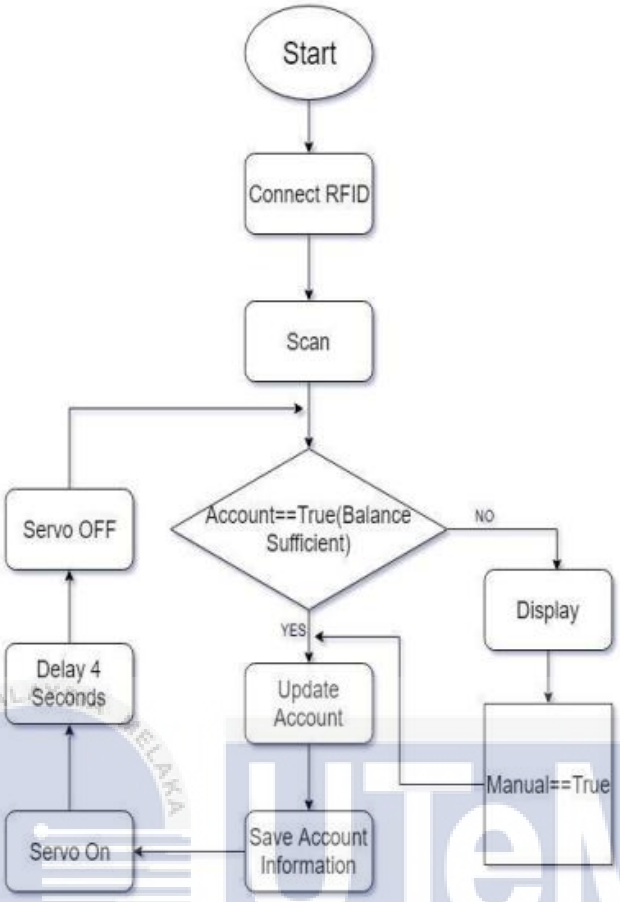


Figure 2.10 Block Diagram of the automated toll collection system based on RFID sensor [10]



### 2.3.11 Smart Warehouse Management System with RFID and Cloud Database

Smart Warehouse Management System with RFID and Cloud Database based on [11] project is a system developed for warehouse management. The RFID based system where it also use the object-detection and remote data-access from th cloud database is conducted to help managing the warehouse better. The system works with the RFID tag being put to every items and container inside the warehouse can easily be monitor from a far as the position of the items and container are stored into the cloud database beforehand. With the used of NODEMCU, a device that handling the cloud and data storation via the Wi-Fi and the Arduino that help controling the item's scan process makes it easier for the user to access the system remotely from the web or smartphone application. The huge storage of the

cloud database that allow lots of data storation in it makes it even more convinient to be use for the warehouses.

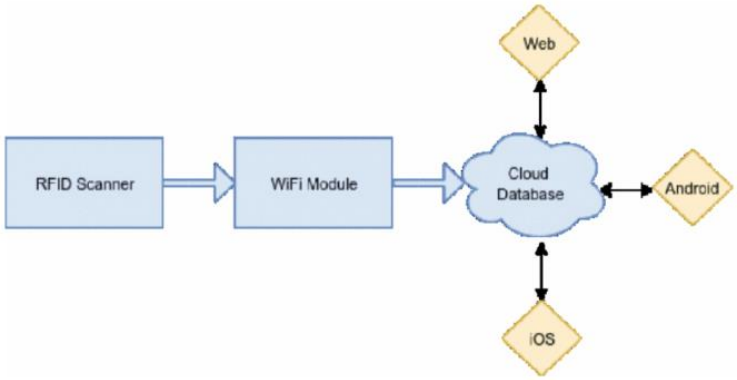


Figure 2.11 Block Diagram of Smart Warehouse Management System with RFID and Cloud Database [11]

### 2.3.12 Designing an Inventory Database Software Suitable for Small Business

Designing an inventory database software suitable for small business by [12], is developed to help the entrepreneur run their business at the peak time of Covid-19. Numerous nations have taken immediate action as a result of the rapid spread of Covid-19 and its identification. Many economic actors, not least innovative companies, have experienced an exogenous shock as a result of the lockout of significant portions of society and the economy. The study uses an example of an entrepreneur with inventory management issues to highlight the differences between the organization's current system and the suggested database system. A wireframe design is produced at the conclusion of this paper to help small business owners communicate with their clients more easily. The suggested database's wireframe designs are made with simple and user-friendly characteristic that will benefit both producers and consumers cause by the less complicated processing between them. Less supervision from the owner is possible thanks to a systematized inventory. The suggested database, which would be created using Microsoft Access database software, would be framed and built upon the wireframe. With a comparable foundation, small firms can utilize the suggested solution as well.

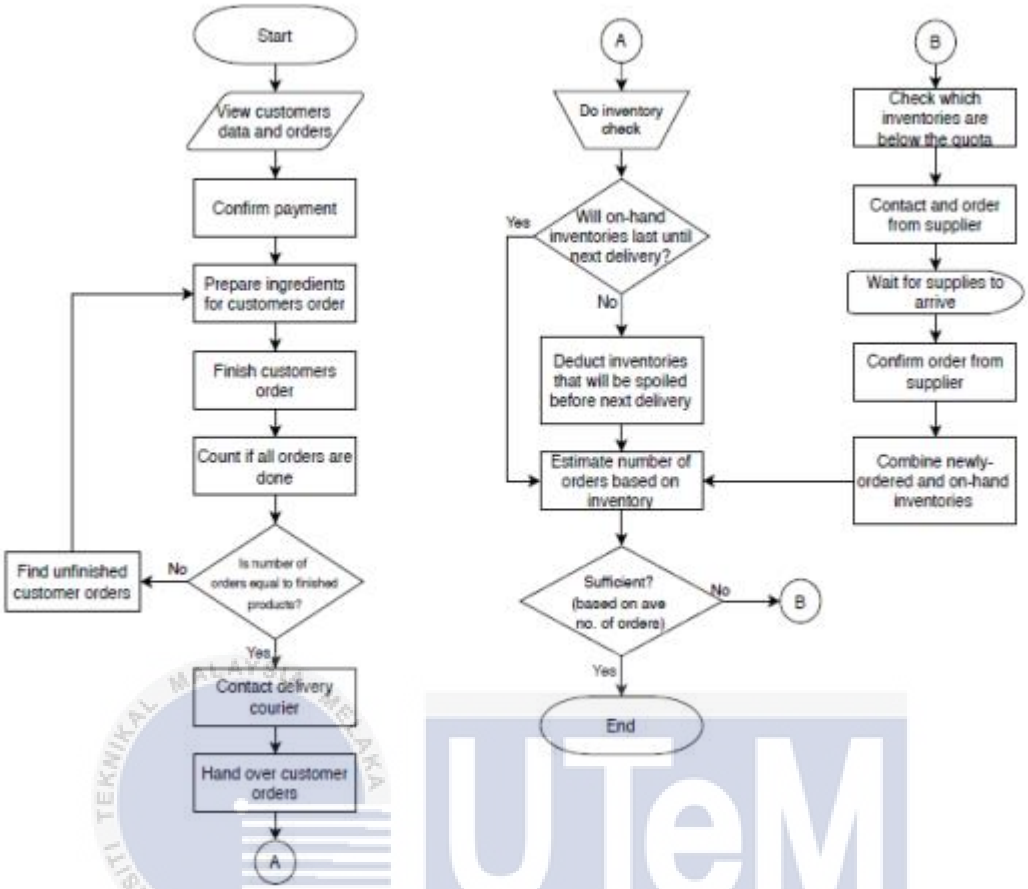


Figure 2.12 The present system in the business operation of the coffee company [12]

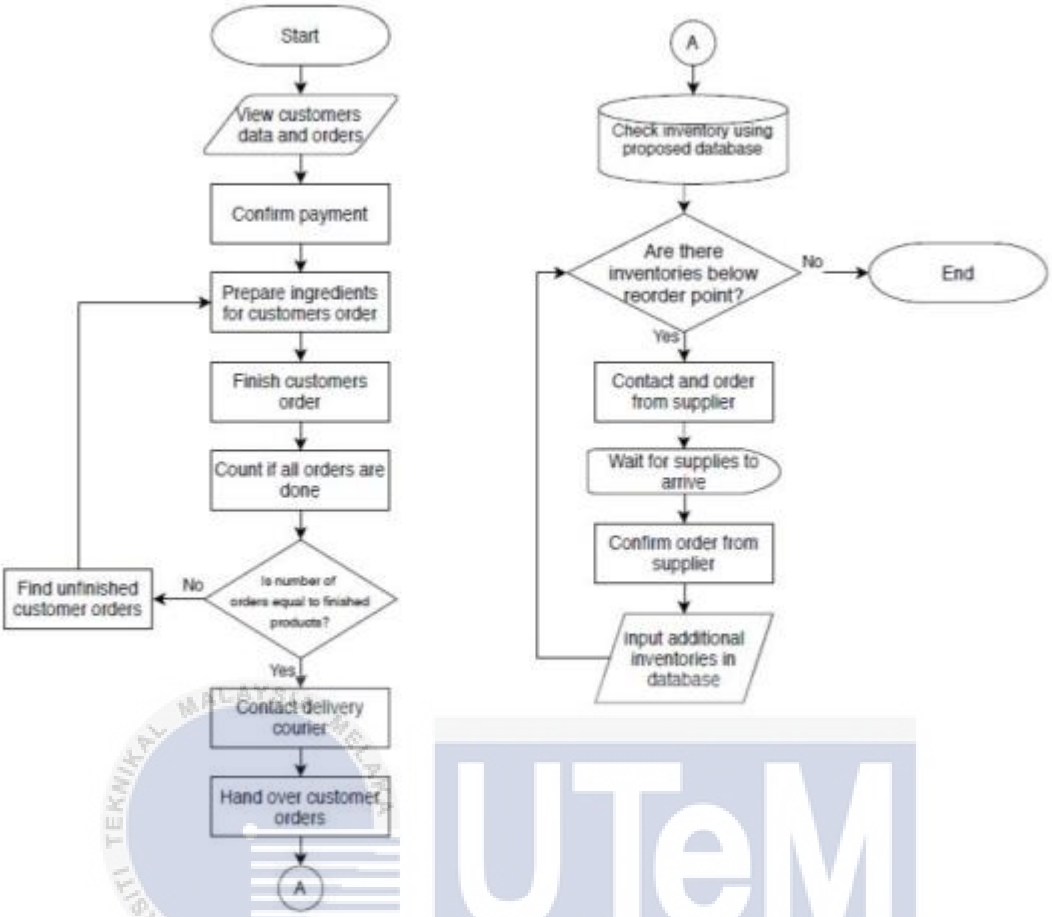


Figure 2.13 Utilization of the Microsoft Access database to the present system of the coffee company [12]



### 2.3.13 An intelligent health management system based on the internet of things (IoT)

An intelligent health management system based on the internet of things (IoT) by [13] is a system developed with the IoT technology and linked database for the system. Population aging over time, the prevalence of chronic diseases, and the rising cost of healthcare have all become major socioeconomic issues. In order to improve people's health and keep the overall expense of medical treatment under control, health management system adoption is a crucial link. This study develops an internet of things-based intelligent health management system and examines its architecture, functionality, and deployment process using hypertension monitoring as an illustration. People can use the system to check on their health status and quickly get medical advice while living at home. With regard to the

integrated prevention and treatment of chronic diseases, the system successfully transitions from a hospital-centered medical paradigm to a combined prevention and treatment model centered on family self-management.

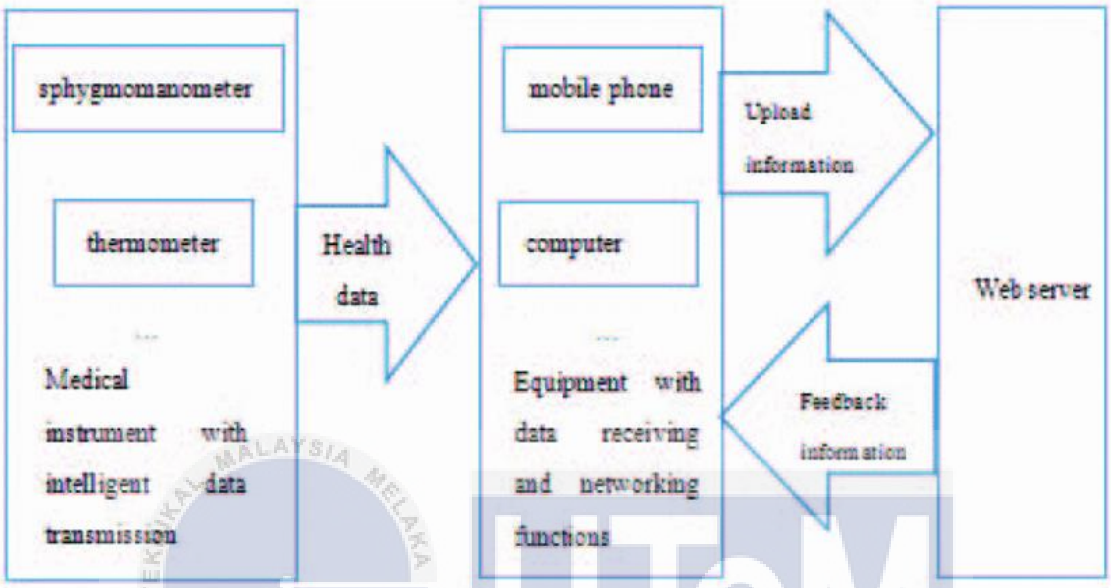


Figure 2.14 Intelligent health management system architecture based on the Internet of Things technology [13]

### 2.3.14 COVID-SAFE: IoT Based Health Monitoring System Using RFID in Pandemic Life



IoT Based Health Monitoring System Using RFID in Pandemic Life by [14] is a system that controling the patients'data with a single unique identification number which is the ID of the RFID tag itself on the hospital levels. As the self-isolation and social distancing was a mandatory at the time as the Pandemic of Covid-19 reach its peak, all the parameters such as the body temperature, height and weight that need to be recorded can be done with the help of IoT where a contactless sensor is being used to measure all of these thing and send the data to the database. The project which basely on the implementation of RFID tag and unique identification number for every different patients and connected to the database

where all the data stored in it can be access everytime and everywhere really help the doctors and medical staffs controlling and managing the patients of the pandemic on its peak time.

