UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **LAB EQUIPMENT TRACKING SYSTEM USING RFID**

SESI PENGAJIAN: **2011/2012**

Saya **MUHAMMAD AFANDI B BAHARUDIN (890417-08-5685)**
(HURUF BESAR)

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Alamat Tetap:

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NOOR ZIRWATUL AHLAM BT NAHARUDDIN

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LAB EQUIPMENT TRACKING SYSTEM USING RFID

MUHAMMAD AFANDI B BAHARUDIN

This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Hons.) (Electronics)

Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang

6 JUNE, 2012

SUPERVISOR'S DECLARATION

" I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering (Electronics)".

Signature : .....

Name of Supervisor : NOOR ZIRWATUL AHLAM BT NAHARUDDIN

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ABSTRACT

Monitoring laboratory equipment record is important to ensure every item is always in place. Generally, in and out equipment is handled manually by technician by writing down the equipment information, including time and date in equipment circulation form. Radio Frequency Identification (RFID) is one of the most practical and applicable in real implementation in-line with the nature where most of the systems are made computerized. In this project, I want to design laboratory equipment monitoring system using RFID technology. The RFID tag is tagged on the laboratory equipment where the tag contains laboratory equipment information and RFID reader is located at the door of each laboratory room. This monitoring system enables the head of laboratory and technician to monitor in-out equipment in actual environment and also increase the efficiency in managing equipment in the laboratory. Besides that, this system had been build using LABVIEW to create the block diagram for reading and the database system. The database for all the equipment information had been store in Microsoft Access and all the data including data logging from laboratory equipment can been seen from the output table. This system can easily access by laboratory staff to manage the equipment data. Benefits of the system include enhancement of the safety of University asset and reduce losses of assets and enhancement of the laboratory inventory control of equipment

ABSTRAK

Rekod pemantauan peralatan makmal adalah penting untuk memastikan setiap peralatan adalah sentiasa di tempat yang betul. Secara umumnya, rekod keluar masuk peralatan dikendalikan secara manual oleh juruteknik dengan menulis maklumat kelengkapan, termasuk masa dan tarikh dalam bentuk borang. Pengenalpastian Frekuensi Radio (RFID) merupakan salah satu yang paling praktikal dan boleh diguna pakai dalam pelaksanaan sebenar sejajar dengan sifat di mana kebanyakan sistem yang dibuat sekarang berkomputer. Dalam projek ini, saya ingin merekabentuk sistem pemantauan peralatan makmal menggunakan teknologi RFID. Tag RFID diletakkan ke atas peralatan makmal di mana tag yang mengandungi maklumat peralatan makmal dan pembaca RFID yang terletak di pintu bilik setiap makmal. Sistem pemantauan ini membolehkan ketua makmal dan juruteknik untuk memantau keluar masuk peralatan dalam persekitaran sebenar dan juga meningkatkan kecekapan dalam menguruskan peralatan di makmal. Selain itu, sistem ini telah dibina menggunakan LabVIEW untuk mewujudkan gambarajah blok untuk membaca dan sistem pangkalan data. Pangkalan data bagi semua maklumat peralatan telah dibuat menggunakan Microsoft Acces dan semua data termasuk data dari peralatan makmal boleh dilihat dari jadual output. Sistem ini dengan mudah diakses oleh kakitangan makmal untuk menguruskan data peralatan. Faedah sistem itu termasuklah peningkatan keselamatan aset Universiti dan mengurangkan kerugian aset dan peningkatan kawalan inventori makmal peralatan.

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LIST OF ABBREVIATIONS

RF	Radio frequency
RFID	Radio Frequency Identification
UMP	University of Malaysia Pahang
WEM	Web-based Laboratory Equipment Monitoring
LAN	Local Area Network
PC	Personnel Computer
EPC	Engineering, Procurement and Construction
ISO	International Standards Organization
APF	Authentication Processing Framework
LABVIEW	Laboratory Virtual Instrumentation Engineering Workbench
MS	Microsoft
SQL	Structured Query Language
SDLC	System development life cycle
ID	Identification

CHAPTER 1

INTRODUCTION

DESIGN LAB EQUIPMENT TRACKING SYSTEM USING RFID

1.0 INTRODUCTION

Radio frequency (RF) technology is used in many different applications, such as television, radio and radar. RFID stands for radio frequency identification. RFID is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be attached to or incorporated into a product, animal or person for the purpose of identification using radio waves. Laboratory equipment monitoring system using RFID is proposed to effectively monitor the in-out equipment from the laboratory. Currently, the lab equipment is monitor manually, therefore the system prone to weakness such as misuse of the equipment log records, losses of equipment, no in-out record and misplace of equipments. To overcome these issues, the RFID is selected where it has been widely utilized by many sectors to increase the management efficiency by reducing time and effort. By using RFID, the equipment does not have to be placed directly under reader unlike barcodes.

