Mobile RFID Linen Monitoring for UTAR Hospital

BY

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It is hereby certified that LAI HOI YIN (ID No: 20ACB04333) has completed this final year project/ dissertation/ thesis* entitled "Mobile RFID Linen Monitoring for UTAR Hospital" under the supervision of Ts Dr Goh Hock Guan (Supervisor) from the Department of Computer and Communication Technology, Faculty/Institute* of Information and Communication Technology.

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ABSTRACT

Nowadays, most hotels and hospitals that use a lot of linens every day have linen monitoring issues. Staff in hotels and hospitals need to manually monitor the linen, which is inefficient and prone to some human errors. For example, the staff enters wrong data in the database, the staff counts the wrong number of linens, which can lead to data loss and inaccurate. Since RFID is a tracking system that uses radio frequency to search, identify, track, and communicate with items and people, it is very suitable for linen monitoring systems.

In this project, RFID will be used to build a linen monitoring system for UTAR Hospital. Compared with the ordinary linen monitoring system, the monitoring system using RFID will be more user-friendly and efficient. The purpose of the system is to monitor the quantity and condition of the linens when they are sent for use and when they are brought to laundromats for laundering.

This project will focus on the RFID mobile reader, which is a reader that user can carry to anywhere and anytime to scan the RFID tags. Compare with RFID gantry reader, RFID mobile reader will be more convenient and suitable for hotel or hospital which have a large area and large amount of linens.

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LIST OF ABBREVIATIONS

RFID	Radio Frequency Identification
UTAR	University Tunku Abdul Rahman
ID	Identification
SQL	Structured Query Language
QR Code	Quick Response Code
RSSI	Received Signal Strength Indicator
EPC	Electronic Product Code
PC	Personal Computer
UHF	Ultra-High Frequency

Chapter 1
Introduction

In this chapter, we present the background of this project, problem statement and motivation of the project, and also objective of the project.

Project Background

UTAR hospital is a not-for-profit hospital that provide advance sun-specialized services, do some clinical research and development, and provide clinical training for undergraduates, postgraduates and also continue medical education.

Based on [1], UTAR hospital will not only will provide affordable, high-quality primary and specialist medical services to students and the public, it will also provide clinical training for the College's MBBS, Traditional Chinese Medicine and Health Sciences students.

The initial phase of UTAR hospital will have 250 western medicine beds and 100 Chinese medicine beds. In the future it will also have an additional 250 beds. UTAR hospital will provide service like outpatient and inpatient care, diagnosis and treatment, medical and non-medical support, research and education, and facilities for staff, students, and the administrative center.

Figure 1.1 Artist' impression of UTAR Hospital

Same as other hospital, UTAR hospital also will used a lot of linen in every day. For example, bed sheet, pillowcase, towels, lab coats, doctor and patient gown and scrub suits. After these linens had been used, the hospital needs to send them to the laundry to clean them. So, a good linen management system can help the hospital to avoid and reduce many problems and save more resources.

Figure 1.2 Example of hospital linens

1.1 Problem Statement and Motivation

Problem Statement

Since that the RFID mobile reader has come with its own application. But this application only can do some simple action such as read, write, lock, and kill RFID tags. Since this application is a default application in this reader, so it cannot be modified, this mean that we cannot add some new function or modify the function in the application. So, there will be not so flexible when we use the mobile reader.

When the reader read data from the RFID tags, it will only display the data on the screen of the reader, it will not store the data. This will cause that the user does not know when the reader has been used and what data has been scanning by the reader. Since that the data will not been stored, so when the user wants to record the data of the RFID tags, they may need to record the data manually by copy the data from the mobile reader before they clear the data from the reader.

Other than that, the data monitoring is no efficient and unfriendly. After the RFID tags scanned by the mobile reader can be stored, user also need the mobile reader to view the stored data. This will be very inconvenience and user friendly. For example, when user what to view the records, they need to get the mobile reader first, then they need to search for the record they needed from the mobile reader. This may cause other problem such as when one of the users is using the mobile reader, the others user needs to wait for the first user then only can use the mobile reader for data monitoring.

Motivation

The aim of this project is to build an application for the RFID portable reader to read RFID tags and store data to the database to help the UTAR Hospital. Based on [2],

Radio frequency is used by an RFID tag, a tracking device, to locate, recognize, follow, and communicate with objects and people. An RFID tag is essentially a smart label that can contain a variety of data, including serial numbers, brief explanations, and even data pages. Therefore, using RFID to create a linen monitoring system can simplify linen monitoring.

Besides, linen monitoring system using RFID is also very user friendly and efficiency. By using RFID, the hospital staff only need to scan the RFID tags to store or read the information of the linen, they do not need to manually key in the data to the database. This also can prevent some man-made problem such as staff count the number of linens wrongly and staff enter the wrong data into the database.

In addition to that, as just mentioned, RFID tags are smart tags that can store a range of information. Therefore, the use of RFID also allows workers to store and read more linen information. For example, the condition of the linen, which lab coats and doctor gowns belong to which staff, etc.

1.2 Objectives

The first objective of this project is **to develop an application for the RFID mobile reader**. Since that, the default application of the RFID mobile reader cannot be modify, so develop an application which can be modify or have more function is very important. this allows the developer to perform further update to the mobile reader such at adding other features and functions.

The second objective of this project is **to implement a database to store data read by the mobile reader**. This database will store all the records when the user uses the mobile reader to read the RFID tags. This allow user to get the data for data monitoring and also for furthers uses at any time and no need to record the data manually before the data have been cleared.

The third objective of this project is **to develop a user interface for data monitoring**. This user interface allow user to get the data form the database for data monitoring. This will also allow user to get the data at anytime and anywhere, not only needed to get the data from the mobile reader. This makes data monitoring become more efficient and user friendly for the user.

1.3 Project Scope and Direction

The project is mainly focused on developing an application for the RFID mobile reader. Some of the most important hardware that will be used are RFID tags, portable RFID readers, PCs, etc. RFID mobile reader is to scan data from RFID tags and a computer is to develop the application by using Android Studio. Other than that computer will also be used to display the user interface which user can use for data monitoring.

The deliverable at the end of this project is an application for RFID mobile reader which allow user to scan RFID tags. Other than that, a database will be implement to the application to stored data read by the mobile reader. Users can monitor data or record of using RFID mobile reader to scan from the user interface using a PC.
In this project the hardware used are mobile reader to scan data from RFID tags and a computer to develop the application by using Android Studio. Other than that computer will also be used to display the user interface which can use for data monitoring.

1.4 Contributions

The first objective (**to develop an application for the RFID mobile reader**) can solve the problem that the default application of mobile reader cannot be modify. Since that, the objective is to develop a now application for the mobile reader, so there will be no limit for developer to modify or update and add more features to the application for mobile reader.
The second objective (**to implement a database to store data read by the mobile reader**) can solve the problem that the mobile reader only can read data and cannot store the data. After mobile reader scan the RFID tags, the data will automatically be stored to the database. So that the user does not need to record the data manually.
The third objective (**to develop a user interface for data monitoring**) can solve the problem that the data monitoring is no efficient and unfriendly. Before implement the user interface, user only can get the data from the mobile reader. With the user interface, user not only can get the data from the mobile reader, also at another device such as a computer or a smartphone, at anywhere and anytime.

1.5 Report Organization

The details of this project are shown in the following chapters. In chapter 2, some related systems' backgrounds are reviewed. Then the system methodology is present in chapter 3. In chapter 4, the system design will be presented. Last but not lease, the conclusion will be presented in chapter 5.

Chapter 2
Literature Review

2.1 Review of the technology

2.1.1 Hardware

The hardware that will be used in this project is RFID portable reader. Some reviews have been done on some different RFID mobile reader which are Chainway C72, Turck smartphone UHF RFID reader and Audio Jack UHF RFID Portable Reader.

The first RFID portable reader is Chainway C72. Based on [3], Chainway C72 is a best-in-class UHF RFID reader for Android. It provides a read distance of more than 15 m outside thanks to inbuilt Impinj E710 and R2000 technology. The Octa-Core processor, 8000mAh powerful battery, and optional barcode scanning of the RFID reader perfectly satisfy the demands of intense applications, particularly in asset management, retail, warehousing, garment inventory, expressway toll, fleet management, finance, etc.