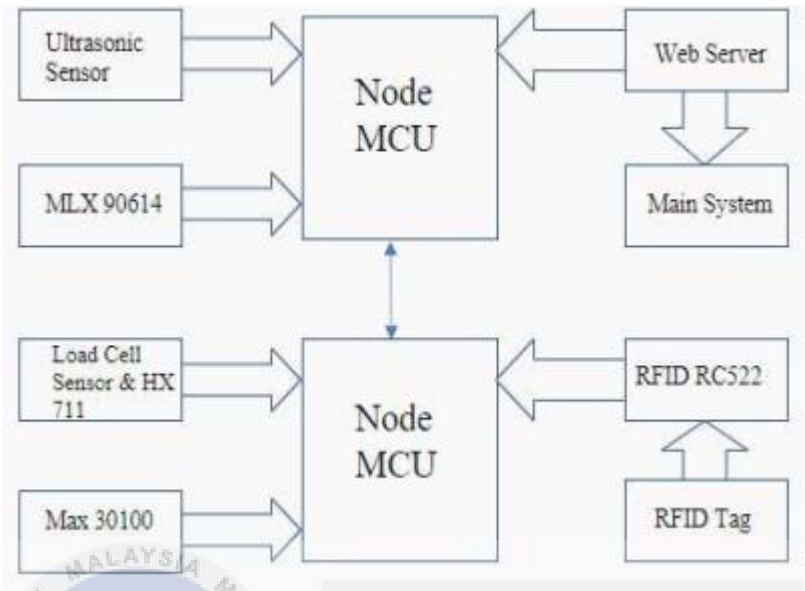


Figure 2.15 Block Diagram of IoT Based Health Monitoring System Using RFID in Pandemic Life [14]

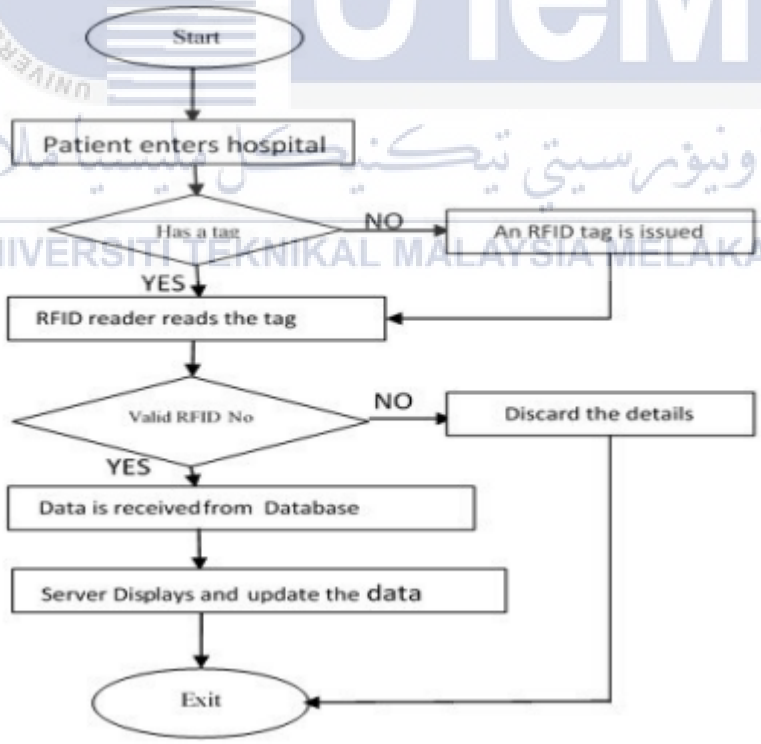


Figure 2.16 Flowchart of IoT Based Health Monitoring System Using RFID in Pandemic Life [14]

### 2.3.15 RFID System-used For Monitoring And Tracking Patient (MTP)

[15] had developed RFID system-used for monitoring and tracking patient (MTP) for the use of tracking the patient's medical informations such as the medicine given to them and other check-up histories, helping in assisting the medical staffs handling the patients better with the help of RFID and IoT technologies. With this system, the field of healthcare can be improve greatly in safety and efficiency as all of the processes can be done quickly and taken less time and at the same time, can be retrieve immediately no matter whenever or wherever they are. The main objective of the system developement are to ensure that the work of nurses and doctors be reduce in recording the patient's information so that they can focusing more in treating them instead, to expanding the capabilities of treating the patients with allowing the information interchanges between different servers so that they can go to wherever hospital they want, giving maximum protection and help to eldery patients that stay home alone and to provide proper informations to the family of the patient and hospital's staff that treating them so that proper treatment can be given immediately without waiting responses and information from other hospitals.



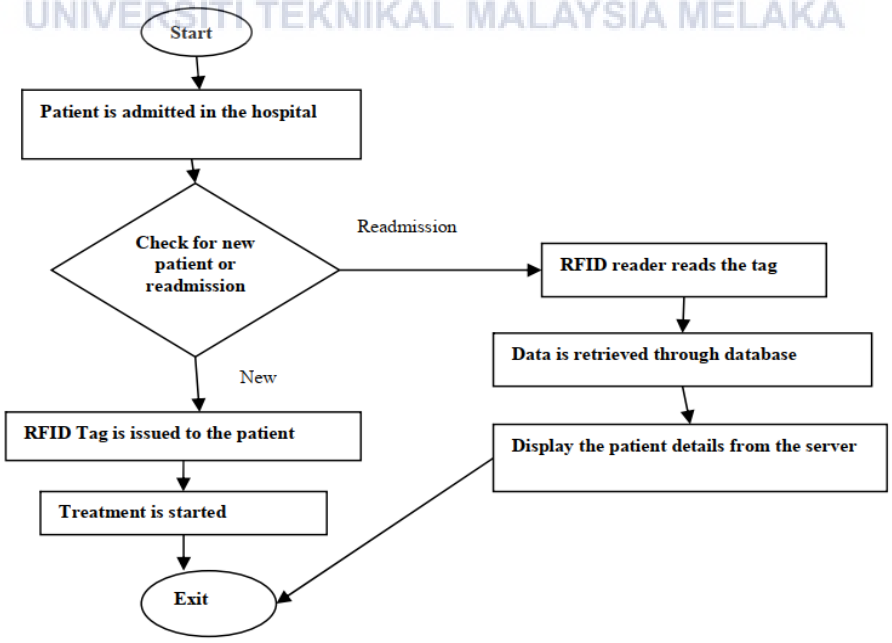


Figure 2.17 Flowchart of RFID system-used for monitoring and tracking patient (MTP) [15]

### 2.3.16 Design Of Doctor-Patient Management Platform Based On Microservice Architecture

Design of doctor-patient management platform based on microservice architecture by [16] is developed to help provided all the necessary resources that needed by the doctors and medical officer when treating their patients. Accidents usually occur caused by the lack or incorrect information of medical history of the patients can be prevent with the help of the Doctor-Patient Management Platform developed. The platform where both being used by patients and doctors, will send all the relevent data collected from the patients where it will be processed and synchronise from the cloud data warehouse to the hospital HIS system, which is hospital information system that store all the data for the said hospital. The doctor can then easily get all the data transmitted from the database quickly so that the best treatment can be perform on the patients as soon as they can. The data from the database that can also be view by the patient's smartphone not only can help the doctor of the said hospital but also all around the world to give the best treatment to the patients whenever and wherever they are.



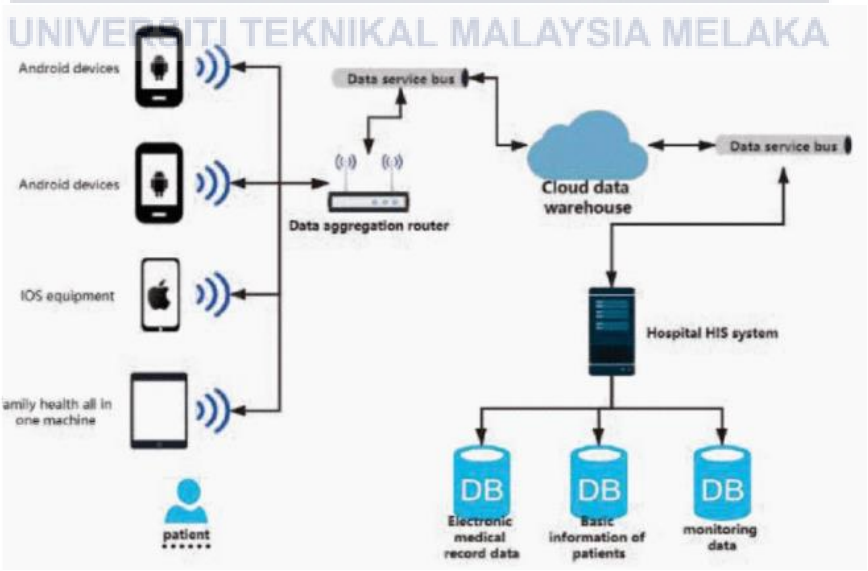


Figure 2.18 Network architecture of doctor-patient management platform based on microservice architecture [16]

### 2.3.17 Design of Cloud Computing Based Digital Inventory for Administration and Supervision of Hospices Patient Data

[17] had developed a system to manage patient information with a connected database. The uses of Matrix Laboratory (MATLAB) to design a simple information system is employed in numerous cutting-edge projects and for technological exploration. The main purpose is to create an HIS that the hospital administration may use to store patient data and maintain. The database can be managed, modified, or deleted by the administrator while the patient's information were entered by the receptionist. The doctors will be able to see data in the database, offering their suggestions and write prescriptions for medications that will be viewable by the pharmacy. The IoT-based ThingSpeak Cloud technology utilized in patient monitoring systems and the use of MATLAB by HIS would greatly aid hospital database management.

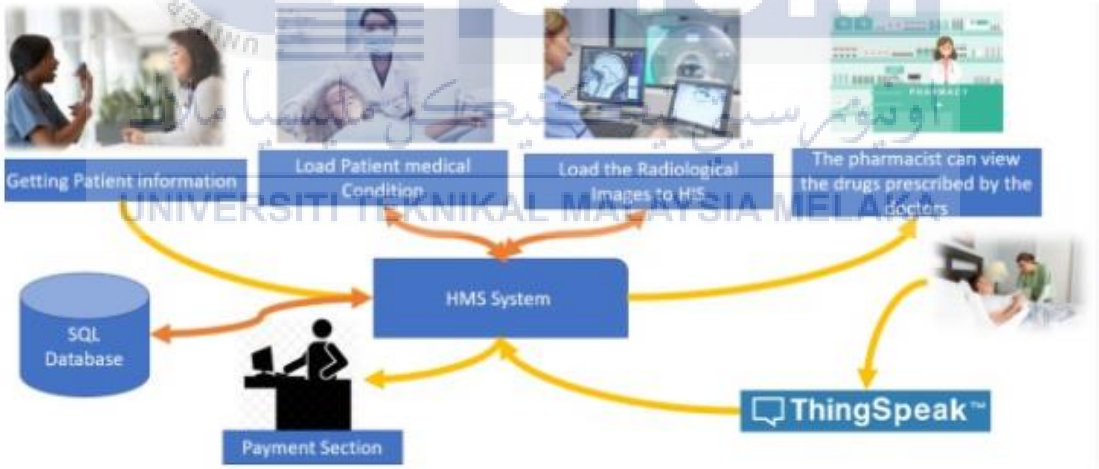


Figure 2.19 Block Diagram of Cloud Computing Based Digital Inventory for Administration and Supervision of Hospices Patient Data [17]

### 2.3.18 Design and Implementation of Intelligent Health System Using Big Data and Cloud Computing

Design and implementation of intelligent health system using big data and cloud computing by [18], had been design to increased health awareness and self-personal health

management. The use of personal health management systems can produce the best outcomes in health management as the system is examined and explored using big data technology so that its features can be more effectively utilized, its purpose can be more fully achieved, and the system can be used more effectively. In order to better play and fulfill the functions of the personal health management system, the system uses big data technology to evaluate and research the personal health management system. The function of managing one's own health encourages the system's perfect application. The personal health system uses database and research methods to design a personal health system that primarily implements the functions to managing the personal health information. It is simple and easy for the application users to view epidemic information whenever and whenever they are managing their personal health.

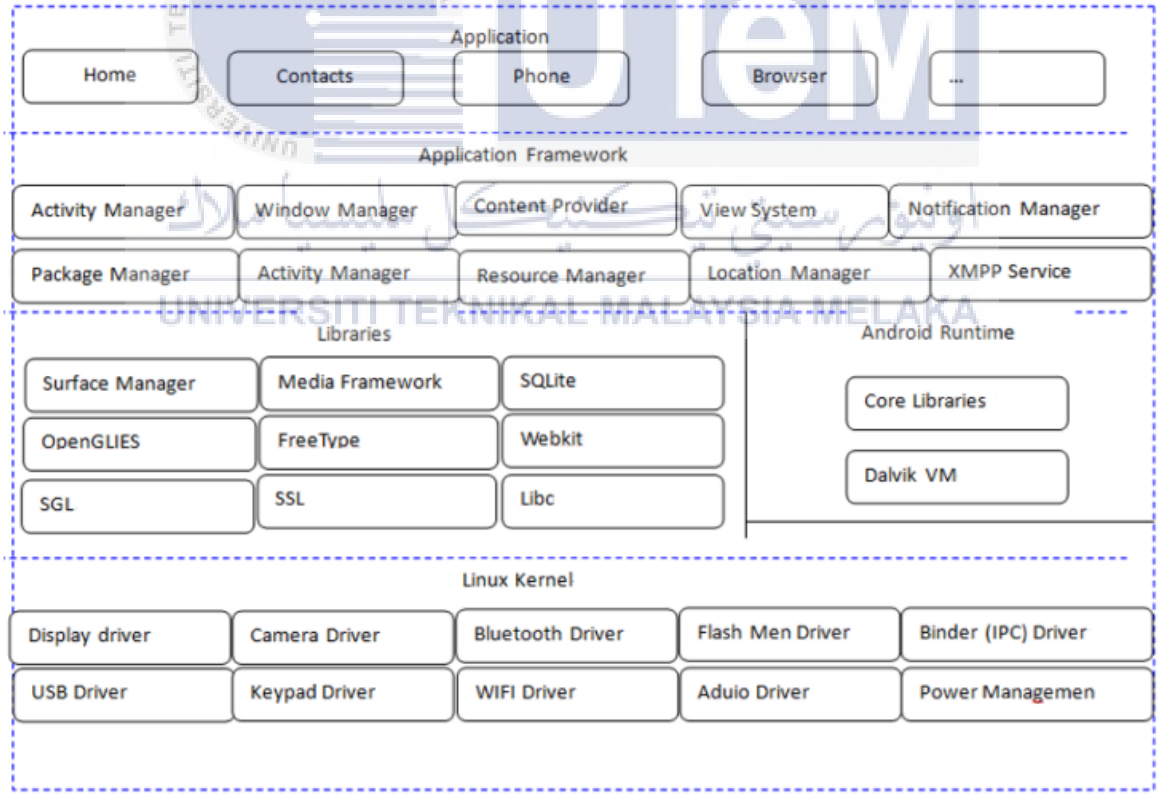


Figure 2.20 System framework diagram [18]

### 2.3.19 System Design and Effectiveness of RFID Introduction into Large Hospitals

System design and effectiveness of RFID introduction into large hospitals by [19] implemented the RFID technology for tracking in the hospital's inventory and surgical suplies that not only in large quantities but also varied in types and purpose. SIMSAFE, the tracking system for the surgical instrument works with putting the RFID tag into these instuments and connecting them to the terminal that will be installed on several locations on the hospital. As the surgical operation happen all the time at the hospital, the instruments for the operation must always be ready and on stand-by and needed a system that can not only keep monitoring but also keep tracking all these processes to ensure everything go smoothly and without problem. The technology of RFID that can read and transmit data and information quickly making it the best option in handling these problems. With tag on the instruments, all of the informations needed can easily be refer to the system from the database immediately by the staffs without disturbing the hectic schedules that always come with the hospital's staffs.