Radio Frequency Identification (RFID) is one of the automatic identification technologies more in vogue nowadays. There is a wide research and development in this area trying to take maximum advantage of this technology, and in coming years many new applications and research areas will continue to appear. This sudden interest in RFID also brings about some concerns, mainly the security and privacy of those who work with or use tags in their everyday life. [1]

RFID has for some time, been used to access control in many different areas, from asset tracking to limiting access to restricted areas. Although the use of RFID systems in educational institutions is not new, it is intended to show how the use of it came to solve daily problems in our university.

Nowadays, there are so many institutions that have been growing in Malaysia whether private or government. One of that is University of Malaysia Pahang (UMP). Universities in Malaysia still using old method to record in and out data equipment in the laboratory which makes it waste of time plus the total number of laboratory in this university is a lot. This will drive to the data logging error.

In a developing country like ours, lot of latest technology that has been developed such as RFID, wireless, Bluetooth, robot and so on. Therefore, these technologies can be adopted to improve our daily routines so take our life more comfortable and easy. All universities should try adopting these technologies to improve their quality of laboratory management. Besides not being left behind in latest development, it will produce more quality and efficient management for the laboratory equipment. Equipment management in universities should be done in more advanced method with using the latest technology. This system was developed to help staff to manage the equipment in more effective method.

As for system development and implementation, it should be able to help the staff to managing their equipment systematically. The system must have database that contains equipment information and it must be able to help staff to manipulate data, update database, alert staff accordingly, and also nice interface to make it easier to use. Finally, the equipment management system must be user friendly for commercial purpose. This thesis will focus on UMP laboratory equipment tracking by using RFID technology.

1.1 PROBLEM STATEMENT

Most of the labs in universities still use old method to record all data for the lab equipment by manually write it on form before remove the equipment to other lab. This method will cause a problem if the form is lost. Difficulty will follow afterwards if the lab equipment itself lost from the lab. This kind of method will notice a few staff about the transfer of the lab equipment and it waste of time for the staff to re-check the data of the transferred equipment. In Universiti Malaysia Pahang lab also still use this kind of method.

In the matter of controlling and monitoring all the lab equipments in all laboratories plus there is lack of lab assistant staff to monitor all the equipment, it is important to have an efficient system to monitor all the facilities in one room. The entire data log about equipment in lab will be stored in one server to make an efficient management.

Each equipment will be tag by RFID card that store the id number that will match the data from the database while each reader was located in each lab will uniquely identify the physical location of the lab so the server will know the location of all the equipments. All processing power has to be on the server and not on the readers or else the latter will have to be loaded with the entire information on type of equipment, staff in charge and time.

1.2 RESEARCH OBJECTIVE

The objectives of this research are:

a) To implement RFID technology in lab equipment tracking system

b) To record the RFID tags from the RFID reader and stored in system database

1.3 Scope of the Project

In order to achieve the objective of the project, several scopes have been outlined. The main scope of this project is to verify in and out equipment information for UMP lab. It also includes database, monitoring and interface. The interface is to connect the RFID with the database, manage the equipment information automatically. Other scopes of this project are:

1. This tracking system was developed for UMP laboratory only.
2. Users of this system are administrator, laboratory staff in UMP only.
3. Administrators can update, add or delete students and lecturer's data, view attendance record, and can block the use of the system.
4. Analyze equipment transferred data for each day to check if there are any losses.

1.4 PROJECT INTEREST

In general, the system will help to improve the accuracy, efficiency, and productivity in managing asset. It also increases the accessibility of the information regardless of location and time, and most importantly the system is able to integrate information among processes or users. Specifically, the system will help to;

Increase the accuracy of the information, since most of the data that need to be keyed in is validated through pre-defined and pre-coded data.