Figure 2.1.1.1 Chainway C72 UHF RFID Portable Reader

The second RFID portable reader is Turck smartphone UHF RFID reader. Based on [4], the Turck smartphone UHF RFID reader is a low-cost UHF portable reader. It is a portable, user-friendly RFID reader solution for smartphones from the PD-IDENT handheld. The UHF antenna on the handheld gadget communicates with the user's smartphone via the audio port.

Figure 2.1.1.2 Turck Smartphone HUF RFID reader

The third RFID portable reader is Audio Jack UHF RFID Portable Reader. Based on [5], the 3.5 mm headphone audio jack on smartphones running Apple's iOS or Android operating systems can be used to connect the audio jack UHF RFID portable reader. The primary application areas are capital equipment inventory, personal RFID terminal devices, NFC electronic tag reading and writing, and intelligent browser tools.

Figure 2.1.1.3 Audio Jack UHF RFID Portable Reader

2.1.2 Database

There are many types of databases can be used in this project such as Microsoft SQL server, MySQL and SQLite.

Based on [6], SQL Server, a RDBMS (relational database management system) which is introduced by Microsoft. SQL Server is based on SQL, a common programming language for communicating with relational databases, same as other RDBMS applications. The Microsoft SQL implementation known as Transact-SQL, or T-SQL, which includes a number of exclusive programming constructs, is linked to SQL Server.

Based on [7], MySQL allow user to delivery Online Transaction Processing (OLTP) systems that are both fast and scalable. It offers the same famed MySQL simplicity of use in addition to performance and dependability fit for an industrial setting. User may also deliver scalable and high-performance applications with MySQL Replication.

Based on [8], SQLite is permissible to utilise SQLite's code for any purpose, whether private or commercial, as it is in the public domain. The most extensively used database in the world, SQLite has more applications than we can list, including a number of well-known initiatives. SQLite does not have a separate server process, in contrast to the majority of other SQL databases.

2.1.3 Programming Language

The programming language that can be used to develop RFID portable application are Java and Kotlin.

Based on [9], Java is an object-oriented, network-centric programming language that runs on multiple platforms. This approach to programming, in which objects were used to represent data and other aspects, is credited to Java. Its development significantly overtook procedural programming. When it comes to creating applications for Android, Java is still the language of choice for developers everywhere. This is due to Java's environmental compatibility, which is why Android was created and is built in Java.

Based on [9], With the open-source programming language Kotlin, programmers can use the Java Virtual Machine (JVM). The programming language is platform-independent. In order to provide a unique and self-sufficient platform, Kotlin also integrates functional programming with object-oriented programming (OOPs). Furthermore, a single plugin can be installed to smoothly integrate Java stacks with Kotlin. You can move from Java to Kotlin with the help of this plugin. Kotlin is a statically typed programming language, in addition. Kotlin has recently been acknowledged as one of the officially supported languages for application development in the Android space, according to a recent Google I/O announcement.

2.1.4 Summary of the Technology Review

After review for the different type of RFID portable reader, the Chainway C72 will be used in this project. This is because compare with the others two RFID portable reader, the Chainway C72 is the most suitable. It has a bigger battery for a continuous use for 12 hours and it also has a 15m of reading distance which is very far compare with the other two devices.

The database that will be used in this project is Microsoft SQL Server. This is because it is easy to install, and it also has an impressive security track record. Other than that, it is also compatibility with other Microsoft product. The majority of commonly used programmes and the operating system market are still dominated by Microsoft. It's just simpler to stick with Microsoft products everywhere because compatibility is optimised when a DBMS and OS are produced by the same firm.

The programming language that will be used in this project is the Java programming language. This is because Java is still the most popular programming language in Android based application. Most of the library that needed to develop the application are all build in Java. Although using Kotlin and convert Java into Kotlin itself, but this will be more complicated.

2.2 Review of the Existing Systems

2.2.1 RFID for Inventory Monitoring

Figure 2.2.1 Example of RFID tag

Radio frequency identification (RFID) is referred to as an acronym. RFID tags have sensors that transmit data over radio waves when they are scanned. Significantly, RFID readers may simultaneously scan more than 100 RFID tags without revealing a single tag.

Based on [10], The field of inventory management may undergo a radical transformation as a result of the new technology known as RFID. An RFID tag uses radio waves to communicate with a scanner and can then be used for inventory management. Tags are encased in plastic or paper covers, and they can be attached to a variety of surfaces for tracking. Most RFID tags used for inventory monitoring are passive, meaning they don't contain batteries and get their power from the reader's radio waves. Active tags are used for long-distance tracking of machinery like trucks and railroad wagons. They are powered, more expensive, and come with batteries.

There are many advantages to using RFID tags for inventory management, including lower labour costs and quicker scanning. Because an RFID tag does not need to be in the "line of sight" like a barcode, it can be scanned at any distance for quick inventory processing. Furthermore, users can read scanner codes at any angle, giving them easier access to inventory and allowing for more regular updates. Labor costs constitute 50 to 80 percent of distribution center expenses, making RFID a potentially useful tool in controlling these costs.

While there are certain advantages to implementing RFID tags for inventory management, there are also a number of limitations that limit the use and raise other issues, such as security. Despite ongoing updates and data security improvements, RFID devices can still be vulnerable to hacking. It is occasionally possible to scan tags up close and copy tag data using remote devices, including mobile phones. This

is a vulnerability that is especially concerning to the retail sector since it might be used later to copy the data to another tag or construct a cloned tag.

2.2.2 Barcode for Inventory Monitoring

Figure 2.2.2 Example of Barcode

Based on [11], a barcode is a picture of data that can be scanned and decoded to reveal information. Each barcode, which is represented by a series of lines or other forms, has a unique code that serves as a tracking system for products. At first, this technique was represented by the one-dimensional width and gaps between parallel lines. Each of these bars has a binary digit (0 or 1) assigned to it, and they are arranged in the range 0 to 9. The required action is carried out right away when the barcode is processed by a barcode reader after it scans the data. This eventually gave way to additional two-dimensional geometric shapes like rectangles and hexagons. Along with more recent technologies on gadgets like smartphones and desktop printers, this barcode technology can be read by barcode readers.

Barcode has various benefits. Many organisations rely on it as a tried-and-true solution to meet their inventory tracking needs. First, barcodes take human mistake out of the situation. Compared to barcodes, manually entered data has a much higher incidence of errors. A barcode scan is quick and accurate, and it takes a fraction of the time that manual data entry does. Other than that, it is cheap to design and print barcodes. Regardless of its function or the location where they will be attached, they often just cost cents. It come in a variety of finishes and materials and can be affordably customised. Barcodes are an essential tool for monitoring a variety of data, from pricing to inventory, and are both affordable and simple to use. A thorough barcoding system will ultimately result in less overhead.

Besides the benefits, barcode also have some limitation. A barcode reader must be maintained no closer than 15 feet from the barcode label in order for it to work. It will be difficult for the barcode scanner to scan it if it is positioned farther than that. This

shorter range can be problematic for some applications. To read a barcode, a barcode scanner also must have a clear line of sight to it. Besides, barcodes only have one dimension. Since they cannot be ready vertically, they must only be ready horizontally. They are able to store text-based product details such type, size, style, price, and SKU. Depending on the specific sort of barcode using, they can only carry 20 to 25 characters.

2.2.3 QR Code for Inventory Monitoring

Figure 2.2.3 Example of QR Code

Based on [12], QR code is an image that can be read by a variety of scanners. Its black squares and dots transform the code into a predetermined order. The end result is something that the scanner can read and quickly understand, whether it's product information or a short-term promotion.

Most modern inventory management systems are already equipped to accept QR codes. To put it another way, all users have to do is generate them. For real-time tracking, users can use them on product packaging. Although many shops usually make them at least twice as big, these codes can be as small as 1 cm x 1 cm. Furthermore, they are not constrained in terms of the amount of data they can hold, regardless of how small they are. Additionally, the code is clever enough to be read by almost any scanner, even if it isn't placed exactly right.

The major benefit of QR codes for inventory management is how much data can be obtained from just a quick scan. QR code can support more than 100 times as many numeric characters. The quantity of information that may be provided is simply astounding, from URLs to product specifics. Additionally, the data is encrypted, which may contribute to a more secure management system. Because QR codes have three layers of detection, it is simpler to spot minor errors before they become a financial disaster.