Figure 2.21 Flow of the surgical instruments used in an operation [19]

### 2.3.20 Smart Medical Health Card For Hospital Management

[20] had developed a system, smart medical health card for hospital management for managing their patients' data that keep increasing in numbers daily. As the purpose of technologies to help the human lives their life easier, a card reader implemented with the latest technology of RFID is seen as the best way in increasing productivity and also efficiently helping the hospital in managing thousands of patient datas. The implementation of smart patient management system help monitoring and keep tracking all the information the patient go through like the medicine administor to them, the check up done to them and other medical histories that is important for the doctor's records. Patient's information that can being stored in a card and can be used by the hospitals in retrieving the important information is really an effective solution for handling and managing thousands of patient's data for the hospital.

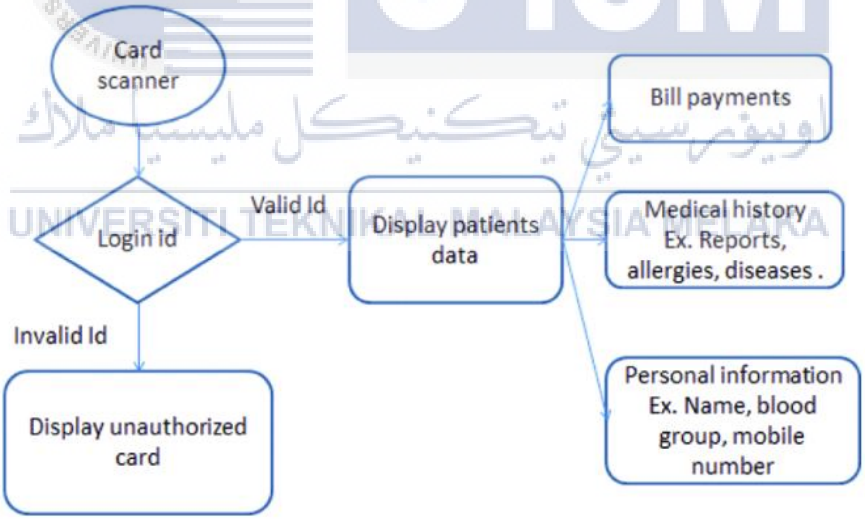


Figure 2.22 Flow of smart medical health card for hospital management [20]

## 2.4 Comparison Table

A lot of literature review have been research for this project's development. Lots of techniques, methods, hardware equipment and components along with software used on the researched literature review has been explored and evaluated to determine the best method, hardware and software part for this project development. Table 2.1 shows the summarization of the researched literature review conducted on the past project developed.

Table 2.1 Comparison table of RFID card reader technologies and database of management systems based on results obtained from past project developed.

| No. | Author / Years | Project Title | Component | Advantage | Disadvantage |
|---|---|---|---|---|---|
| 1 | Lijuan Shi and Qing Li, 2020 | An Attendance System Design Based On RFID Technology | Arduino UNO R3, MFRC522 RF module, RFID tag, NODEMCU ESP8266, I2C LCD1602, Database | Easy implementation and quick transmission. | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 2 | K. Aravindhan, S.K.B. Sangeetha, K. | Design Of Attendance Monitoring System Using RFID | Arduino UNO R3, MFRC522 RF module, | User-friendly system, less cost implementation, the | Require Wi-Fi connection for the data transmission |

| | | | | | |
|---|---|---|---|---|---|
| | Periyakaruppan, K.P. Keerthana, V. SanjayGiridhar and V. Shamaladevi, 2021 | | RFID tag, NODEMCU ESP8266, Database | system had the ability to keep tract the employee of the company and blocking unauthorize person from the company. | and connection to the database and needed of power supply to be on. |
| 3 | Rashmi A, S Brindha, Srinithin S B and Gnanasudharsan A, 2022 | Smart Attendance System Using RFID And Face ID | MFRC522 RF module, RFID tag, NODEMCU ESP8266, NODEMCU ESP32, IoT, Database | User-friendly system, the system had the security features by blocking unauthorize person from the company with the implementation of face recognition system. | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 4 | Q.Y. Tan, P.S. Joseph Ng and K.Y. Phan, 2021 | JomRFID Attendance Management System | MFRC522 RF module, RFID tag, Database | Easy implementation and less time-consuming for recording the data receive, | Require Wi-Fi connection for the data transmission and connection to the |

| | | | | | |
|---|---|---|---|---|---|
| | | | | help validating the rightful person with the unique ID. of RFID tag. | database and needed of power supply to be on. |
| 5 | Unnati Koppikar, Shobha Hiremath, Akshata Shiralkar, Akshata Rajoor and V. P. Baligar, 2019 | IoT Based Smart Attandance Monitoring System Using RFID | MFRC522 RF module, RFID tag, LED, Database | Easy implementation and less time-consuming for recording the data receive, help validating the arrival and departure time of the person by the data transmitted to the database | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 6 | Rokhmadi, Aghus Sofwan and Maman Somantri, 2021 | Smart School System With Single ID Based On RFID Through NFC Using FCM Notification | MFRC522 RF module, RFID tag, management system, mobile application, database | Easy implementation and less time-consuming for recording the data receive, help validating the arrival time of the person by the | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. Also |

| | | | | | |
|---|---|---|---|---|---|
| | | | | data transmitted to the database, had security features of login. | needed the mobile application for authorization to the system. |
| 7 | Khush Bakht, Amad Ud Din, Aiman Shehzadi and Maryum Aftab, 2019 | Design Of An Efficient Authentication And Access Control System Using RFID | Arduino UNO, RF reader, smart card RTC module, LCD display, Database | Easy implementation and less time-consuming for data transmission, had security features by only allowing validated person from the database information | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 8 | Raghavendra Ch, B. Lakshmi, P Naveen Krishna, C Sai Rama Krishna and A Sowmya Sree, 2021 | Implementation On RFID Based Device Control And Authentication System | Arduino UNO R3, RFID reader, RFID tag, NODEMCU ESP8266, Wi-Fi module | Easy implementation and less time-consuming for data transmission, had security features by only allowing validated person | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |

| | | | | | |
|---|---|---|---|---|---|
| | | | ESP8266, LCD display, Database | from the database information and save power as the system only turn on when needed. | |
| 9 | Shreya Andhale, Nirmayee Dighe, Akanksha Kore, Darshana Gaikwad and Jayasudha Koti, 2020 | RFID Based Smart Ticketing System | Arduino UNO, Raspberry Pi, RFID reader MFRC522, GPS module, LCD display, Database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the route taken from the implementation of GPS module. | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 10 | Sabbir Ahmed, Tamkin Mahmud Tan, Anna Mary Mondol, Zawad Alam, Noshin | Automated Toll Collection System Based On RFID Sensor | Arduino Mega R3, Raspberry Pi, RFID scanner, potentiometer, LCD display, Database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the | Require Wi-Fi connection for the data transmission and connection to the |

| | | | | | |
|---|---|---|---|---|---|
| | Nawal and Jia Uddin, 2019 | | | route taken and displaying the total payment needed to be pay on the toll. | database and needed of power supply to be on. |
| 11 | Mahmudur Rashid, S. M. Abdul Ahad, Shahida Siddique and Tamanna Motahar, 2019 | Smart Warehouse Management System With RFID And Cloud Database | RFID scanner, Wi-Fi module, Cloud Database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the item of the warehouse and displaying the information and location of it | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 12 | Sabbir Ahmed, Tamkin Mahmud Tan, Anna Mary Mondol, Zawad Alam, Noshin | Designing An Inventory Database Software Suitable For Small Business | Web-based system, mobile application, database | Easy implementation, user-friendly interface and less time-consuming for data transmission. Help | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |

| | | | | | |
|---|---|---|---|---|---|
| | Nawal and Jia Uddin, 2019 | | | the entrepreneur run the business easily online. | |
| 13 | Dong Wang, Honghe Wei, Yong Ji and Yufeng Shi, 2022 | An intelligent health management system based on the internet of things (IoT) | IoT, RFID scanner, mobile application, database | Easy implementation, had the ability to keep tracking the patients' data and submit it to the database for doctors' references | Require mobile application, Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 14 | Krishna Veni Sahukara, Mahesh Babu Ammisetty, G S K Gayatri Devi, Surisetty Prathyusha and T Sneha Nikhita, 2021 | COVID-SAFE: IoT Based Health Monitoring System Using RFID in Pandemic Life | NODEMCU, Max 30100 sensor, HX711 sensor, load cell and ultrasonic sensor, MLX 90614, RFID RC522, RFID tag | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit it to the database for doctors' references | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |

| | | | | | |
|---|---|---|---|---|---|
| 15 | Shivani Joshi and Avinash Dwivedi, 2020 | RFID System-Used For Monitoring And Tracking Patient (MTP) | RFID scanner, RFID tag, LCD display, web-based system, mobile application, database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit it to the database for doctors' references | Require mobile application, web-based application for user interface, Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 16 | Xiaomin Wang, Yue Chen, Jun Wang and Airong Yu, 2020 | Design of doctor-patient management platform based on microservice | Mobile terminal equipment, data service bus, Cloud data warehouse | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit it to the database for doctors' references. | Require mobile application, web-based application for user interface, Wi-Fi connection for the data transmission and connection to the database |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | and needed of power supply to be on. |
| 17 | N. Vigneshwari, M. Dhineshkumar, K.S. Anuvarshini, M. Anisha, M. Sushmitha and Ezhil E. Nithila, 2022 | Design of Cloud Computing Based Digital Inventory for Administration and Supervision of Hospices Patient Data | MATLAB, web-based system, mobile application, MySQL database, GSM interface with HIS software | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit it to the database for doctors' references. | Require mobile application, web-based application for user interface, Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |
| 18 | Xiaolei Zhong, 2022 | Design and Implementation of Intelligent Health System Using Big Data and Cloud Computing | Mobile application, Java Server Page (JSP), MySQL database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit | Require mobile application, web-based application for user interface, Wi-Fi connection for the data transmission and |

| | | | | | |
|---|---|---|---|---|---|
| | | | | it to the database for doctors' references. | connection to the database and needed of power supply to be on. |
| 19 | Eisuke Hanada and Tsutomu Sawa, 2019 | System Design And Effectiveness Of RFID Introduction Into Large Hospitals | RFID scanner, RFID tag, HIS system, database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the hospital instruments, doctor's schedules, patients' data and submit it to the database for references of hospital staffs. | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |

| | | | | | |
|---|---|---|---|---|---|
| 20 | Anagha Gharat and Gargi Phadke, 2022 | Smart Medical Health Card For Hospital Management | Arduino UNO, MFRC522 RF module, RFID tag, Database | Easy implementation and less time-consuming for data transmission. Had the ability to keep tracking the patients' data and submit it to the database for doctors' references. | Require Wi-Fi connection for the data transmission and connection to the database and needed of power supply to be on. |

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## 2.5 Summary

For years, most of the development of a system have been referring to the past projects developed with the intention to learn about the development processes, the objective and intention of the project, the benefits and also the limitation of those projects. It is an advantage to be able to research and learn of those past projects developed as a new idea may come out from it or improvement being made for the future projects. Based on the researched literature review conducted, the implementation of the RFID system in recording and managing the attendance or in this project, the registration of the clinic's patients is seen as the best solution. The usage of the Arduino UNO microcontroller and MySQL database that widely being use in developing new project also being chosen to ensure that this project can be done effectively, achieving all the objectives of the project as overall. Understanding the theories, concept, ideas, objective of even the technologies is a must and one of the important process in project development to prevent obstacles coming from unprepared or unrealistic project development.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

In general, accuracy and effectiveness are considered one of the most important elements in developing a project. Without valid and suitable data, the output display shall mean nothing and invaluable. In the field of health care, every data is important and slight mistake can lead to something fatal, which is something that need to be prevented. The availability of the data also important so that actions can be taken immediately in life saving. Project implemented need to have all the features so that these problems can be counter and enhancing the health care and medical field largely. Every aspect need to evaluate properly so that all the equipment, components, system and database that will be develop can meet all the criteria of the features needed, able to receive and counter all of the information that they receives daily, able to sustain all the tasks programmed for them and can also be maintain for a long period of time.



## 3.2 Selecting and Evaluating Tools for a Sustainable Development

In designing and implementing a data management project with a focus on availability and sustainability, selecting and evaluating tools that shall be used need to be done carefully to ensuring that it can performing the tasks given and needed of the system. The tools that shall be chosen should also need to be able to understand the concept that shall be implemented, the algorithm that shall be used and also had the important features needed in development process of the project. An advance tools or system can be used but shall it does not need in the project's features, it may only be a redundant and space consuming and

also decreasing the performance of the systems significantly. Tools that too simple and easy to be use may also need lots of patch-up or updates to be able to perform effectively for a long period of time. So, the tools chosen for the project must be select and evaluate carefully and specifically to prevent the problems occur for the near future. Every specification needs to be check and features implemented be confirm so that great performance can also be achieve and at the same time, the maintenance of the program is cut to the minimal. Figure 3.1 shows the block diagram of the Clinic's Patient Data Management System by using the RFID module and the Arduino UNO microcontroller connect to the MySQL database and the web-based clinic's data management system.