Increase the efficiency and productivity of the staff involved in managing the asset. Most of the information needs to be keyed in only once, except for that information which needs to be updated such as placement/ reallocation and inspection history.

The information can be accessed by the users with different access level after they have successfully authenticated themselves to the system; this will enhance the consistency of the data.

One of the objectives of the audit exercise is to make sure that the practice of managing asset complies with the UMP procedures and regulations. Having the system implemented, the potential problems which might occur during the audit exercise will be minimized.

1.5 CONCLUSION

By knowing the problems and requirements required by the organization, a system was successfully developed. Development of the system will be based on problems be addressed and which can meet the needs of the organization. Apart from the analysis of problems and research needs, objectives and scope project was set to give a preliminary and a more functional clearly to ensure the smooth running of the system has been developed.

However, the development of more effective systems should be based on objectives and scope of the project was determined. Overall, this chapter was describing the early stages carried out before a more thorough study is done to develop this system. This chapter also discussed the information should be recorded and the process flow for the development of systems to be built.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCITION

In the process of system development, literature reviews conducted to understand the theory, methods and technologies associated with systems that have been developed. Background research on the organization and comparative studies of existing systems is also done to more understand the system requirements before the system was developed.

Lab equipment tracking system has been developed using RFID technology. Through this chapter, the technology that will be used will be discussed briefly.

2.1 STUDIES ON TECHNOLOGY, EQUIPMENT AND TECHNIQUES USED TO SOLVE PROBLEM

This section will briefly describe the research done on the technology, equipment and techniques have been used in the development of this system.

2.1.1 Radio frequency identification (RFID)

RFID stands for Radio Frequency Identification, which is a wireless communication technology that is used to uniquely identify tagged objects or people [5]. RFID systems have been widely used in many application areas, such as inventory control, product tracking through manufacturing and assembly, parking lot access and control, container or pallet tracking, ID badges and access control, equipment or personnel tracking in hospitals, etc. [6]

RFID systems use radio waves to transmit information from an integrated circuit tag through a wireless communication to a host computer [7]. These systems consist of three components that are the tag (transponder), the reader (interrogator) and the host computer (controller). The reader communicates with the tags in its wireless range and collects information about the objects to which tags are attached [8]. Compared to other automatic identification technologies, like optical barcode systems, RFID has several advantages, such as tag data can be read automatically without line of sight, thought some materials, simultaneously tag reading and from a range of several meters [9]. RFID has the following main components and figure 2.1 was shows the basic components of RFID systems and concepts.