The QR code must be at least 70% intact, which is one of its primary limitations. The sticker or print won't function at all if it is ripped, dirty, or improperly produced. Find a QR code generator that permits for limitless reprinting if you're utilizing this inventory management so you can quickly switch out labels.

2.2.3 Summary of the Existing System

Table 2.2.3 Summary of the Existing System

Existing System	Advantages	Disadvantage
RFID for inventory management	- Lower labor costs - Quick scanning.	- security issue - high implementation cost
Barcode for inventory management	- Minimize human mistake - Low implementation cost	- Limited scanning range - limited data storage on the tags
QR Code for inventory management	- Can store a large number of numeric characters on tags - Data is encrypted	- Must be at least 70% intact.

2.3 Concluding Remark

In this chapter, some review of the technologies and review on existing system had been done. For the review of the technologies, some review had been done on hardware, database, and programming language. Finally, Chainway C72 has been selected as the hardware, Microsoft SQL Server had been selected for the database, and Java had been selected for the programming language that will be use in this project.

Chapter 3
System Methodology/Approach OR System Model

The project process is divided into different stages in the development process, namely pre-project development, data pre-processing, model training architecture construction and data training, and test data set prediction.

3.1 System Development Model

3.1.1 Waterfall

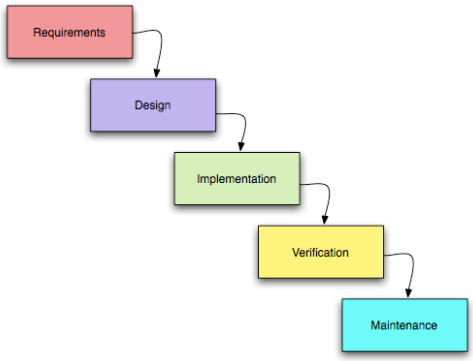

Figure 3.1.1 Example of Waterfall Model

Based on [13], the Waterfall model, also known as the waterfall methodology, is a progressive development process that flows like a waterfall through all project phases (such as analysis, design, development, and testing), with each phase completely finished before the initiation of the next.

Many believe that the "measure twice, chop once" philosophy and the waterfall methodology are equivalent. The effectiveness of the Waterfall approach depends on the quantity and quality of work completed upfront, including the documentation of all features, iterations, user requirements, and interface design. The majority of the research is completed up front, allowing for more accurate time estimations for each requirement and, ultimately, a more predictable release date. If parameters change along the way, it is more challenging to change course with a Waterfall project than it is with Agile technique.

3.1.2 Iterative

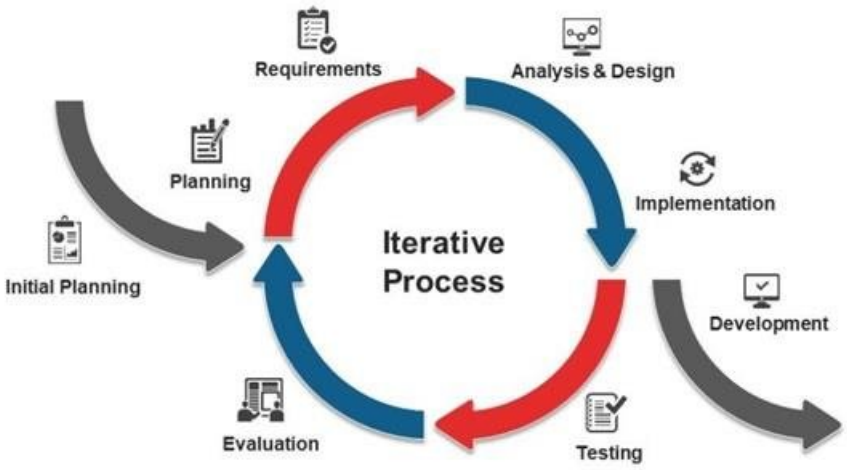

Figure 3.1.2 Example of Iterative Model

Based on [14], In the iterative system development model, the procedure iteratively improves the evolving versions until the entire system is developed and prepared for deployment. It begins with a rudimentary implementation of a limited set of software requirements.

An iterative process implementation of a part of the software system is the beginning of an iterative process, which incrementally improves the developing versions until the entire system is completed. With each generation, new practical features are incorporated in addition to altered designs. This method's central notion is to build a system by repeatedly repeating cycles while focusing on smaller parts at a time (incremental).

3.1.3 DevOps

Figure 3.1.3 Example of DevOps Model

Based on [15], DevOps is a methodology aims to enhance productivity throughout the whole software development lifecycle. DevOps implies that an IT team's design software that fully satisfies user requirements, instals quickly, and performs well right away. To do this, organisations use a mix of culture and technology.

DevOps proponents employ containers or other techniques to ensure the programme behave consistently from development through testing and into production in order to release good code. They implement modifications one at a time so that issues may be tracked. For consistent hosting and deployment environments, teams rely on configuration management. Code modifications are frequently made in response to issues they find during live operations, frequently following a transparent post-mortem analysis and regular feedback loops.

3.1.5 Selected Model

The system development model that will be implement in this project is the iterative model. This is because early on in the development process, a functioning model of the system exists, making it simpler to identify functional or design faults. Finding problems early on allows for the implementation of solutions with a constrained budget. Besides, with this system development model, testing and debugging will be easier during smaller iteration system.

3.2 System Requirement

The overall system developed consists of three parts: hardware, software, and database. The hardware used in this project will be RFID mobile reader, RFID tags and a computer. The software used in this project are Android Studio and Microsoft SQL Server.

3.2.1 Hardware

The hardware involved in this project is RFID tag, portable RFID reader, and computer. The RFID tags will be embedded, sewn or heat sealed on the linen for tracking. The portable RFID reader are issued to read the RFID tags and store the data into the database. A computer issued for the access the user interface of the linen monitoring system to monitor or track the linen.

Table 3.2.1.1 Specifications of laptop

Description	Specifications
Model	Asus ROG Strix G173QC
Processor	AMD Ryzen 7 5800H
Operating System	Windows 10
Graphic	NVIDIA GeForce RTX 3050 4GB VRAM
Memory	16GB DDR4 RAM
Storage	256 GB M.2 SSD + 1TB SATA SSD

Table 3.2.1.2 Specifications of portable RFID reader

Description	Specifications
CPU	Cortex-A53 Octa-core 2.5 GHz
RAM+ROM	3 GB + 32 GB / 4 GB + 64 GB
Expansion	Supports up to 128 GB Micro SD card
Operating System	Android 8.1; Soti MobiControl, SafeUEM supported

Table 3.2.1.3 Specifications of RFID tags

Description	LinTag 200		
Type	embed	Stitch	Hot seal
Base Model Number	6F8991-001	6F8990-001	6F8992-001
Operating Frequency	860-960 MHz (worldwide)		
Chip Type	MONZA M5		
Memory	128-bit EPC		
Reading Distance	Up to 23 ft (7 m)		
Size	64 × 22 mm	64 × 28 mm	64 × 22 mm
Thickness	1.7 mm at module, 0.9 mm over rest of tag		
Mounting Method	Sew into pouch	Stitch onto fabric	Apply via heat-seal

3.2.2 Software

The most important software is the Android Studio. This software is used to develop the application for the RFID mobile reader so that it can perform some function such as read RFID tags and store them into the database. Besides that, Microsoft SQL Server will be used as the database for data storing. Other than that, SQL also will be used to work with the data in the database, JavaScript will be used to design the user interface of the system and also some programming language such as python, C++ and java will be used to program the system.

3.3 Functional Requirement

The functional requirement of the project is user can use RFID mobile reader with the application developed on it to scan the RFID tags. This application requires to allow user to scan the tag in single mode and auto mode. In single mode, user need to click the start button every time to scan the tag. In auto mode, the user can scan as many tags as he wants until he clicks the stop button.

Other than that, user also can use the filter function to filter out the data that he wants. At the same time when the user scans the tags, the record will be automatically store to the database, and all these record that store in the database also will be use for data monitoring on the user interface.