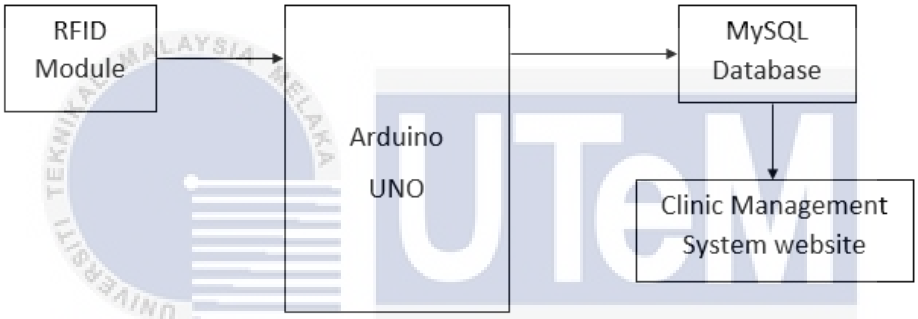



Figure 3.1 Block diagram of the Clinic's Patient Data Management System



## 3.3 Methodology

This documentation presents a new approach in managing the vast data obtain daily by the patients of local clinic that need to be handle immedaitely and quickly so that proper action can be taken by the doctors and staffs of the clinic in taking care of their patients. The flowchart in Figure 3.2 shows the general process of the clinic's data management system daily while for Figure 3.3 and Figure 3.4 show on how the clinic's patient data management system project register the patients and how it work when the RFID card is tag in, helping the clinic's staffs handling the new information obtain daily, storing it into the database and updating to the clinic's system after gaining new information to be stay updated, both for the staff's and doctor's side respectively.

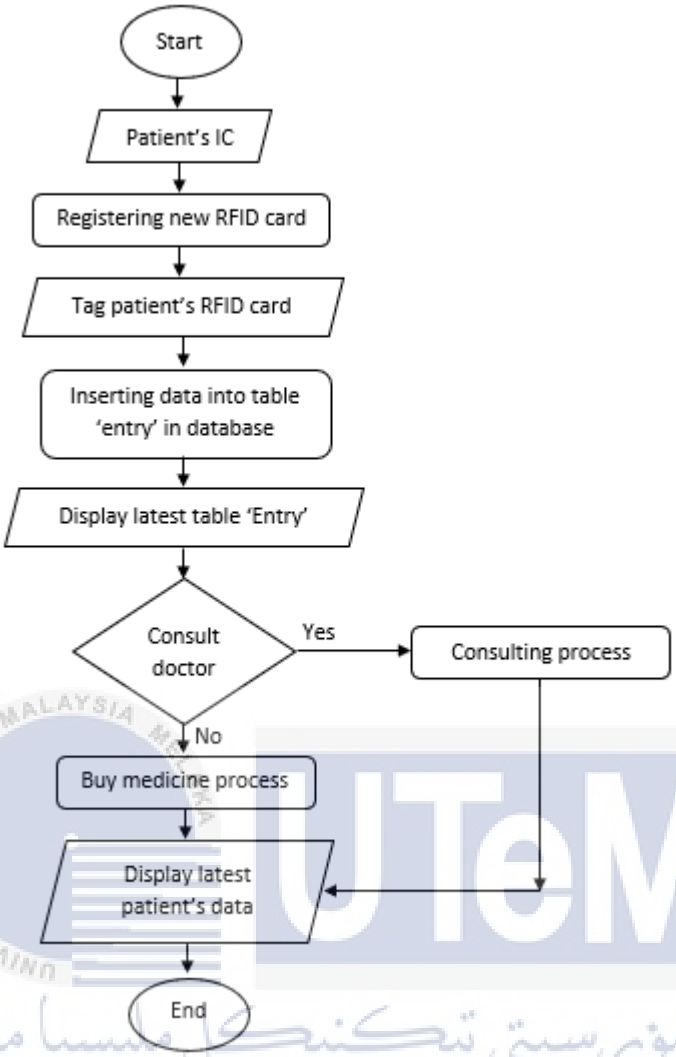



Figure 3.2 The flowchart of the Clinic's Patient Data Management System

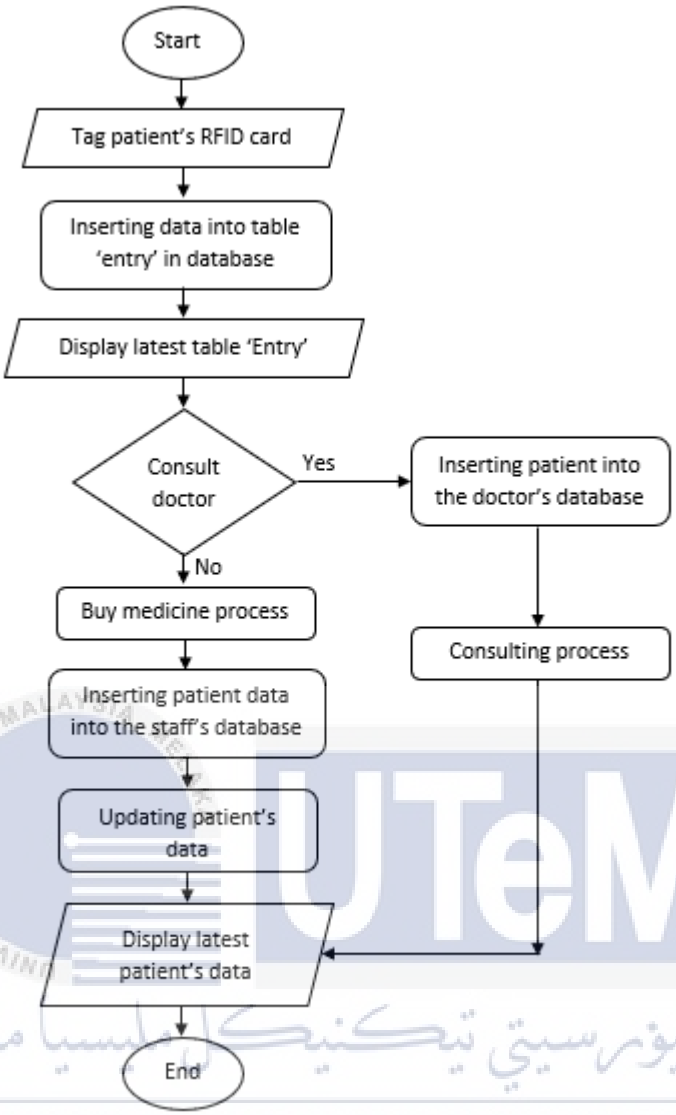





Figure 3.3 The flowchart for the staff's side of the Clinic's Patient Data Management System

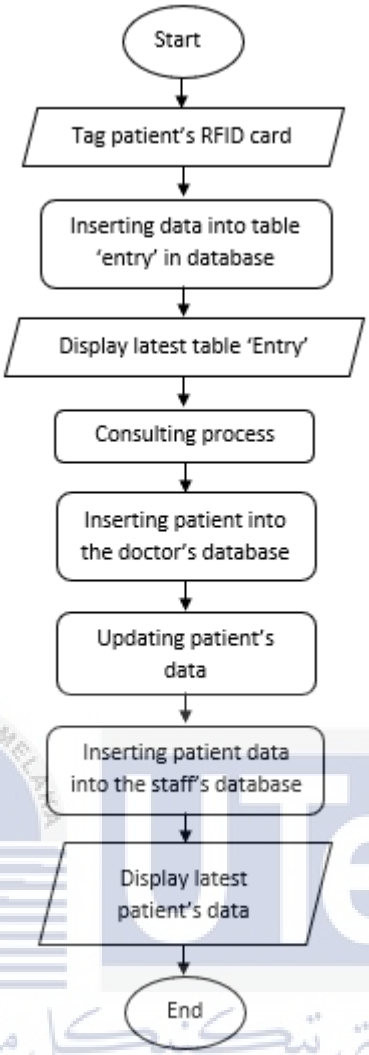



Figure 3.4 The flowchart for the doctor's side of the Clinic's Patient Data Management System



### 3.3.1 Experimental setup

The use of Arduino UNO as microcontroller that control the data display that needed by the system through the codes programmed on the Arduino IDE and pyhton IDLE. The algorithm codes programmed allow all the data entries from the RFID module being recorded whether for one time only or multiple times entries, limiting the data recorded into the database with only the value of the unique ID of the RFID card.

The RFID module is one of the major component needed for the clinic's patient data management system project as it act as the identification card for all of the patients where

the unique ID of the card act as the unique number that link to the database of the clinic to several information of the said patient. Most of the local clinics used the number of the identification card (IC) of the patient as their patients ID as it also unique for every person but with the implimentation of the uses of RFID card, the usage of the identification card (IC) can be reduce and the exposure of the said number being minimalise.

MySQL database, as one of the major purpose of it in data management, is use to store all the patients data that had been recorded whether from the RFID card or directly from the web-based system. The database of MySQL also allow the manipulation of the data will be link to the Arduino UNO and RFID module, displaying all the data needed based on the command of the algorithm of the Arduino IDE and python IDLE. The phpMyAdmin, a tools that will act as the middle-man between the user and database of MySQL also allow the user to update and makes changes to the data stored in the database easily and quickly.

#### 3.3.1.1 Equipment

- **Arduino UNO**

For the data management project, Arduino UNO, shown in Figure 3.5 has been used as the microcontroller in controlling all the transmitted and displayed of the data needed for the program. The used of Arduino instead of Raspberry Pi is seen more suitable as the Arduino is usually being used in developing projects that contain hardware connected while for the Raspberry Pi, it is more suitable for the software-based projects development.

Figure 3.5 Arduino UNO

- **RFID module**

Figure 3.6, the RFID module and cards are used as the identification card used for the clinic's system to easily differentiate different patients and easy access to the details of patient through the unique ID of the RFID card. It is also seen as the suitable approach in reducing the exposure of the identification card (IC) which is a private and confidential and also not suppose to be given to any other person easily.



Figure 3.6 RFID cards, keychain and MFRC255 module

- **MySQL Database and phpMyAdmin application**

MySQL database is one of the common database used for data storing in data management system project. It is an open-source and quite easy to be implemented make it as one of the suitable database for this project. Not to mention the phpMyAdmin, Figure 3.7 is a tool and application used to handle and manage the MySQL database make it easier to the MySQL database. phpMyAdmin which is written in PHP also allow the creation of the web-based system that directly connected to the database of MySQL, make it easier for project that intended in making the web-based system like clinic's patient data management system project. Figure 3.8 shows the example of the data stored in one of the tables created for the system's database.

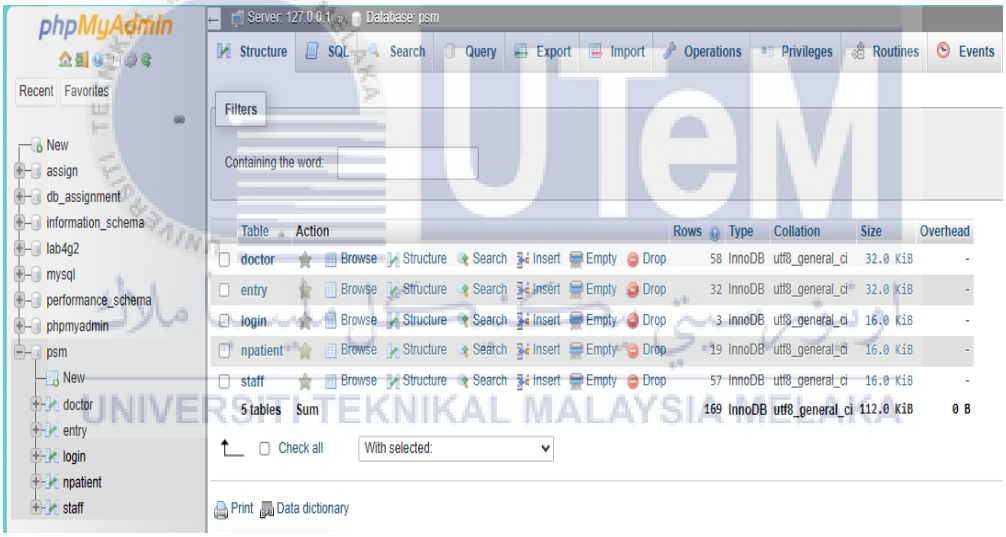



Figure 3.7 MySQL database on phpMyAdmin interface

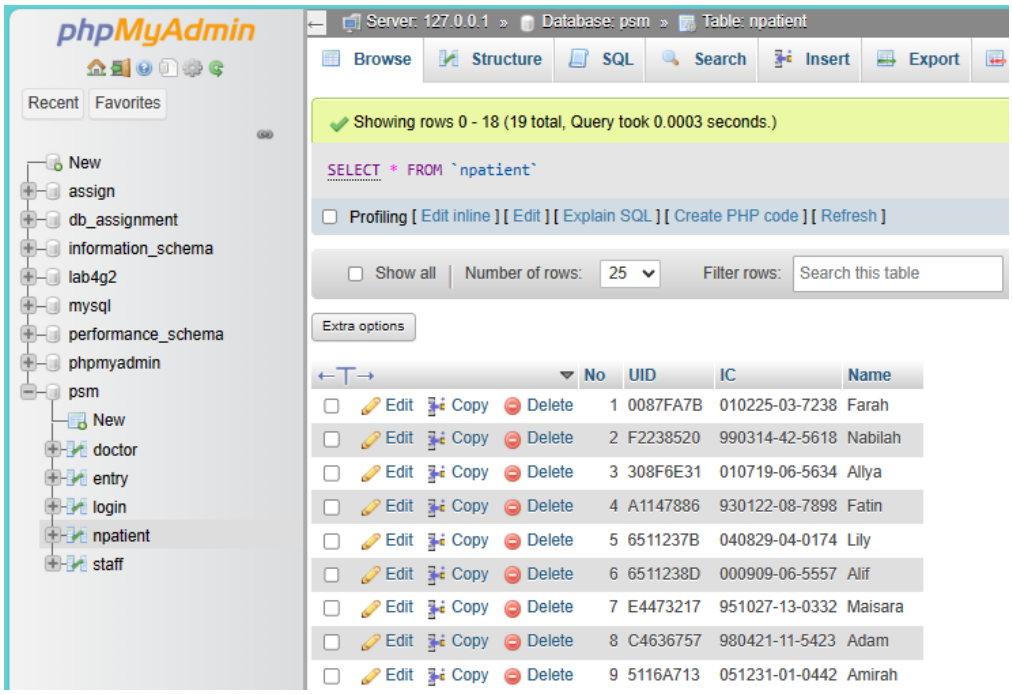


Figure 3.8 Example of information store in MySQL database in phpMyAdmin

## 3.4 Limitation of proposed methodology

Every system is develop with the purpose of helping in solving the problems rises. The develop of the system will tries to achieve every requirements and expectations given but not all as all things have their own limitations, no matter how advance the system they use. Limitation is something that cannot be prevented when a new system being develop and it is the same for this project.