- RFID Tag / Transponder
- RFID Reader
- RFID Antenna
- PC /Database

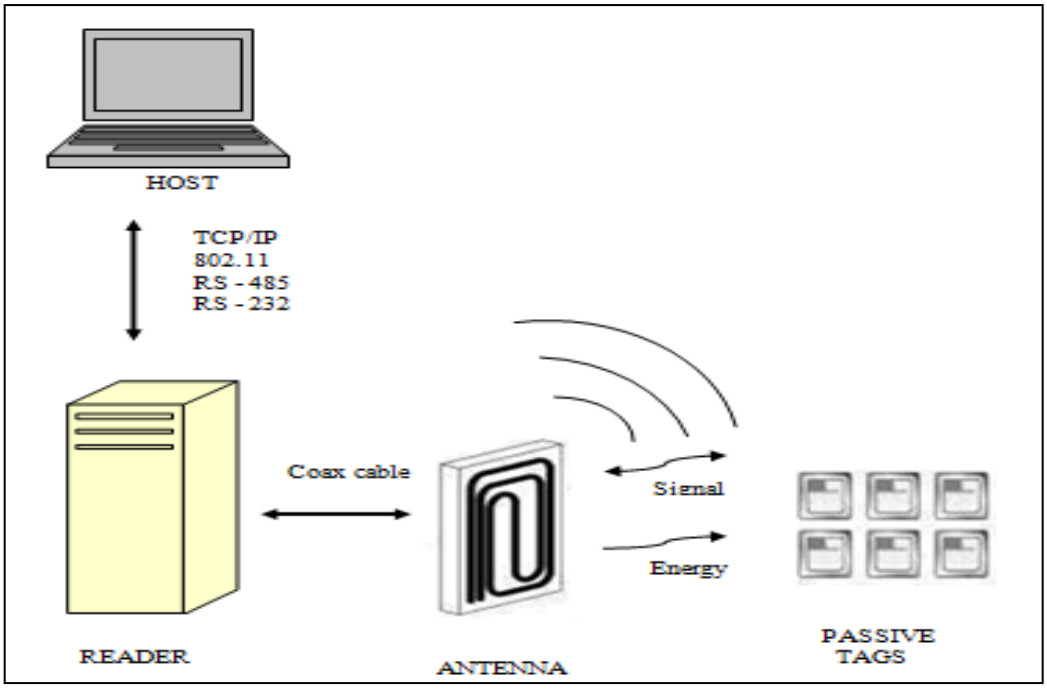

Figure 2.1: The basic components of RFID systems

However, there are three types of RFID tag that are active tags, passive tags and semi-active tags.

2.1.1.1 Active RFID Tag

An RFID tag is an active tag when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry and antenna. Some active tags contain replaceable batteries for years of use, others are sealed units. (Note that It is also possible to connect the tag to an external power source.) [10]

The major advantages of an active RFID tag are:

- It can be read at distances of one hundred feet or more, greatly improving the utility of the device
- It may have other sensors that can use electricity for power.

The problems and disadvantages of an active RFID tag are:

- The tag cannot function without battery power, which limits the lifetime of the tag.
- The tag is typically more expensive, often costing $20 or more each
- The tag is physically larger, which may limit applications.
- The long-term maintenance costs for an active RFID tag can be greater than those of a passive tag if the batteries are replaced.
- Battery outages in an active tag can result in expensive misreads.

Active RFID tags may have all or some of the following features:

- longest communication range of any tag
- the capability to perform independent monitoring and control
- the capability of initiating communications
- the capability of performing diagnostics
- the highest data bandwidth
- active RFID tags may even be equipped with autonomous networking, the tags autonomously determine the best communication path.

2.1.1.2 Passive RFID Tag

A passive tag is an RFID tag that does not contain a battery, the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. [10]

The major disadvantages of a passive RFID tag are:

- The tag can be read only at very short distances, typically a few feet at most. This greatly limits the device for certain applications.
- It may not be possible to include sensors that can use electricity for power.
- The tag remains readable for a very long time, even after the product to which the tag is attached has been sold and is no longer being tracked. [10]

The advantages of a passive tag are:

- The tag functions without a battery, these tags have a useful life of twenty years or more.
- The tag is typically much less expensive to manufacture
- The tag is much smaller (some tags are the size of a grain of rice). These tags have almost unlimited applications in consumer goods and other areas.

2.1.1.3 Semi-Active RFID Tag

Semi-active tag is a similar tag to active tags that have their own power supply such as battery. The difference is the tag uses battery power only to switch on the microchip circuit inside and not to transmit the signal wave to the reader. Radio waves frequency is emitted as a passive tag with reflect the transmitted wave that was sent from reader.

2.1.1.4 RFID Reader

An RFID reader is a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves; the tag responds by sending back its data. A number of factors can affect the distance at which a tag can be read (the read range). The frequency used for identification, the antenna gain, the orientation and polarization of the reader antenna and the transponder antenna, as well as the placement of the tag on the object to be identified will all have an impact on the RFID system's read range.[10]

2.1.1.5 RFID Antenna

Generally, the antenna has been designed and is available in various forms but serve to obtain data from individuals or objects that pass through the antenna. When the inclusion of RFID tags print antenna, the tag was will be able to mark the activation of the antenna and microchip that will generate accumulated in the tag. The next process happens is that it will send information to the microchip was generated by printing antennas. This means that there are interactions between the tag and antenna.

2.2 Web-based Laboratory Equipment Monitoring (WEM) System

RFID system is good for monitoring purpose. In supports of solving problem identified and discussed in the previous chapter, this journal by Mohd Helmy A. Wahab [1] from UTHM intends to implement RFID technology to monitor the laboratory equipments which is named Web-based Laboratory Equipment Monitoring (WEM) System. The main aim of his study is to design the WEM and apply the system in each laboratory room to monitor in-out equipment flow and immediately update through web-based environment.