After that, user can do some data monitoring on the user interface. At the user interface, there will be a table that contain the records. The records will contain time when RFID mobile reader scan the tag, data, count and RSSI of the RFID tags. This allows user to do data monitoring at anywhere and anytime by only need to go to the user interface.

3.4 Project Milestone

Task Description	Start Date	End Date	Week													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
FYP 1	**13/06/2022**	**2/9/2022**														
Project Analysis	13/06/2022	14/07/2022														
Gather information about the assignment	13/06/2022	30/06/2022														
Define the objective of the project	1/7/2022	6/7/2022														
Determine which programming language will be used	7/7/2022	14/07/2022														
Project Development	**15/07/2022**	**16/08/2022**														
Getting familiar with the hardware device that will be used	15/07/2022	16/07/2022														
Developing read function of the application	17/07/2022	6/8/2022														
Developing function to store data into database	7/8/2022	11/8/2022														
Developing user interface to display data from database	12/8/2022	16/08/2022														
Project Tesing	**17/08/2022**	**2/9/2022**														
Install the application to the RFID portable reader	17/08/2022	17/08/2022														
Test the read function by scanning the RFID tags	18/08/2022	23/08/2022														
Test the database by observing will the data go to database	24/08/2022	29/08/2022														
Test the user interface by observing is the data displayed	30/08/2022	2/9/2022														

Figure 3.6.1 Project Milestone for FYP 1

Task Description	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FYP 2														
Project Revising														
looking for function that can be implement to the application														
Developing setting function of the application														
Improve the user intherface in the application														
improve the user intherface for data monitoring														
Project Tesing														
Test the setting function by scanning the RFID tags														
Test the new user interface of the application														
Test the new user interface for data monitoring														

Figure 3.6.2 Project Milestone for FYP 2

3.4 Concluding Remark

In this chapter, system requirement, functional requirement and project milestone are listed out. System requirement is the brief of what hardware and software have been used in this project, functional requirement is what can user do with the application after it has been develop. The project milestone is to show the project timeline of FYP 1 and also the project timeline for FYP 2.

CHAPTER 4

System Design

4.1 System Architecture

Figure 4.1 System Architecture Diagram

In this system architecture, there will be 4 components, which is RFID tags, RFID mobile reader, database, and a computer.

First, all the RFID tags will come with data and when it scanned by the RFID mobile reader, the data will be display on the RFID mobile reader. At the same time, the record of that contain timestamp, data of the RFID tags, count of the RFID tags has been scanned and also the RSSI of the RFID tags will be store to the database.

After that, user can monitor the record of reading RFID tags on the user interface by using a computer. There will be a table that contain the time of reading the RFID tags, data, count and also the RSSI.

4.2 Functional Modules in the System

In this application, there will be three functional modules, which is read RFID tag in single mode, read RFID tag in auto mode and filter function.

In the single mode, the RFID mobile reader will read the RFID tag only when the user clicks the scan button. This is for the user to scan only one tags or only a small number of tags. The disadvantage of this mode is when there is a large number of tags, user need to click the scan button for many times in order to scan all the tags.

In the auto mode, after the user clicks the start button, the RFID mobile reader will keep scanning for the tags until the user click the stop button. This will be easy for user when there are many tags, user no need to keep clicking the scan button to scan many tags.

For the filter function, user can filter out which tag he want to scan. When user use the filter function, only the RFID tag' data which match with the filter requirement will be scan and show at the RFID mobile reader.

4.3 System Flow

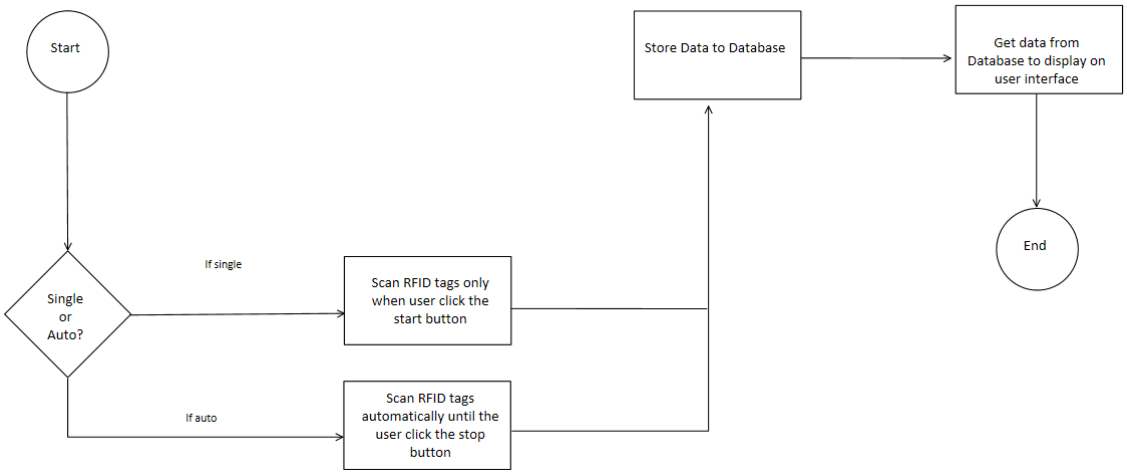

Figure 4.3 System Flow Diagram

After the system start, users can choose single mode or auto mode. If users chose single mode, the RFID portable reader will only read the RFID tags when user click the start button. If the users choose auto mode, after clicking the start button, the RFID portable reader scan RFID tags automatically until the user click the stop button. After that the data will be store to the database. Then the user interface will retrieve data from the database and display the data in a table.

4.4 Database Design

	Column Name	Data Type	Allow Nulls
▶	Time	text	☐
	EPC	text	☑
	EPC_TID	text	☑
	RSSI	text	☑

Figure 4.4 Database design

The design of the database is simple. There will be only 4 columns in the table which is Time, EPC, EPC_TIP and also RSSI. The data type of all these 4 variables are text, which can receive string data from the application of the RFID portable reader. Besides, the Time cannot be null because it is the primary key of this table, all the data will be sort according to it.

4.5 GUI Design

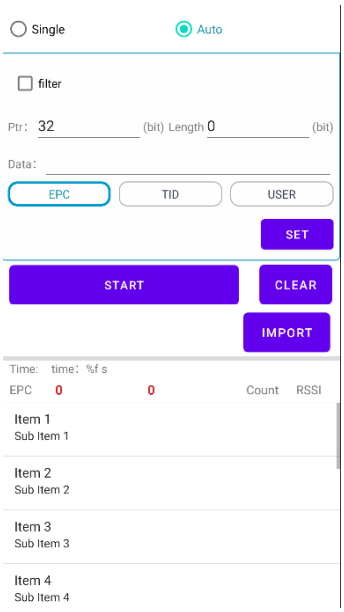

Figure 4.5.1 User Interface design of the application for RFID portable reader

The diagram above is the user interface on the RFID portable mobile reader. First, at the top of the user interface, there will be 2 radio button which are single and auto. These radio buttons are for user to select to read RFID tags in single mode or auto mode. Bellow the radio button is a check list named filter. This check list is to enable and disable the filter function. Bellow it is the filter function, user can enter the parameter that they want, and the reader will only scan the data that match with the filter parameter.

At the next section is the main function of this application which is the read tag function. The start button is to start the scanning process when the user clicks on it. If in the auto mode, after the start button has been clicked, it will change to a stop button. When the stop button has been clicked, it will change back to start button again. The clear button is for the user to clear the data at the display area. The import button is for user to send the data to the database. Last but not lease, the section at the bottom of the user interface is the display area. This area will display the data that read by the RFID portable reader.