Clinic's patient data management system may help the clinic's staff managing their documentation better but unfortunately, it is not applicable to the other clinics. Should a new patient come, they will be needed to register as the new patient of the clinic and their past medical history from the other clinics will not be available for the staffs. The patients will might be needed to contact the other clinics for their important medical record should it needed for their health consultation, which is inconvienent to them.

The other limitation of the system is should the RFID card reader went missing, the attendance of the patient cannot be recorded into the system and the consulation process will

not be able to conduct. It is because the patient new record can solely be added only after the system record a new entry. The only way to solve the problem of the missing RFID card is to register a new card for the patient which not only complicating the consultation process as the same information being registered in the system twice but also not relevant and systematic as the system might not be able to hold the same information for two different RFID card in the clinic's database.

The clinic's management system also not available for the patient to be view as it can only be access by the clinic's staffs. The patients will still needed the references from the doctor should they need to buy any specific medicine at the other clinics or pharmacies. The usage of paper that act as the refer letter will still be needed which might not be convinient as should the patient lost the refer letter, they might not be able to get the medicine they needed for their health.

Another limitation of the clinic's management system is the lack of appointment scheduling and a notification pop-up as a reminder. As the system is developed for the clinic's staffs to manage their patients' data and information with the website as their system interface, the scheduling features is seen as not something that too significant as most of the private clinic's out there will provide a refer letter for the schedulling consultation or medication for their patients at the government clinics or hospital. As for the notification for the scheduling reminder, it is not suitable for the web-based system as it will only be activate when the website is open, unlike the mobile application where it will notify their user whenever it needed.



## 3.5 Summary

This chapter presents the proposed methodology for the development of clinic's patient data management system project. All the tools and equipment along with the work

flow of the system is explained in this chapter to show how the overall work of the project properly and all the purpose of the proposed equipments and components. The limitation of the project also had been explain to understand more about the proposed project. This project develop with the purpose of helping the management of data for local clinics, decreasing the use of documentation that usually needed in handling the patients data and also reducing the time taken for handling those documentation, allowing them more time for the interaction between the clinic's staff and patients when they come for consultation.

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## 4.1 Introduction

This chapter presents the results and analysis along with the system evaluation that have been obtain for the clinic's data management patients project conducted by using the Arduino UNO, RFID tags and module and the MySQL database. The connection between Arduino Uno, RFID module and cards along with the MySQL database using the Arduino and python code for RFID MFRC522 that allow the entries of the RFID card that had been tag on the RFID module being recorded instantly into the MySQL database and display it on the website of the Clinic's Management System. All the features, functions and information needed for the system were program on the Arduino IDE, python IDLE, phpMyAdmin and JavaScript so that the whole system can run and function fully and smoothly.



## 4.2 Results and Analysis

The results obtain from the complete flow of registration patient at the clinic daily. The system recording every RFID card tags on the RFID module for every entries even for a short period of time so that it can record every access done on the system. It is to ensure that every new data recorded and updated to the right data entries and should any problems occure, the staff of the clinic can trace back through the data entries of the clinic.

### 4.2.1 Login System

The login page for the Clinic's Management System as shown in Figure 4.1 is where the staffs and doctor of the clinic have their own specific ID and password, ensuring that they only have access to their website of staff or doctor only for security measure. The doctor or the owner of the clinic will have both staff's and doctor's ID and password so that should their staff forgot about it, they can still inform them for the system access. It is to make sure that only the doctor can update the consultation and specific medicine. It is the same for the staff's side where they can only update the payment of the consultancy and the medicine that the patient can buy without the prescription from the doctor. The staff's side can be accessed by the doctor but only to see the latest information of the patients that their staff updated from time to time.


Figure 4.1 The login system of the Clinic's Patient Data Management System

### 4.2.2 Staff's side

For the daily routine of the clinic's staff, whenever the patient come for doctor's consultation or simply buy the medicine from the clinic, the staff will use the patient's RFID card that has been registered when they become the patient of the clinic, and the entry of the card scanned will be added into the clinic's database and also appear on the entry page just

like in Figure 4.2, on the staff's side. The staff will then add the patient into the doctor's consultation list by clicking the 'consult' link or the 'add' link for the process of where their patients come to buy their medication. The 'consult' link will take the staff to a new page with a form, Figure 4.3 where it will add the patient name and IC into the doctor's patient waiting list.

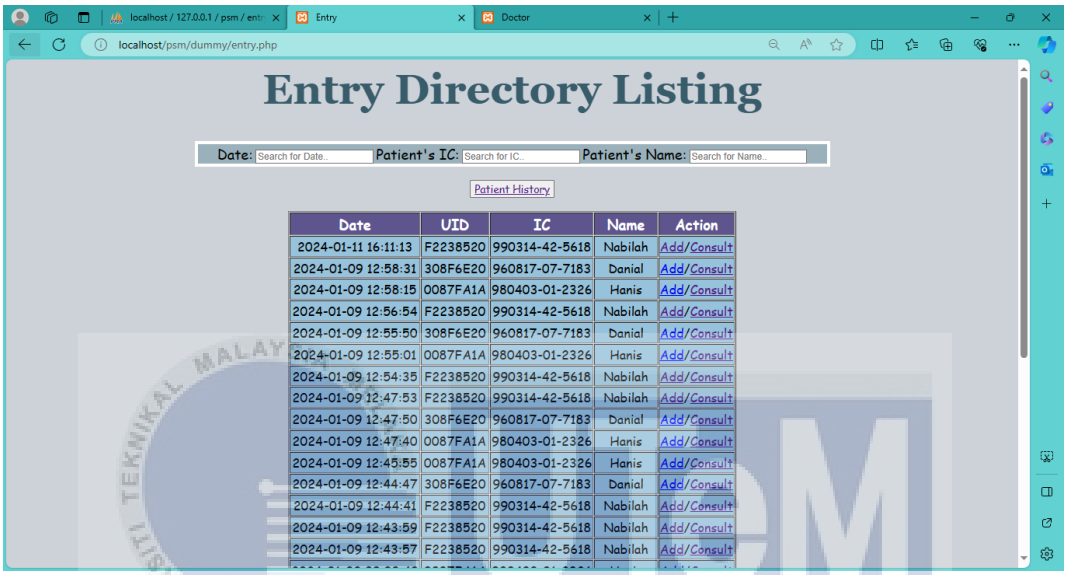


Figure 4.2 The Entry page of the Clinic's Patient Data Management System

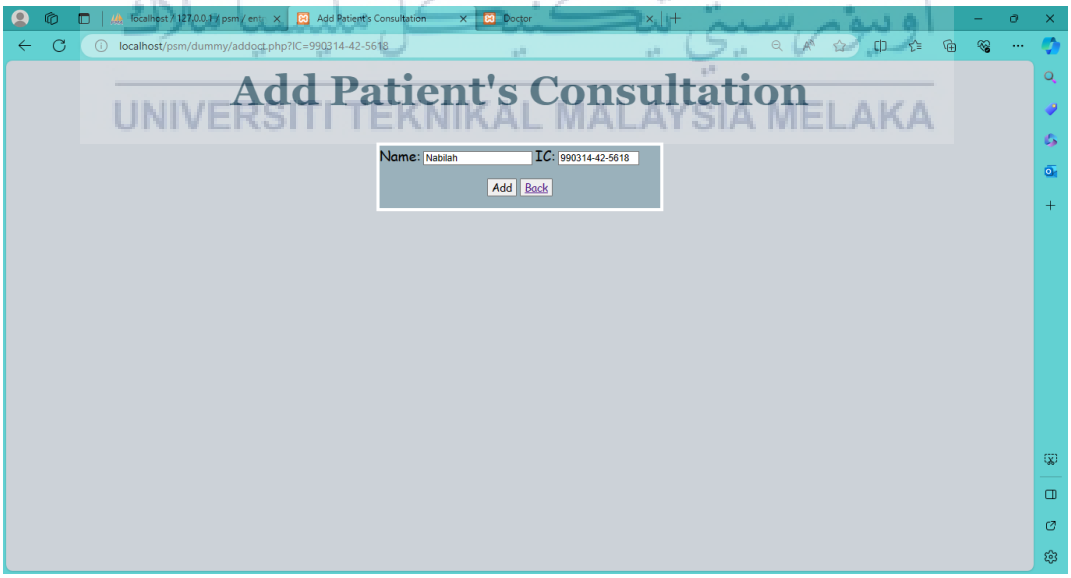


Figure 4.3 The addition of patient's consultation form

After the doctor's consultation, the new information will be added into the staff's patient table, Figure 4.4 where the staff will then fill in the form, Figure 4.5 regarding the

payment and any addition information of the patient like whether they paid the payment or the additional medicine that they buy along with the prescribed medicine from the doctor. Figure 4.6 shows the updated information of the payment and additional information inside the patient's table.

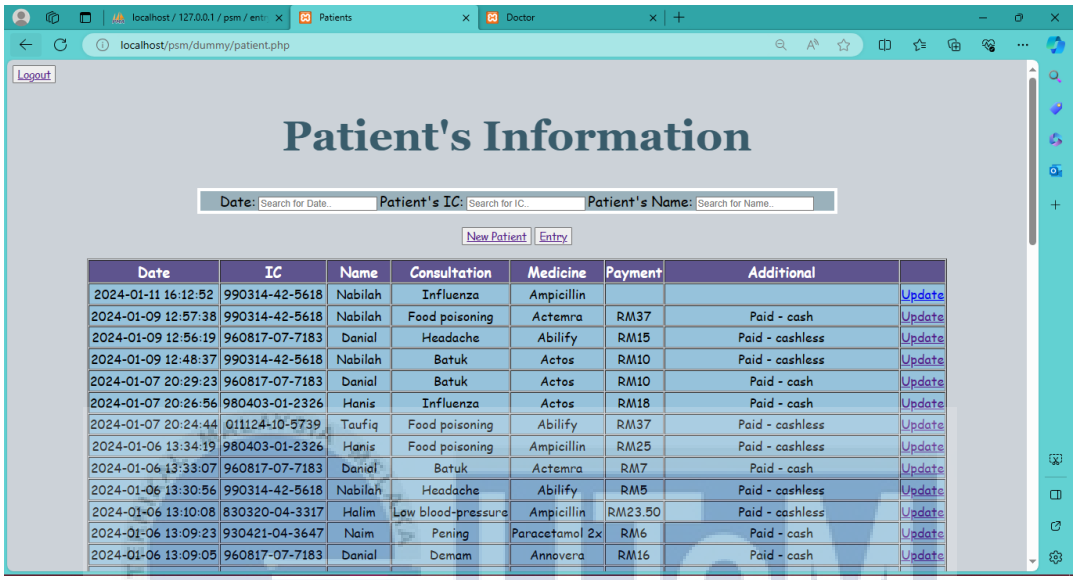



Figure 4.4 Patient's information page

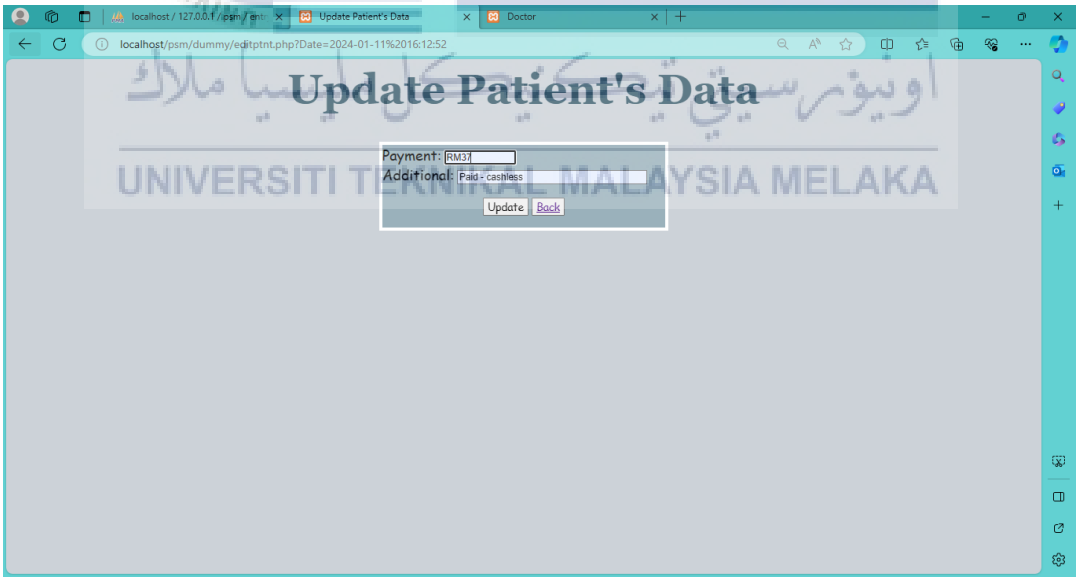



Figure 4.5 Update patient's data form

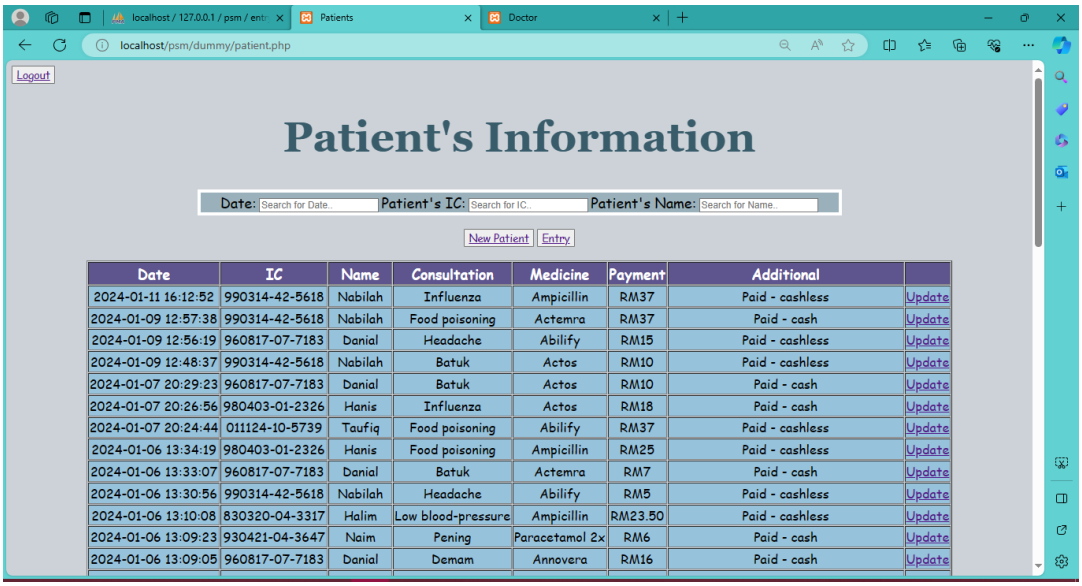



Figure 4.6 Updated patient's information page

For the patient that come only to buy the medicine, the staff will click on the 'add' link, Figure 4.7 and will bring to the new page with form, Figure 4.8 that shows the information like the total payment and the medicine they bought along with other information necessary for their references. Just like the process where the patient received the doctor's consultation, the additional information can be see from the doctor's side on the patient's history page, Figure 4.9.