This project enables the authorized personnel to monitor in or out equipment in real time to replace the manual logging system. So, to overcome this problem the RFID is selected where it has been widely utilized by many sectors to increase management efficiency by reducing time and effort. WEM is divided into 2 components which are software and hardware. In hardware component there are 5 others components which are RFID tag (transponder), RFID reader (interrogator), personal computer, RS232 cable and LAN hub. And for the software part there are 2 components which are database design and web design. The master server contains the database which is used to store all data collected from RFID reader where user can read or change all information in the

database. The RFID tags contain antennas to enable the receiving and transferring data .The passive RFID tag creates power from magnetic field and uses it to energize the circuits of the RFID chip and sends information back to the reader in the form of radio-frequency waves.

WEM interface system developed by using visual basic 6.0 software. There is also the floor plan for WEM system where RFID reader is place at the entrance door in the laboratory and there is a server room to monitor all of the laboratory equipments. [11]

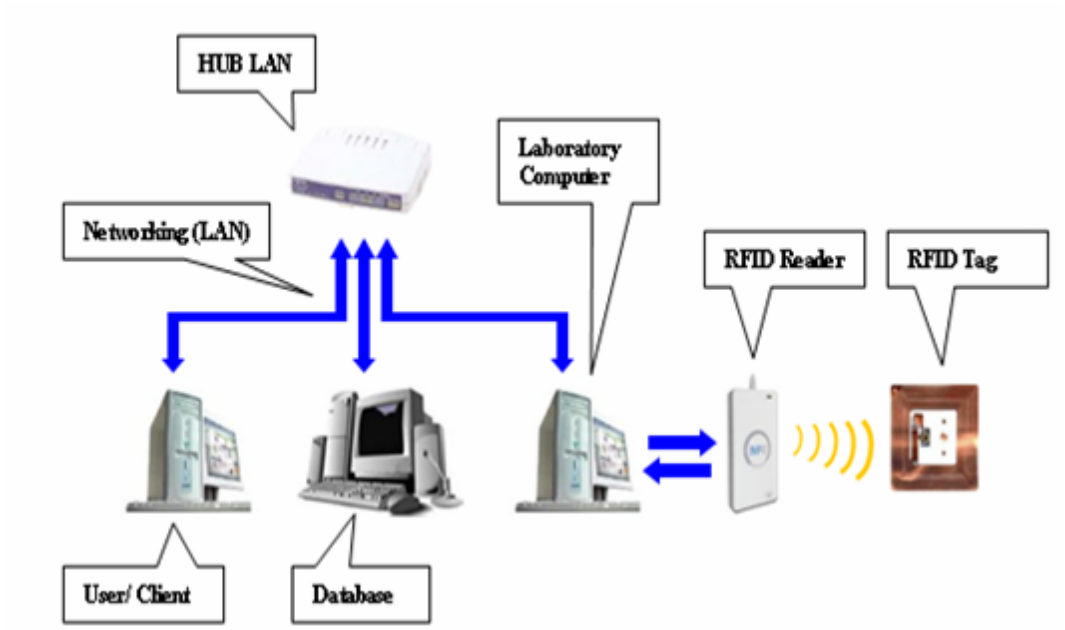

Figure 2.2 Architecture of WEM system

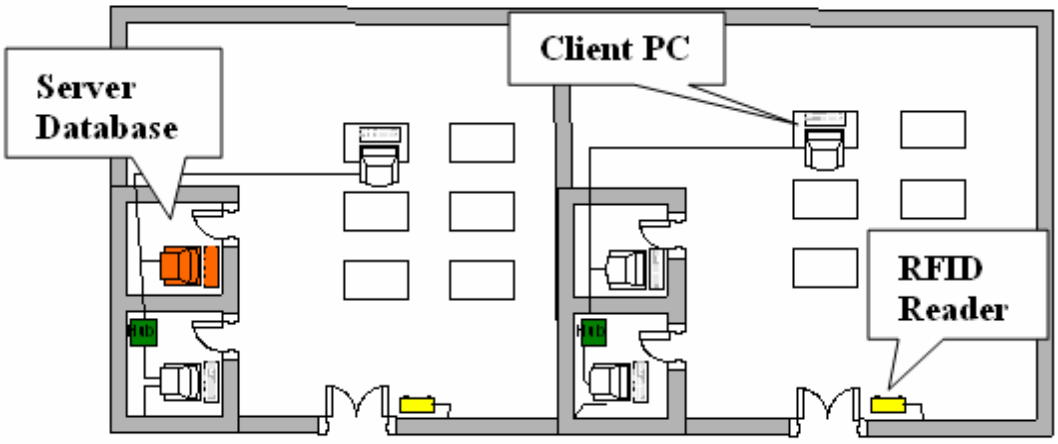

Figure 2.3 WEM System Hardware Proposed floor plan

2.3 RFID development

RFID system had been used and commercialized starting from 1980's. This system had been used worldwide in many applications such as television, radio, radar and many more. The advantage of using RFID is that it does not require direct contact or line of sight scanning. According to the journal from Hazrullizam b Idris[12] about his research of development of tracking system using RFID, an RFID system consists of three components, antenna and transceiver which often combined into one reader and transponder that usually the tag. The antenna use RF waves to transmit the signal to activate the transponder. When activated, the transponders transmit data back to the antenna. The data is to notified a programmable logic controller that an action should occur the action could be as simple as raising an access gate or as complicated as interfacing the database to carry out a monetary transaction.

There are two types of RFID which is active RFID and passive RFID. Active RFID are used on large asset such as cargo container, rail cars and large reusable container which need to be tracked over a long distance. They usually read distance from 60-100 meters. There are two types of active tags, transponder and beacon. For the passive RFID tags, there no power source and no transmitter there cheaper than active tags and no require maintenance. They have much shorter read range under 30 feet. An RFID tags is a device that can be store and transmit data to the reader in contactless manner using radio waves. RFID reader also known as interrogator is a device that can read from and write data to compatible RFID tags. The component that consists in RFID reader is transmitter, receiver, microprocessor, memory, controller, communication interface and power.

The preceding subsections mentioned the advantages and characteristics of RFID, but RFID cannot be well used in all applicable areas. Studies of barcode history showed that it took approximately 25 years from the development of the first barcode by the Drexel Institute of Technology in Philadelphia in 1949 to the first commercial