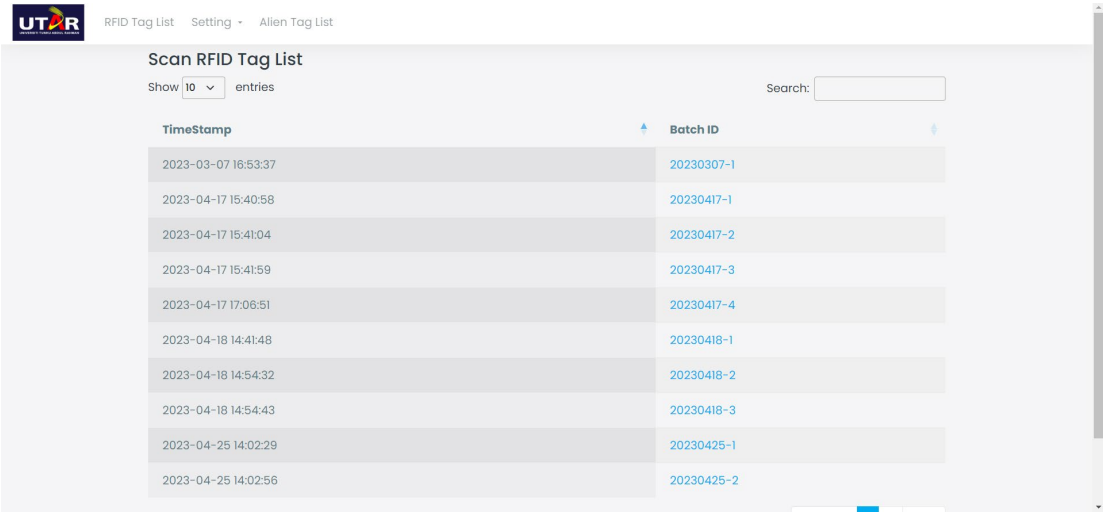

Figure 4.5.2 User Interface design of on computer for data monitoring

The diagram above is the user interface for data monitoring. This user interface will retrieve data from database and display the data in a table.

4.5 Concluding Remark

In this chapter, system architecture, functional module in the system and system flow of this project has been explained. Besides, this chapter also explain database design and also design of graphic user interface.

CHAPTER 5

System Implementation

5.1 Hardware Setup

The setup of hardware is separated into three parts:

- **Computer**
- **RFID Mobile Reader**
- **RFID Tags**

The computer needs to be power on. Then connect the computer to connect to the hospital internet, so that it's able to get data and also store data from and into the database. Besides the computer also needs internet to view the admin management pages of the system, so that user can view and change the data of the RFID tags in the admin management pages.

The RFID mobile reader also need to be power on. Then connect the RFID mobile reader to the hospital internet, so that it's able to get data and store data from and into the database. After that, user need to install the reader application into the RFID mobile reader. There are two ways to install the application. The first way is by connect the RFID mobile reader to the computer with a cable, then, click run application on the Android Studio in the computer, the application will be installed in the RFID mobile reader, and the cable can be unplugged. The second way is by download it online. Create a APK file which is a mobile application installer file of the application, then upload it online or commit it to the play store, then download it to the RFID mobile reader and install it.

The RFID tags needs to be hot-seal, Stitch or sew on the linen of the hospital. Then user need to user the reader and scan the RFID tag to make sure the data of the linen is correct. If the data is incorrect or empty, user need to first enter the correct the data into the RFID tag, so that the RFID tag will not be showing incorrect information when in used.

5.2 Software Setup

The setup of software is separated into two parts:

- **RFID mobile reader application**
- **Admin Management website**

For the RFID mobile reader application, first need to make sure it can run without any error or bugs. Then the application can be deployed and to be used. The application can be deployed in two ways, which is connect a cable to the RFID mobile reader and deploy or deploy it as a APK file and upload to online so that the RFID mobile reader can download the APK file and install it.

For the Admin Management website, the first step is to check is that any error and bugs and is all the function on the website can run smoothly. If there is no problem, then can publish the website so that the user can connect to the website to view and change data on it.

5. 3 Setting and Configuration

For the setting and configuration of the RFID mobile reader, first user needs to enable all the permission that required by the application, so that all the function in the application can run smoothly without errors. Other that that, user need to configure the connection information of the application. This connection information is to connect the application to the database that required. User needs to enter the IP address of the database located, the port number, the database name and also the login credential to the database. Then, all the setting and configuration of the RFID mobile reader have already done.

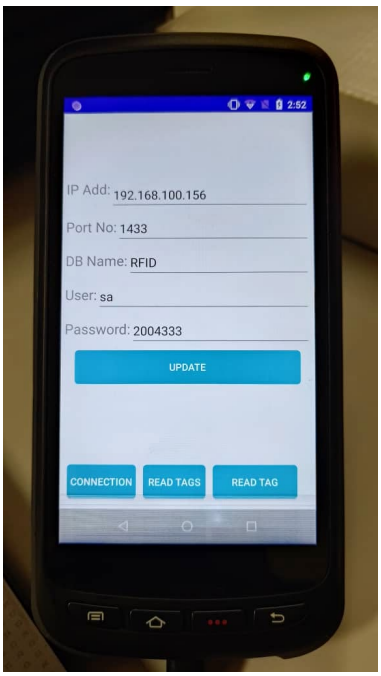

Figure 5.3.1 Connection configuration page in the RFID mobile reader application.

5.4 System Operation

When user start the RFID mobile reader application, the front page of the application will be showed.

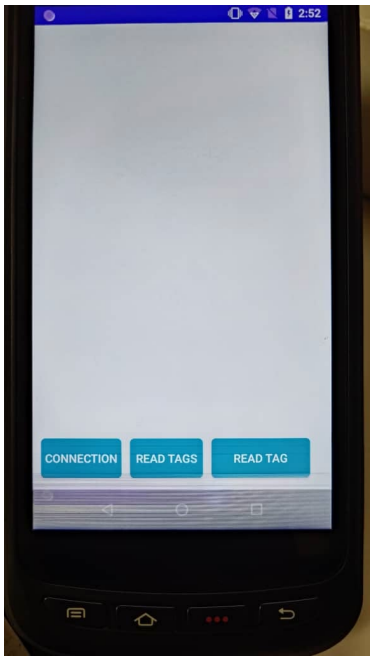

Figure 5.4.1 the front page of the RFID mobile reader.

This front pages only contain 3 buttons, which is connection button, read tags button and read tag button. The connection button is to navigate to the page that allow user to configure the connection information. The read tags button will navigate user to the page that allow user to read multiple RFID tags and store into the database. The read tag button will navigate user to the page that allow user to scan a RFID tag and modify the data of the RFID tag.

In the connection page, it only contains 5 input text and one button. These 5 input text are IP address, Port number, Database name, login name and login password. User can input the correct information and click the update button, then the application will be enabled to connect to the correct database.

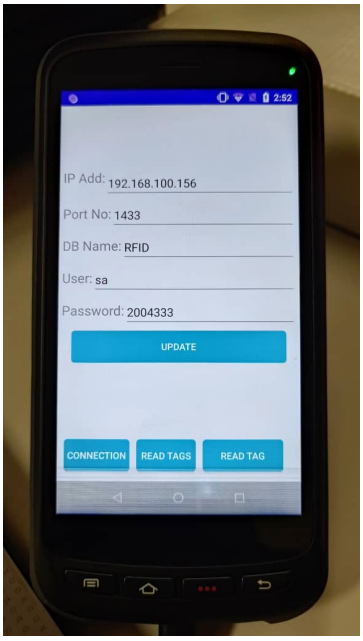

Figure 5.4.2 The connection page of the RFID mobile reader application

In the read tags pages, when user click the start button, the reader will start to read RFID tags until user click the stop button.

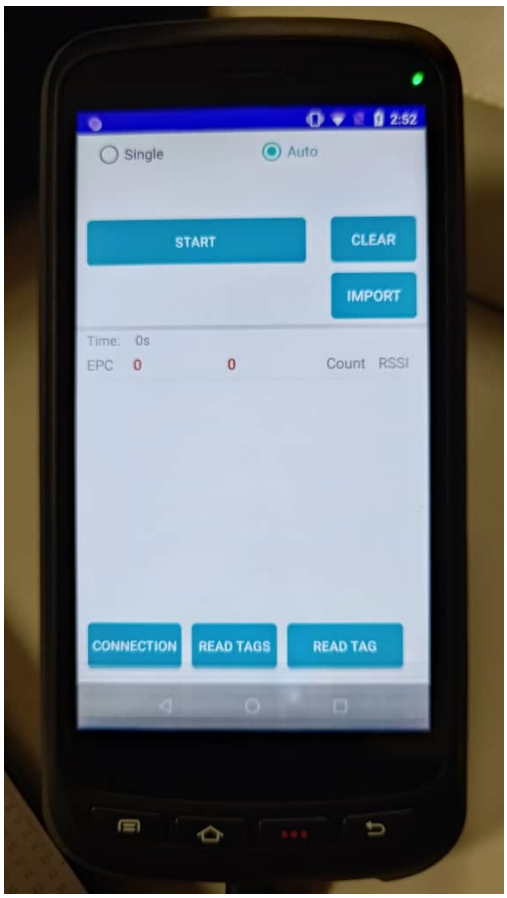

Figure 5.4.3 The read tags page of the RFID mobile reader application.