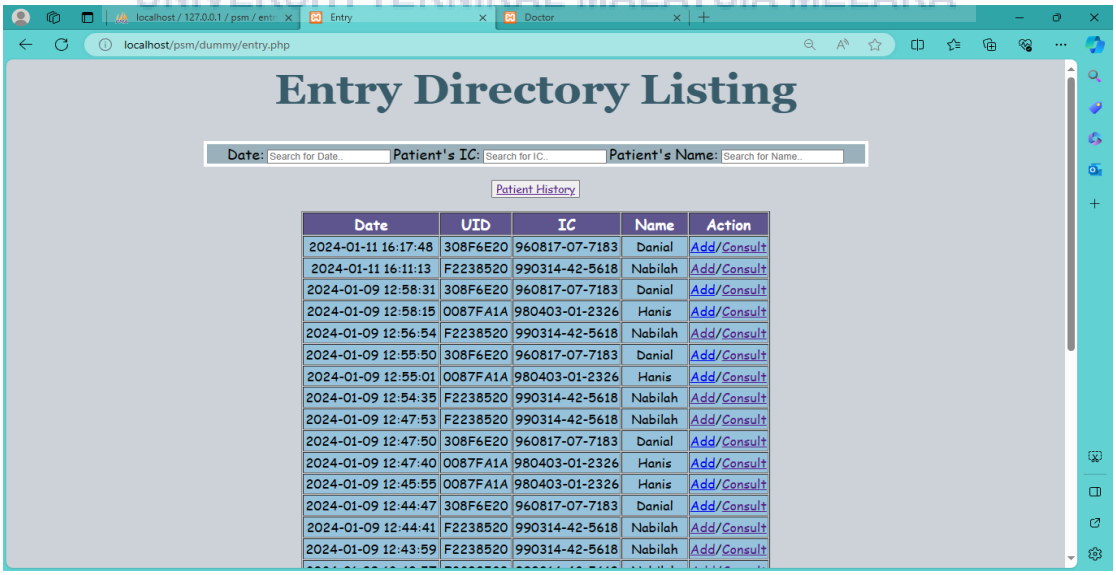



Figure 4.7 Entry page

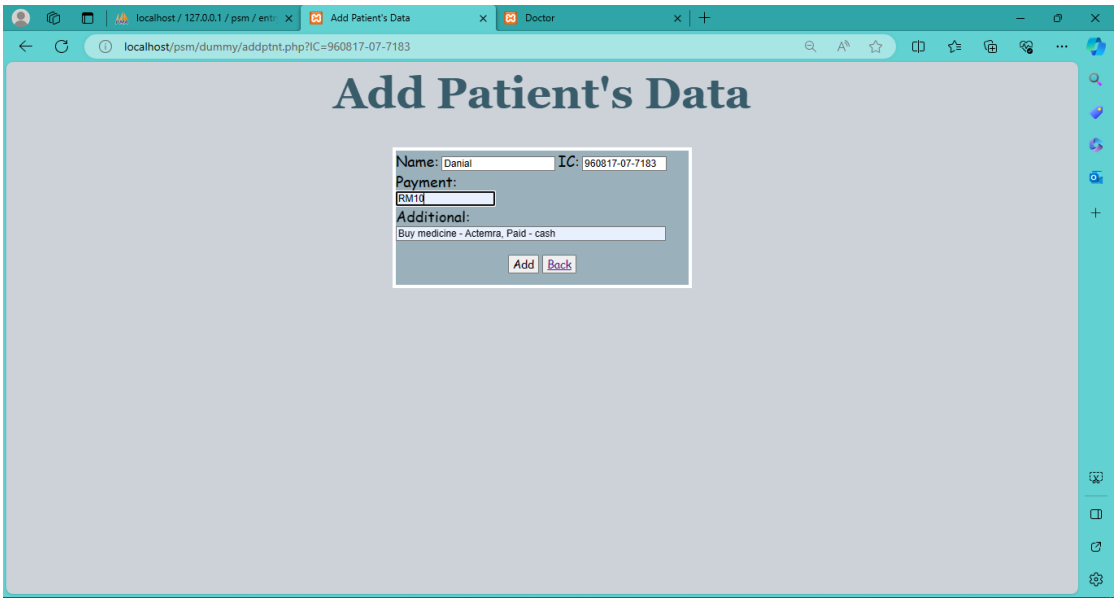



Figure 4.8 Add patient's data form for buy medicine process

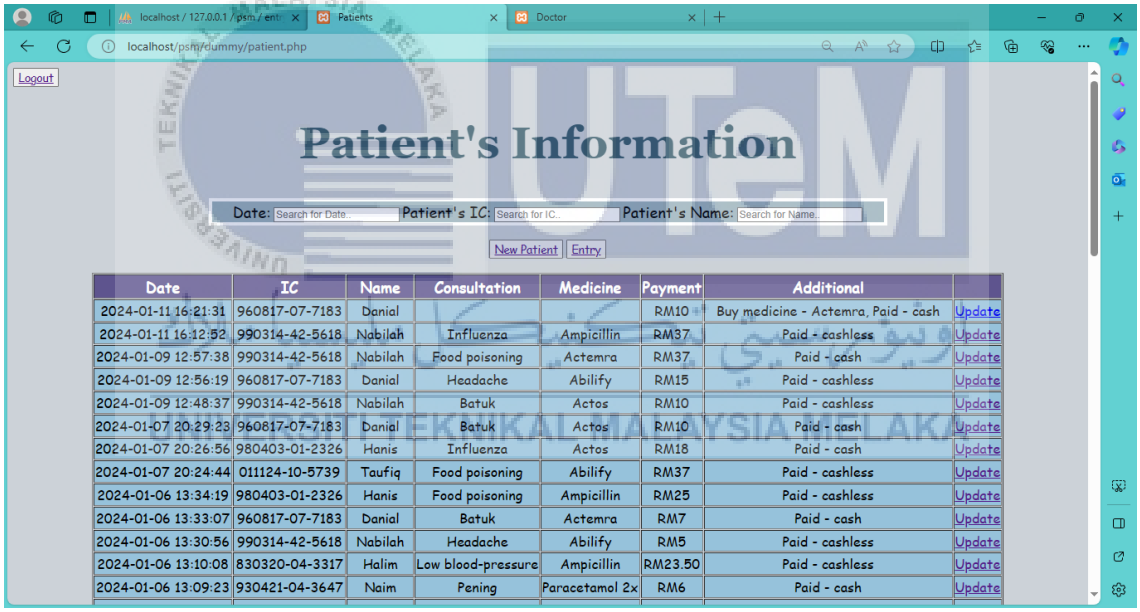
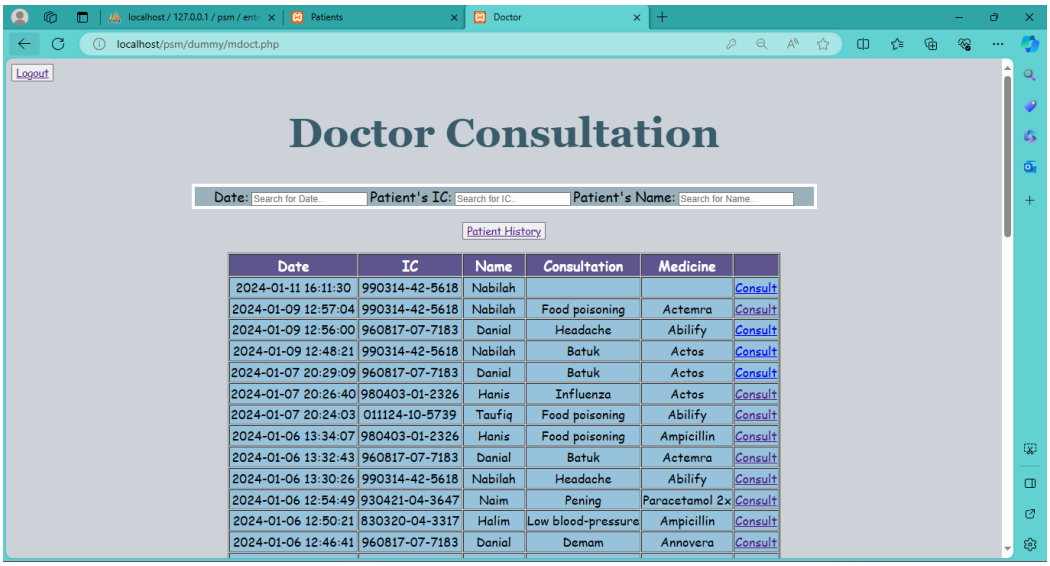



Figure 4.9 Updated patient's information page

### 4.2.3 Doctor's side

This is the doctor's side where all of the patients that come for the consultation that day were listed. The table in Figure 4.10 shows the list of the patients that waiting for a doctor's consultation. Whenever the doctor is ready, they will click the 'consult' link to add the patient's new consultation.




| Date | IC | Name | Consultation | Medicine | |
|---|---|---|---|---|---|
| 2024-01-11 16:11:30 | 990314-42-5618 | Nabilah | | | Consult |
| 2024-01-09 12:57:04 | 990314-42-5618 | Nabilah | Food poisoning | Actemra | Consult |
| 2024-01-09 12:56:00 | 960817-07-7183 | Danial | Headache | Abilify | Consult |
| 2024-01-09 12:48:21 | 990314-42-5618 | Nabilah | Batuk | Actos | Consult |
| 2024-01-07 20:29:09 | 960817-07-7183 | Danial | Batuk | Actos | Consult |
| 2024-01-07 20:26:40 | 980403-01-2326 | Hanis | Influenza | Actos | Consult |
| 2024-01-07 20:24:03 | 011124-10-5739 | Taufiq | Food poisoning | Abilify | Consult |
| 2024-01-06 13:34:07 | 980403-01-2326 | Hanis | Food poisoning | Ampicillin | Consult |
| 2024-01-06 13:32:43 | 960817-07-7183 | Danial | Batuk | Actemra | Consult |
| 2024-01-06 13:30:26 | 990314-42-5618 | Nabilah | Headache | Abilify | Consult |
| 2024-01-06 12:54:49 | 930421-04-3647 | Naim | Pening | Paracetamol 2x | Consult |
| 2024-01-06 12:50:21 | 830320-04-3317 | Halim | Low blood-pressure | Ampicillin | Consult |
| 2024-01-06 12:46:41 | 960817-07-7183 | Danial | Demam | Annovera | Consult |

Figure 4.10 Doctor consultation page

Figure 4.11 is the page where the doctor can fill in the patient's consultation and medicine they prescribe for the patient. The data will then be updated into the doctor and staff's database so that all of the staff can refer to it. Figure 4.12 shows the updated patient's information after the consultation session with the doctor were filled.


| Date | Consultation | Medicine |
|---|---|---|
| 2024-01-11 16:11:30 | | |
| 2024-01-09 12:57:04 | Food poisoning | Actemra |
| 2024-01-09 12:48:21 | Batuk | Actos |
| 2024-01-06 13:30:26 | Headache | Abilify |
| 2024-01-06 11:11:52 | Batuk | Advil |
| 2024-01-06 11:10:34 | Influenza | Abilify |
| 2024-01-06 11:05:53 | Headache | Advil |
| 2023-12-15 13:02:52 | Pening | Paracetamol 2x |
| 2023-12-13 08:18:45 | Demam | Paracetamol 2x |

Figure 4.11 Doctor consultation form

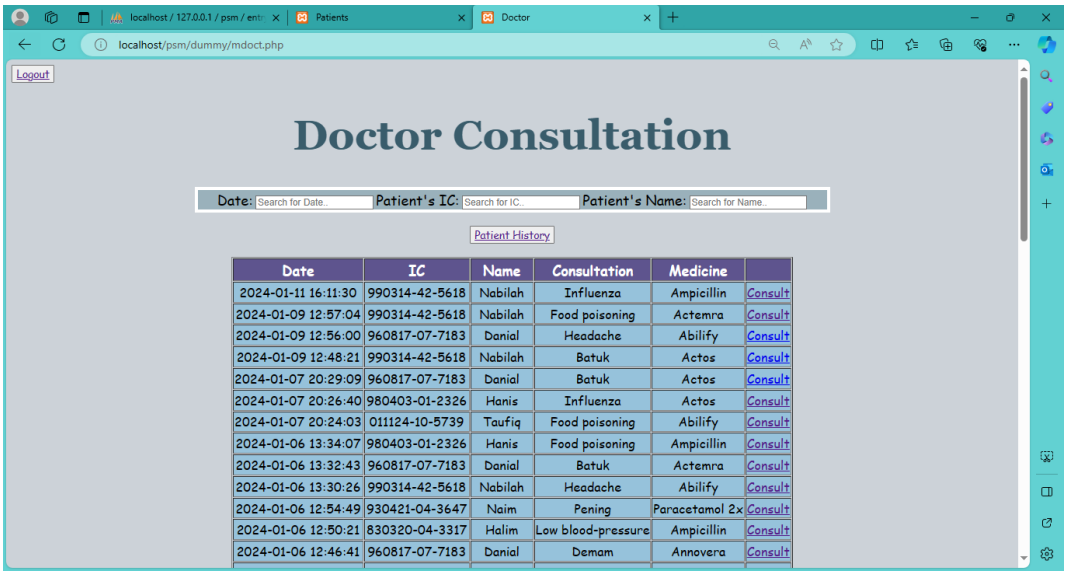



Figure 4.12 Updated doctor consultation page

### 4.2.4 Registration process

Figure 4.13 shows the page where a new patient being registered into the clinic'sdatabase management system. The new patient's information such as their name and IC number will key in and link with the new RFID card where the staff will be use for the next patient entry.