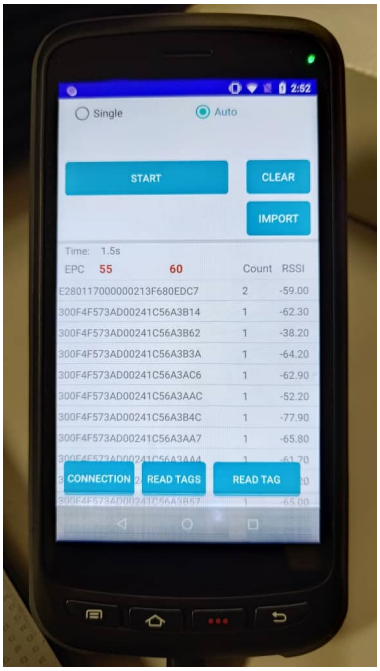

Figure 5.4.4 The RFID mobile reader read a list of RFID tags.

After the RFID mobile reader have read some RFID tags, the RFID tags read will be showed at the bottom box area. Then, if user want to store it into the database, user can click the import button to store the data into the database. If user want to scan another RFID tags, user can click the clear button first, to clear all the data read and click the start button to read another RFID tags.

In the read tag page, when user click the read button, the RFID mobile reader will read the RFID tag and show the data of the RFID tag at the bottom area.

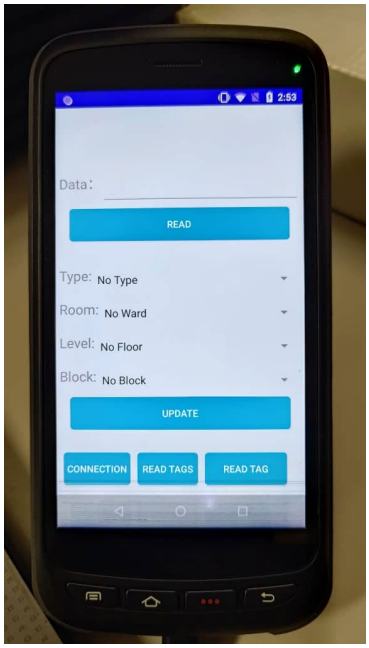

Figure 5.4.5 The read tag page of the RFID mobile reader application

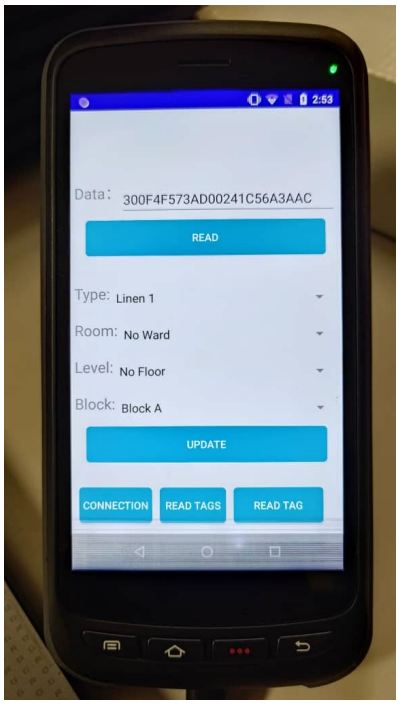

Figure 5.4.6 The RFID mobile reader have read a RFID tag and show the data.

If user wants to change the data of the RFID tag, user can just click on the data that want to change, a drop-down list will appear, and user can choose a data from the list.

5.5 Concluding Remark

In this chapter, hardware setup, software setup, setting and configuration and system operation has been explained.

CHAPTER 6

System Evaluation and Discussion

6.1 System Testing and Performance Metrics

After the application for the RFID mobile reader has been developed, a system testing will be necessary. For the expected system testing, RFID tags, RFID mobile reader and a computer will be needed. To test the system, the user needs to use the RFID mobile reader with the developed application on it, to scan the RFID tags.

For the expected performance Metrics, in this system there will be three performance metrics can be measured, which are:

- Time taken to scan all the RFID tags.
- The accuracy of the reader
- The data can be store into and taken from the database.

The first performance metric is time taken to scan all the RFID tags. The reader needs to scan all the RFID tags in a short time such as no longer than 2 second. If the scanner takes a longer time to scan all the RFID tags, it will cause that user will need to spend more time to just scan the RFID tags.

The second performance metric is the accuracy of the reader. If there are 55 RFID tags, the reader needs to scan all 55 of the RFID tags, and this is the accuracy of the reader. If the reader only can scan 54 tags, and one tag is missing, user will not know which tag is missing and may need to scan again and may cause a long time to spend to just find one missing tag. So, the accuracy of the reader is important.

The third performance metric is the data can be store into and taken from the database. First, the data must be able to store into the database, so that user can check the data from the admin management page at the office. Besides, the data also must be able to store into the database, so that user can modify the RFID tags' data.

6.2 Testing Setup and Result

Before starting the system testing, a RFID mobile reader with application, a computer and some RFID tags are required. First, put the RFID tags together or separately in a room. Then install the application in the RFID mobile reader and make sure the connection information is correct. The system testing can be started.

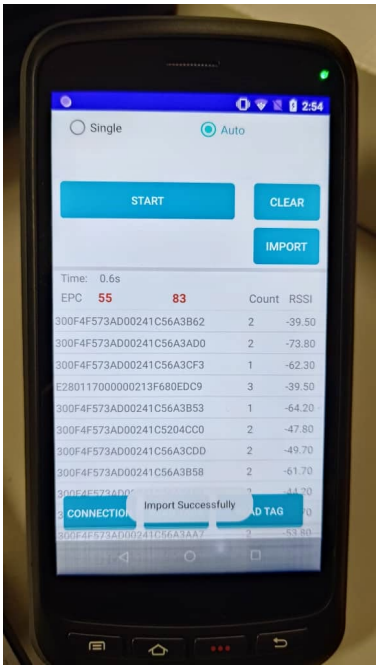

Figure 6.2.1 The result of the system testing 1

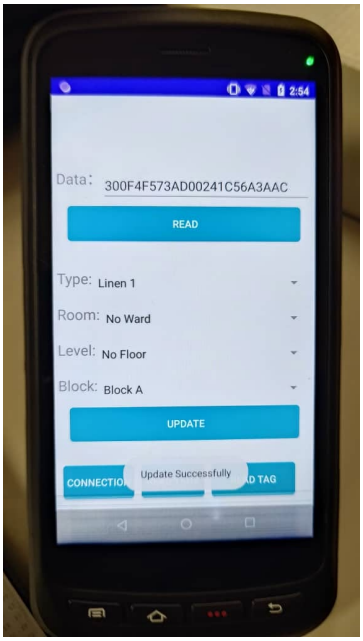

Figure 6.2.2 The result of the system testing 2

The two diagram above show the result of the system testing. In this system testing, 55 RFID tags are used, all 55 of the RFID tags have been scanned. The accuracy of the reader is very accurate. The reader takes 0.6 second to scan all the RFID tags, so the time taken by the reader to scan all the RFID tags is short enough. Last but not least, the data read are able to store into the database and also read from the database and data can be modified. This result showed that this system is useable.

6.3 Project Challenges

since that the application that will be develop in this project is an application for the RFID portable reader, so there will be many functions, methods, and library that are specifically use by the RFID portable reader. These function, methods and library will not suitable and incompatible for other device including the virtual machine in the Android Studio that allow developer to test their application. The application develop only can be run on the RFID portable reader itself, so it will be very inconvenient when the RFID mobile reader is not available or when the RFID portable reader is not around with the developer. The developer needs to wait until the RFID portable reader is available to test the application developed.

Other than that, library that will be used to develop the application for the RFID portable reader also difficult to find. Since that application development for RFID portable reader is not so popular, so there is just a very small amount of library can be found on the internet. Without the library, the application development will become very difficult, and the time need to develop the application in increase.