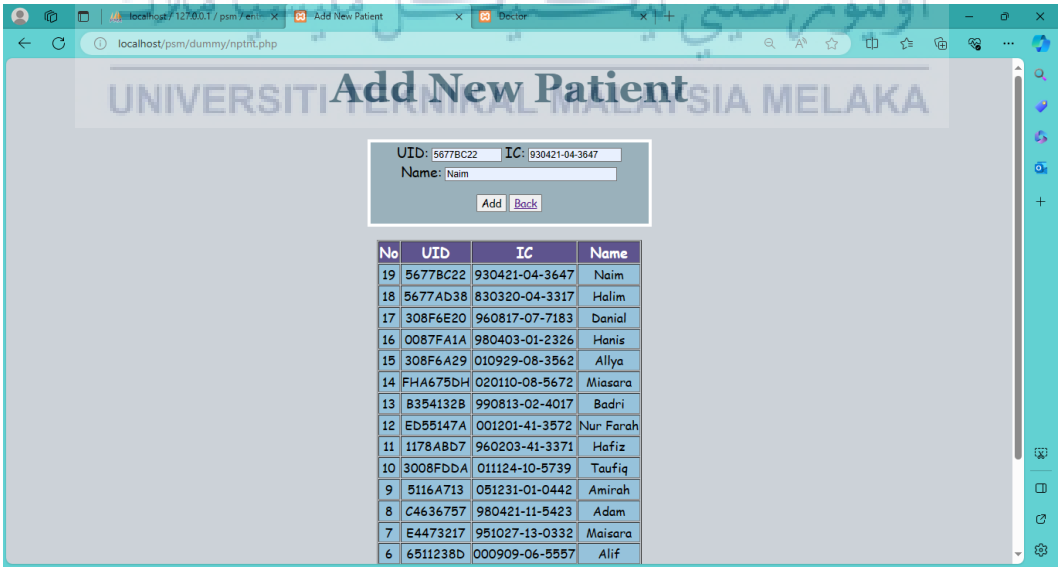



Figure 4.13 New patient's registration page

### 4.2.5 Search engine

Figure 4.14, 4.15 and 4.16 show the feature of the search engine on the staff's and doctor's side where the page that shows the tables containing the list of clinic's patients along with their medical history. The implementation of the search engine is to help the staffs and the doctors in doing their job better as it is easier to look through the patient information by searching specifically on their date, IC number or their name. the search engine will surely help the clinic's staffs where they need to handle hundred or even thousands of patients that they have on their database.


Figure 4.14 Search engine for patient's information page

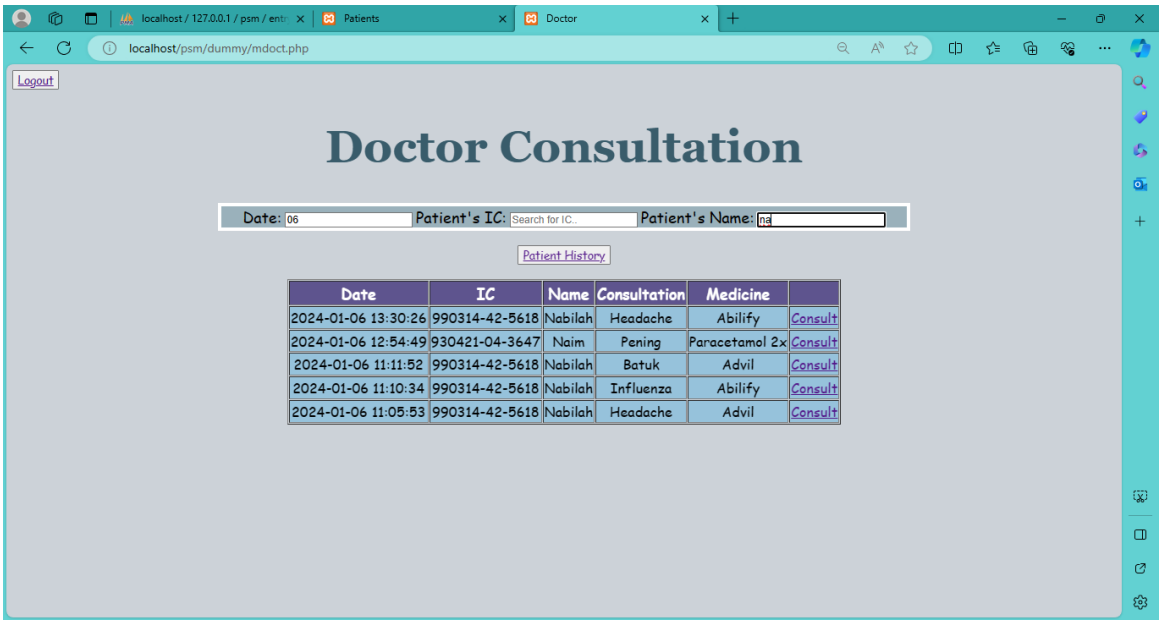



Figure 4.15 Search engine for doctor consultation page


Figure 4.16 Search engine for patient's information page of doctor's side

### 4.2.6 Hardware connection

Figure 4.17 show the connection of the hardware part of the clinic's management system where the Arduino UNO board, which is the microcontroller used for the system and the RC522, the RFID module used to store the attendance of the clinic's patients. Table 4.1 shows the specific PIN connected between the two components the clinic's management system.

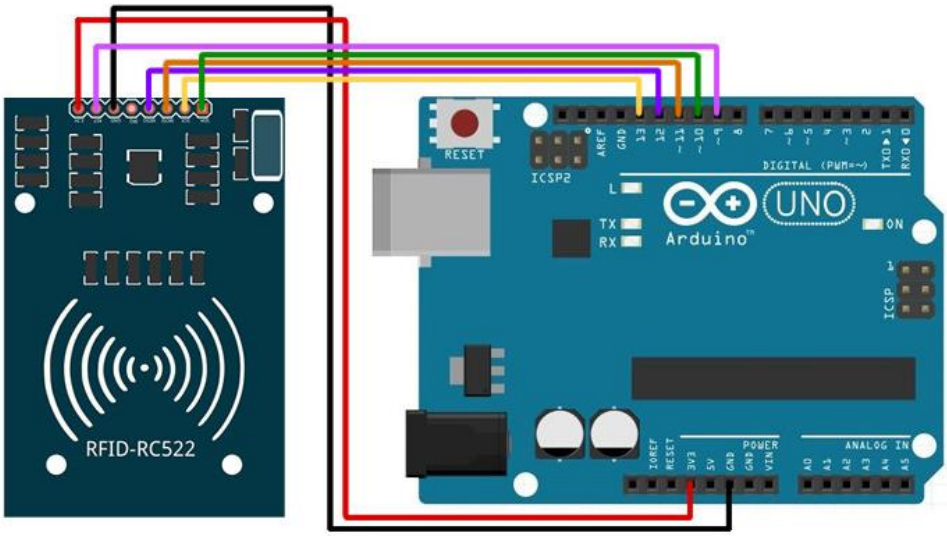



Figure 4.17 Circuit connection of Ardino UNO and MFRC522

Table 4.1 Pin connection between Arduino UNO and MFRC522

| Pin | Arduino Pin Connection |
|---|---|
| 3.3V | 3.3V |
| GND | GND |
| RST | Digital 9 |
| SDA | Digital 10 |
| SCK | Digital 13 |
| MOSI | Digital 11 |
| MISO | Digital 12 |

Figure 4.18 shows the connection and the data insertion between the hardware part, the RFID-RC522 module and the Arduino UNO board with the software part which is the MySQL database and the clinic's data management system using the python IDLE as the intermediary.

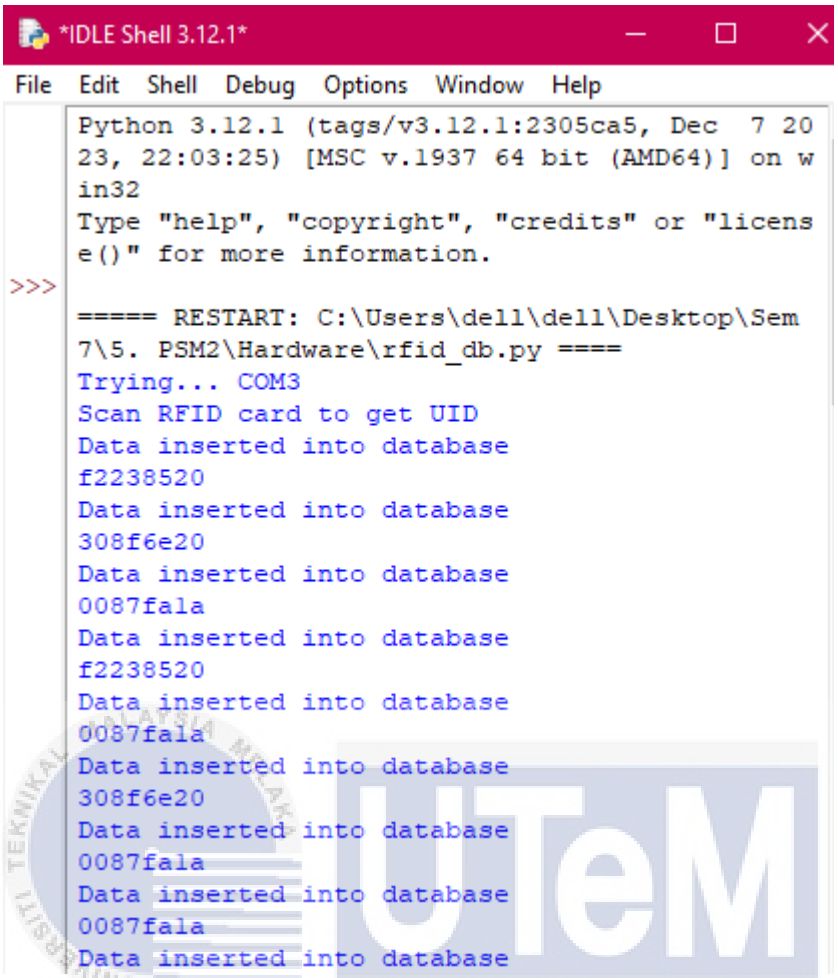



Figure 4.18 Entries of RFID cards on python IDLE

### 4.2.7 MySQL database



Figure 4.19 shows the data entry of the clinic's patients recorded by the MySQL database according to the date and time of the day. The data that get through the RFID card scanned on the RFID module being stored and display on the web-based system of the clinic.

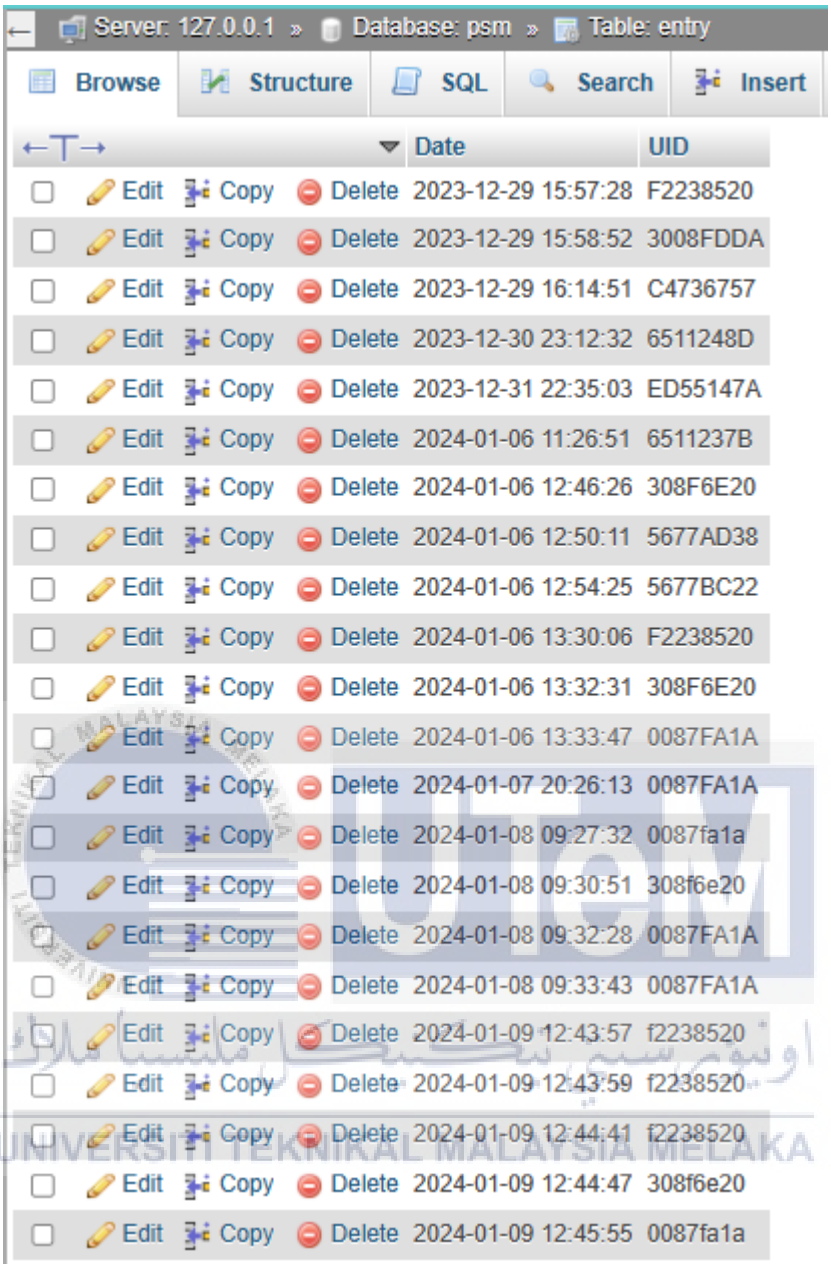




Figure 4.19 Results for the data entries by the RFID cards on MySQL database.

## 4.3 System evaluation

System testing was conducted to evaluate the functionality of the system through a variety of tests. Tests were conducted, setup and results for every module were discussed, and challenges encountered throughout project development were also addressed.

### 4.3.1 **Login system testing**

The login system which developed to ensure the security of the Clinic's Patient Management System. To access the clinic's system, the user, which in this system, the staffs and doctors of the clinic need to use the ID and password assign to them accordingly. Should they unable to key in or forgotten the right ID and password, they will need to ask for the owner of the clinic who have all the ID and password of their staffs. Table 4.2 shows the tests conducted and the results gained for the login system's evaluation.

Table 4.2 Login system testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Login without ID or password | Clicking the login button without entering ID or password | The system will pop-up an alert message, asking the user to input the ID. | Pass |
| 2. | Login without password | Clicking the login button without entering the password | The system will pop-up an alert message, asking the user to input the password. | Pass |
| 3. | Login with wrong ID | Clicking the login button with wrong staff's ID | The system will pop-up an alert message, stating it is the incorrect user's ID and password. | Pass |
| 4. | Login with wrong password | Clicking the login button with wrong password | The system will pop-up an alert message, stating it is the incorrect user's ID and password. | Pass |

### 4.3.2 Staff's side

For the staff's side, there are lots of data added, changed and updated process happened. Whenever the patient come, their registration, consultation and medicine prescribed for them will be fill into the clinic's database and lots of testing need to be conducted to ensure all the data changes happen correctly, properly and accordingly. The testing that will be conduct are the recording of the patient's daily registration, the adding consultation process or the buying medicine process and the updating the latest information process along with registration of a new patient of the clinic into the clinic's database. Table 4.3 shows the test conducted and the results gained for the patient's daily registration system's evaluation using the RFID cards. For the consulting addition and buying medicine system's evaluation, the conducted tests and obtained results are shown in Table 4.4 and Table 4.5 while for Table 4.6 shows the tests and results for the updating process of the latest patient's information. For new patient registration, Table 4.7 shows the tests done on the system along with the results gained from it.



Table 4.3 Patient's daily registration testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Recording the RFID card entry | Tag the RFID card on the card reader | The unique ID of the RFID card is scan into the 'entry' table of the clinic's database | Pass |

Table 4.4 Adding consultation process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Add the doctor's consultation process | Clicking the 'consult' link | The link will take the staff to new page with consultation addition form | Pass |

| | | | | |
|---|---|---|---|---|
| 2. | Add the patient into the doctor's consultation list | Click the 'add' button to add the information of the consultation addition form. | The information of the consultation addition form added into the doctor's consultation list | Pass |

Table 4.5 Adding buying medicine process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Add the buying medicine process | Clicking the 'add' link | The link will take the staff to new page with medicine addition form | Pass |
| 2. | Add the patient information into the patient's information list | Click the 'add' button to add the information of the medicine addition form. | The information of the medicine addition form added into the patient's information list | Pass |

Table 4.6 Updating the latest information process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Updating the patient's information | Clicking the 'update' link | The link will take the staff to new page with update patient's form | Pass |
| 2. | Updating the patient information into the patient's information list | Click the 'update' button to update the information of the update patient's form. | The information of the update patient's form added into the patient's information list | Pass |

Table 4.7 Adding new patient into clinic's database process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Registering new patient | Fill in the patient's information in the 'new patient' page | The new patient registered into the clinic's database | Pass |

### 4.3.3 Doctor's side

For the doctor's side, the data added, changed and updated process is lesser than the staff's side but it still need to be testing to ensure that all the data changes happen correctly, properly and accordingly and at the same time, available for the staffs of the clinic. The testing that will be conduct are the updating of the doctor's consultation information, the insertion of the updated information of the consultation into the doctor's and the staff's table of the clinic's database. Table 4.8 shows the test conducted and the results gained for the updating process of the new coming patient into the doctor's consultation list table. For the evaluation of te doctor's consultaion addition and updating the new consultation information into the system, the conducted tests and obtained results are shown in Table 4.9 and Table 4.10.

Table 4.8 Updating the doctor's consultation information process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Updating the doctor's consultation information | Key in the consultation form | The information updated into the doctor's table | Pass |



Table 4.9 Insertion of the updated information of the consultation into the doctor's table process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Adding the updated information of the consultation into the doctor's table | Click the 'add' button on the consultation page | The information updated into the doctor's table | Pass |

Table 4.10 Insertion of the updated information of the consultation into the staff's table process testing

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Adding the updated information of the consultation into the staff's table | Click the 'add' button on the consultation page | The information updated into the staff's table | Pass |

### 4.3.4 Search engine

To help the clinic's staff doing their job in managing their patients information, the feature like the search engine is implemented on the web-based system. The search engine that act as a filter based on the date, IC numbers and name of the patients make them easier to find the information of the patient that the staffs needed. The testing conducted will cover all the search engine for both staff's and doctor's side which is on the patient's information page of the staff, the doctor consultation list page and the patient's history on the doctor's side. Table 4.11 shows the test conducted and the results gained for the search engine system's evaluation for the staff's side while for Table 4.12 and Table 4.13 show the conducted tests and results obtained for the search engines on the doctor's side for doctor's consultation list table and patients' history table.

Table 4.11 Search engine testing for patient's information of staff's side

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Search engine for date | Entering date | The information show all the data refering to the date | Pass |
| 2. | Search engine for IC | Entering IC number | The information show all the data refering to the IC number | Pass |

| | | | | |
|---|---|---|---|---|
| 3. | Search engine for name | Entering name | The information show all the data refering to the name | Pass |

Table 4.12 Search engine testing for doctor consult

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Search engine for date | Entering date | The information show all the data refering to the date | Pass |
| 2. | Search engine for IC | Entering IC number | The information show all the data refering to the IC number | Pass |
| 3. | Search engine for name | Entering name | The information show all the data refering to the name | Pass |

Table 4.13 Search engine testing for patient's history of doctor's side

| No. | Testing Method | Action Done | Expected Result | Result |
|---|---|---|---|---|
| 1. | Search engine for date | Entering date | The information show all the data refering to the date | Pass |
| 2. | Search engine for IC | Entering IC number | The information show all the data refering to the IC number | Pass |
| 3. | Search engine for name | Entering name | The information show all the data refering to the name | Pass |



## 4.4 Summary

This chapter presented the results achieved by the connection of RFID cards and it's module along with the displayed results obtain from MySQL database and the web-based

system of the clinic where the log of the tags were being recorded for every entries. The MySQL database also show all the necessary information like date, time and the ID of the RFID card for each entries occur instantly, allowing changes done on the patient's information quickly and easily from the clinic's data management system. Evaluation of the overall system where the tests being conducted and the obatined results also presented in this chapter. This project that solely depended on the tag of the RFID cards and recorded data of the database can easily allow the staffs of the clinic to manage and update their system daily and quickly, minimalising the use of paper works and documentation that most local clinic still used for recording the new and updated information for their patients. The recorded data to the database can also prevented lost documents from occur as every information obtain from the patients is very important and needed to be handle thoroughly and carefully.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

This project offers a solution to the numerous issues that arise daily when managing the enormous amount of patient data. The suggested methodology, the usage of the RFID cards and MySQL database is seen to be a solid and effective way to get the greatest results for the clinic's data management system with the least amount of work required from the staff and patients. The implimentation of the RFID cards for patient's daily registration is a major area that needs to be explored in order to make significant improvements and enhancements to the medical and health care fields, which can also help improve performance and patient care qualities significantly. The suggested solution where the RFID cards and MySQL database being used is also the objectives this project is being develop in order to explore the vast solutions for data management system's problems occured in the medical and health care fields that might not only helps the staff by cutting down on the amount of time it takes them to manage the clinic's system but also enabling them to devote their all in providing prompt, efficient patient care. This will allow all medical staff to give their full attention to the patients' health and wellbeing while minimizing the amount of paperwork and documentation that needs to be handled.

## 5.2 Sustainable Development Goals (SDG) of the project

Several Sustainable Development Goals (SDGs) are aligned with the design of a Clinic Management System using RFID technology. By integrating RFID technology into a clinic management system, the following SDGs could be met. With RFID's ability to

improve patient tracking, lower mistakes, and boost overall healthcare efficiency, better health outcomes can be achieved, allowing for the achievement of SDG 3. SDG 9 focuses on infrastructure, innovation, and the industry. It advocates for inclusive and sustainable industrialization, robust infrastructure development, innovation stimulation, and increased system efficiency. The efficient management of clinics inside metropolitan areas, which ensures greater healthcare accessibility and resource efficiency, is made possible by RFID technology. This brings to SDG 11, sustainable cities and communities

## 5.3 Future Works

For future improvements, the clinic's management system could be enhanced as follows:

i) The development of the appointment schedulling system where the patients can schedule their doctor's consultation or the date where they needed to get their daily prescripted medicine.

ii) The implementation of the notification feature where every reminder will be activate to notify their users with any necessary information from the clinic.

iii) The addition of advance features necessary to help gain the additional data or information regarding the patient such as the medical scan conducted, X-ray or blood test result, other refer letters and more.

iv) The development of mobile application for better access for both the clinic's staffs and also the patient of the clinic.

v) Vast accessibility for not only the clinic's staffs but also for their patient and also other medical staffs at any given moment or location.

## REFERENCES


[1] L. Shi and Q. Li, "An attendance system design based on RFID technology," in *2020 8th International Conference on Orange Technology, ICOT 2020*, Institute of Electrical and Electronics Engineers Inc., Dec. 2020. doi: 10.1109/ICOT51877.2020.9468740.

[2] K. Aravindhan, S. K. B. Sangeetha, K. Periyakaruppan, K. P. Keerthana, V. Sanjaygiridhar, and V. Shamaladevi, "Design of Attendance Monitoring System Using RFID," in *2021 7th International Conference on Advanced Computing and Communication Systems, ICACCS 2021*, Institute of Electrical and Electronics Engineers Inc., Mar. 2021, pp. 1628–1631. doi: 10.1109/ICACCS51430.2021.9441704.

[3] A. Rashmi, S. Brindha, S. B. Srinithin, and A. Gnanasudharsan, "Smart Attendance System Using RFID and Face ID," in *2022 International Conference on Communication, Computing and Internet of Things, IC3IoT 2022 - Proceedings*, Institute of Electrical and Electronics Engineers Inc., 2022. doi: 10.1109/IC3IOT53935.2022.9768003.

[4] Q. Y. Tan, P. S. JosephNg, and K. Y. Phan, "JomRFID Attendance Management System," in *3rd IEEE International Virtual Conference on Innovations in Power and Advanced Computing Technologies, i-PACT 2021*, Institute of Electrical and Electronics Engineers Inc., 2021. doi: 10.1109/i-PACT52855.2021.9696816.

[5] Chikkamagaluru. D. of C. S. and E. Adichunchanagiri Institute of Technology, Institute of Electrical and Electronics Engineers. Bangalore Section, and Institute of Electrical and Electronics Engineers, *ICAIT - 2019 : First IEEE International Conference on Advances in Information Technology : proceedings : 24th - 27th July 2019*.

[6] Rokhmadi, A. Sofwan, and M. Somantri, "Smart School System with Single ID based on RFID Through NFC using FCM Notification," in *Proceedings - 2021 4th International Conference on Computer and Informatics Engineering: IT-Based Digital Industrial*

*Innovation for the Welfare of Society, IC2IE 2021*, Institute of Electrical and Electronics Engineers Inc., 2021, pp. 485–490. doi: 10.1109/IC2IE53219.2021.9649272.

[7] IEEE Industry Applications Society, IEEE Power & Energy Society, Institute of Electrical and Electronics Engineers. Lahore Section, and Institute of Electrical and Electronics Engineers, *2019 3rd International Conference on Energy Conservation and Efficiency (ICECE) : proceedings : 23-24 October, 2019, Lahore, Pakistan*.

[8] C. H. Raghavendra, B. Lakshmi, P. N. Krishna, C. Sai Rama Krishna, and A. S. Sree, "Implementation on RFID Based Device Control and Authentication System," in *2021 IEEE International Conference on Mobile Networks and Wireless Communications, ICMNWC 2021*, Institute of Electrical and Electronics Engineers Inc., 2021. doi: 10.1109/ICMNWC52512.2021.9688413.

[9] Institute of Electrical and Electronics Engineers and PPG Institute of Technology, *Proceedings of the 5th International Conference on Communication and Electronics Systems (ICCES 2020) : 10-12, June 2020*.

[10] Anna University and IEEE Aerospace and Electronic Systems Society, *2019 International Carnahan Conference on Security Technology (ICCST) : ICCST 2019 : IEEE 53rd International Carnahan Conference on Security Technology : October 01-03, 2019, Anna University, Chennai, India.*

[11] Institute of Electrical and Electronics Engineers, IEEE Computer Society, IEEE Computer Society Technical Committee on Machine Intelligence and Pattern Analysis, and Wash. International Conference on Activity and Behavior Computing 2019 Spokane, *2019 Joint 8th International Conference on Informatics, Electronics & Vision (ICIEV); 3rd International Conference on Imaging, Vision & Pattern Recognition (icIVPR); International Conference on Activity and Behavior Computing (ABC) venue: Eastern Washington University, Spokane, Washington, USA : date: May 30-June 2, 2019*.

[12] V. S. L. Daracan, R. J. E. Latayan, C. L. D. Padilla, and M. N. Young, "Designing an Inventory Database Software Suitable for Small Business," in *7th IEEE International Conference on Engineering Technologies and Applied Sciences, ICETAS 2020*, Institute of Electrical and Electronics Engineers Inc., Dec. 2020. doi: 10.1109/ICETAS51660.2020.9484166.

[13] D. Wang, H. Wei, Y. Ji, and Y. Shi, "An Intelligent Health Management System Based on the Internet of Things," in *Proceedings - 2022 3rd International Conference on Education, Knowledge and Information Management, ICEKIM 2022*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 838–841. doi: 10.1109/ICEKIM55072.2022.00184.

[14] K. V. Sahukara, M. B. Ammisetty, G. S. K. G. Devi, S. Prathyusha, and T. S. Nikhita, "COVID-SAFE: IoT Based Health Monitoring System using RFID in Pandemic Life," in *2021 IEEE International Conference on RFID Technology and Applications, RFID-TA 2021*, Institute of Electrical and Electronics Engineers Inc., 2021, pp. 203–206. doi: 10.1109/RFID-TA53372.2021.9617312.

[15] "RFID SYSTEM-Used for Monitoring and Tracking Patient(MTP)."

[16] X. Wang, Y. Chen, J. Wang, and A. Yu, "Design of Doctor-Patient Management Platform Based on Microservice Architecture," in *Proceedings - 2020 2nd International Conference on Applied Machine Learning, ICAML 2020*, Institute of Electrical and Electronics Engineers Inc., 2020, pp. 99–102. doi: 10.1109/ICAML51583.2020.00028.

[17] N. Vigneshwari, M. Dhineshkumar, K. S. Anuvarshini, M. Anisha, M. Sushmitha, and E. E. Nithila, "Design of Cloud Computing based Digital Inventory for Administration and Supervision of Hospices Patient Data," in *Proceedings - International Conference on Augmented Intelligence and Sustainable Systems, ICAISS 2022*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 864–870. doi: 10.1109/ICAISS55157.2022.10010923.

[18] X. Zhong, “Design and Implementation of Intelligent Health System Using Big Data and Cloud Computing,” in *2022 IEEE International Conference on Electrical Engineering, Big Data and Algorithms, EEBDA 2022*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 358–363. doi: 10.1109/EEBDA53927.2022.9744850.

[19] G. Velikić, C. Gross, and Institute of Electrical and Electronics Engineers, *Proceedings 2019 IEEE 9th International Conference on Consumer Electronics (ICCE-Berlin)*.

[20] A. Gharat and G. Phadke, “Smart Medical Health Card for Hospital Management,” in *2022 2nd Asian Conference on Innovation in Technology, ASIANCON 2022*, Institute of Electrical and Electronics Engineers Inc., 2022. doi: 10.1109/ASIANCON55314.2022.9909434.