6.4 Objective Evaluation

The first objective of this project is to develop an application for the RFID mobile reader. This objective has been achieved since that the application is working find in the RFID mobile reader. All the function in the application can work in a good condition, so this objective can be consider as achieved.

The second objective is to implement a database to store data read by the mobile reader. This objective has been achieved since that all the data read by the RFID mobile reader can be stored into the database. Besides, the data also can be read from the database and modify the data. So, this objective can be consider as achieved.

The third objective is to develop a user interface for data monitoring. This objective has been achieved since that the data monitoring user interface has been developed and works find. Besides, this data monitoring user interface also can be user to modify the data of the RFID tag stored inside the database. So, this objective can be consider as achieved.

6.5 Concluding Remark

In this chapter, system testing and performance metrics, testing setup and result, project challenges and objective evaluation has been explained.

CHAPTER 7

Conclusion

All of all, RFID have many strengths such aa quick scanning, long scanning range, can scan up to 100 tags at one time without revealing a single tag. So, using RFID in linen monitoring at UTAR Hospital also can bring many benefits such as reduce labour cost, convenient and user friendly, high efficiency.

Since that, this project is focus on the RFID portable reader, the main objective of this project is to develop an application for the RFID portable reader. The application developed will having a read tag function with 2 mode, single mode, and auto mode. Single mode allow user to scan tag one by one, while auto mode will scan tag automatically until the user click the stop button. Then the data scan by the RFID portable reader will be able to send to the database which will be retrieve by a user interface and display in a table for data monitoring.

Although there were some challenges had been encountered, but this project is still able to continue development and finally get an application for the RFID portable reader.

Recommendation

For the recommendation for the next developer, a login and logout function can be added to this system, to ensure the security of the system. Since that the RFID mobile reader have the ability of reading a barcode, so a function that read the barcode on the identification card to allow user login can be done.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 2**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

A simple application for RFID mobile reader done in FYP1.

2. WORK TO BE DONE

improve the application.

3. PROBLEMS ENCOUNTERED

No.

4. SELF EVALUATION OF THE PROGRESS

On progress.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 4**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

Halfway improving the simple application for RFID mobile reader done in FYP1.

2. WORK TO BE DONE

Improve the application.

3. PROBLEMS ENCOUNTERED

No.

4. SELF EVALUATION OF THE PROGRESS

On progress.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 6**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

Halfway improving the simple application for RFID mobile reader done in FYP1.

2. WORK TO BE DONE

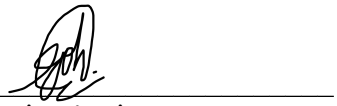
Improve the application.

3. PROBLEMS ENCOUNTERED

No.

4. SELF EVALUATION OF THE PROGRESS

On progress.



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 8**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

Complete the improvement the simple application for RFID mobile reader done in FYP1.

2. WORK TO BE DONE

Develop a User interface for data monitoring

3. PROBLEMS ENCOUNTERED

No.

4. SELF EVALUATION OF THE PROGRESS

On progress.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 10**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

Developed the user interface for data monitoring

2. WORK TO BE DONE

System testing

3. PROBLEMS ENCOUNTERED

No.

4. SELF EVALUATION OF THE PROGRESS

On progress.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3T3	**Study week no.: 12**
Student Name & ID: LAI HOI YIN 20ACB04333	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Mobile RFID Linen Monitoring for UTAR Hospital	

1. WORK DONE

System testing

2. WORK TO BE DONE

Writing reports and preparing for presentation and Demonstration.

3. PROBLEMS ENCOUNTERED

No.

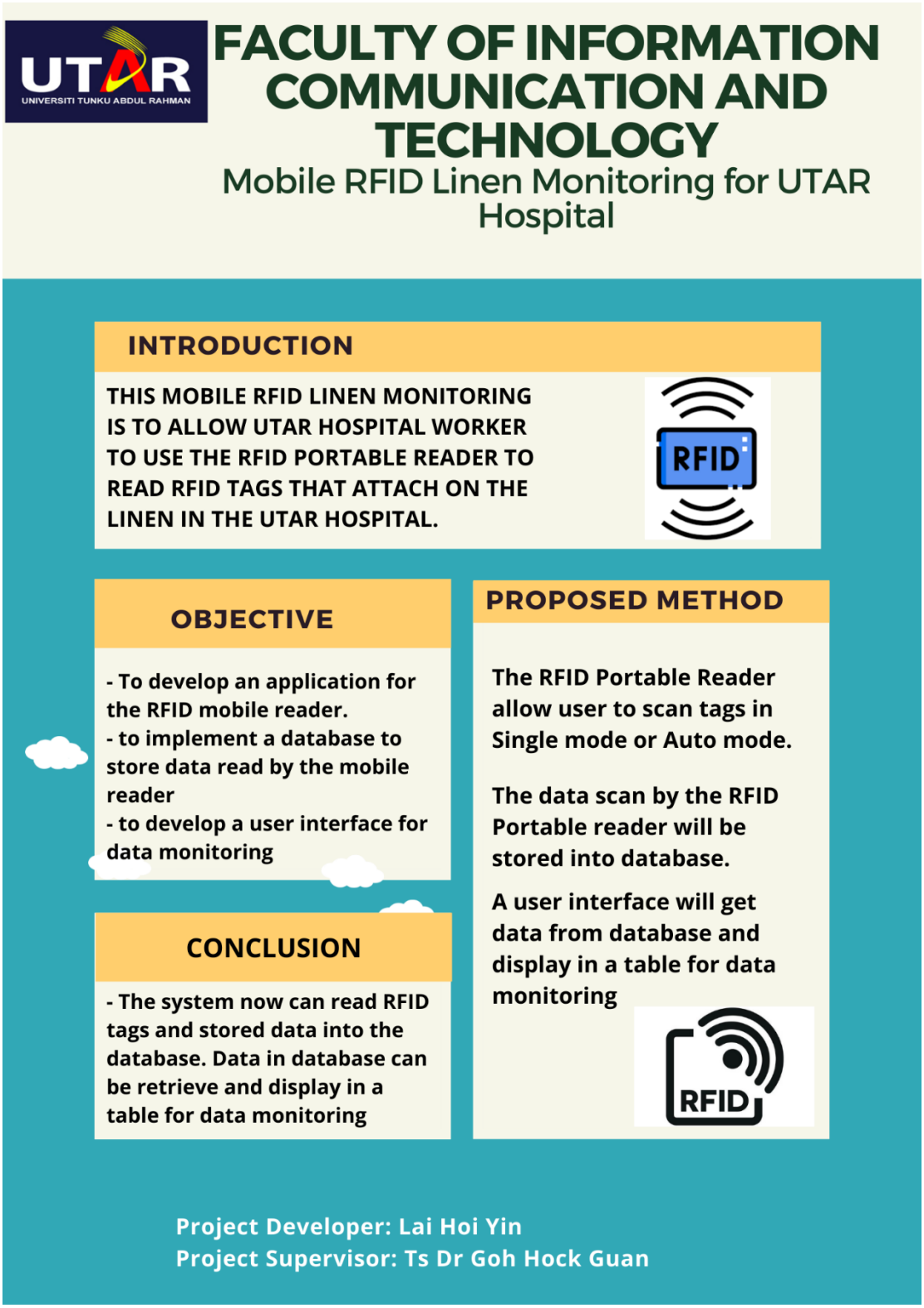
4. SELF EVALUATION OF THE PROGRESS

On progress.

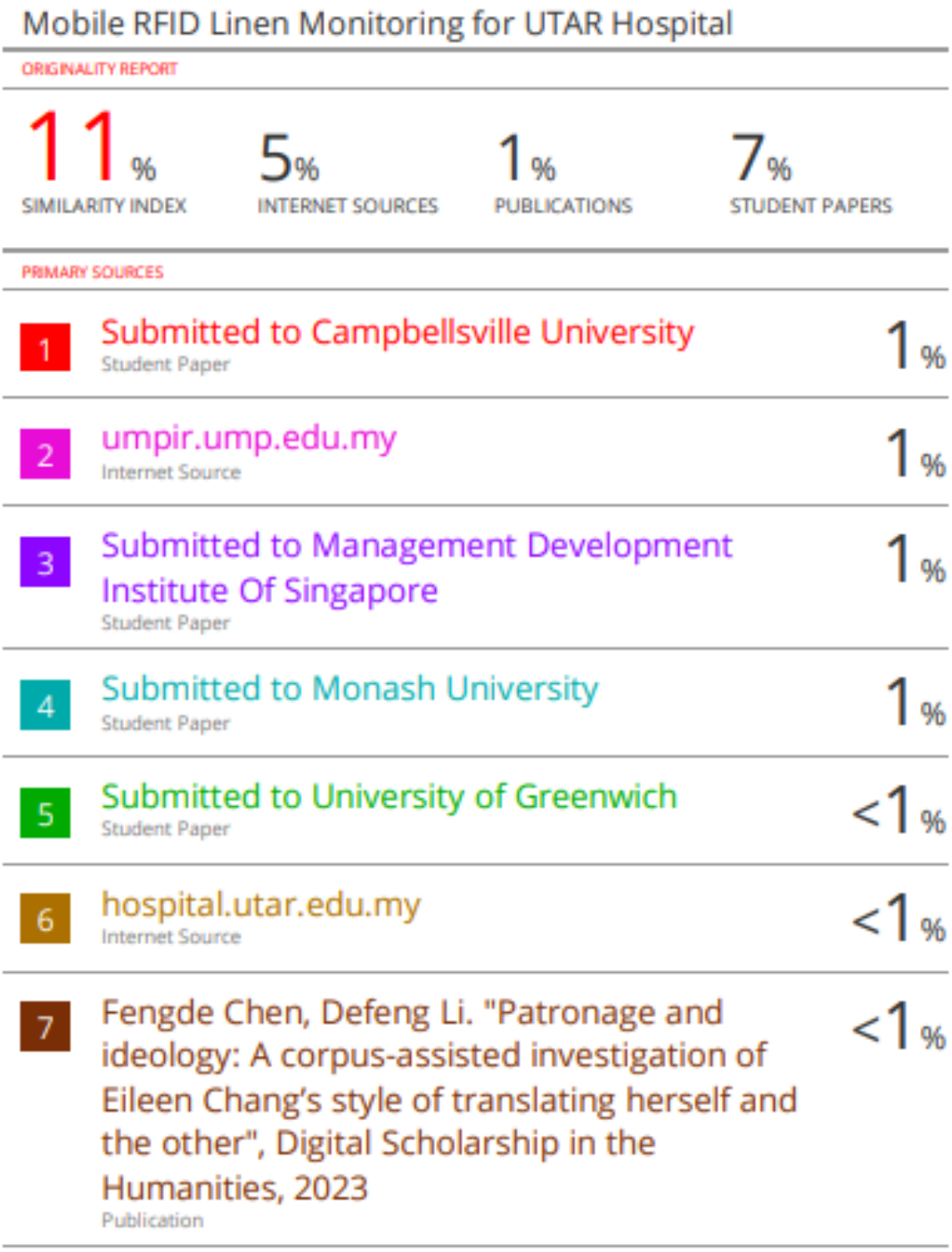
Supervisor's signature

Student's signature

POSTER


UTAR
UNIVERSITI TUNKU ABDUL RAHMAN
FACULTY OF INFORMATION COMMUNICATION AND TECHNOLOGY
Mobile RFID Linen Monitoring for UTAR Hospital
INTRODUCTION
THIS MOBILE RFID LINEN MONITORING IS TO ALLOW UTAR HOSPITAL WORKER TO USE THE RFID PORTABLE READER TO READ RFID TAGS THAT ATTACH ON THE LINEN IN THE UTAR HOSPITAL.
RFID
OBJECTIVE
- To develop an application for the RFID mobile reader.
- to implement a database to store data read by the mobile reader
- to develop a user interface for data monitoring
PROPOSED METHOD
The RFID Portable Reader allow user to scan tags in Single mode or Auto mode.
The data scan by the RFID Portable reader will be stored into database.
A user interface will get data from database and display in a table for data monitoring
RFID
CONCLUSION
- The system now can read RFID tags and stored data into the database. Data in database can be retrieve and display in a table for data monitoring
Project Developer: Lai Hoi Yin
Project Supervisor: Ts Dr Goh Hock Guan

PLAGIARISM CHECK RESULT



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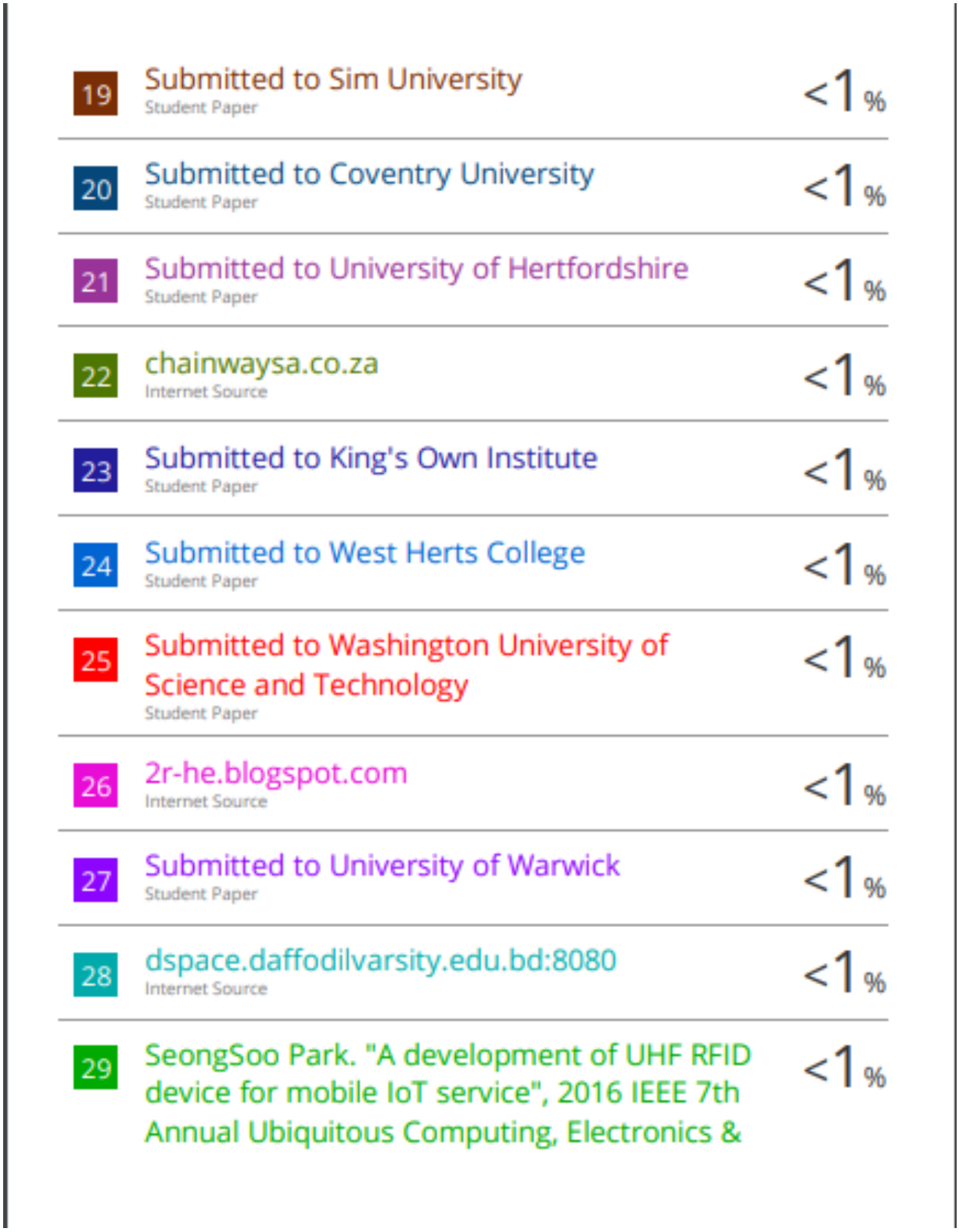
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ID Number(s)	20ACB04333
Programme / Course	BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) COMMUNICATIONS AND NETWORKING
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