barcode scanner installation at a Marsh's Supermarket in Ohio in 1974. The developmental timeframe of RFID is similar. Approximately 25 years have passed between the first RFID technology developed by Los Alamos Scientific Laboratories in 1977 and EPC Global's announcement of the EPC Generation 1 RFID standard in 2003. The interval between development and application of RFID is longer than the barcode, because there are several reasons that RFID cannot be used extensively.

First, the price of the tag and reader are still too high. RFID holds much promise for increasing goods screening and monitoring efficiency, but costs still stand in the way. The major reason is that the price of RFID is too high. One reader costs almost $700, while a barcode reader costs only $79. An RFID reader costs nearly nine times more than a barcode reader. A tag has three types, active, semi-active and passive. An active tag costs about $100 and passive tag about 30cents to $50, while barcode tag only 3 cents. For the industry, the price of a tag must be less than 5 cents or the cost is too high to be widely used. Lower price of RFID components is the most important factor to push RFID to be used more extensively.

Second, to integrate the application system costs much. Not only a reader and tag, the application system also cost much. Because all of the old systems need to be replaced, the new systems need to be developed and employees have to be trained to use the new systems. The biggest enterprise in the world Wal-Mart has spent almost $100billion to develop the total process to utilize RFID and it is not complete yet. The risk is too high to develop such a system by enterprises. Not all of them have that many resources and time to develop it. The third reason is that the standard of RFID has not been unified.

There are two major international standards for RFID, i.e., EPC global and International Standards Organization (ISO). Standards are still evolving and are not completely compatible with each other. Using any one of the standard will influence other companies that support another standard. A unified, globally interoperable RFID standard is ideal to realize the full benefits of RFID applications. The lack of a complete

and unified RFID standard has caused many companies to hesitate in adopting the RFID systems; these companies were afraid of making a commitment that might render their entire RFID system investment worthless in the future.

How to unify the standard is also an important issue to make RFID more convenient to be used in the world. Fourth, people think that RFID will invade their personal privacy. RFID tags have the capability of monitoring what we buy and where we go. This makes customers reluctant to accept RFID. The privacy and security is also a very important topic for the growth of RFID in the future. To increase privacy and security, authentication systems are being developed, and individual information protection employing an RFID technology has begun.

Finally RFID is not totally safe yet. RFID transfers data and information by using radio frequency. If people can intercept the signal, the data might be changed or stolen. The forward channel from the reader to the tag has a longer range and is at more risk than the backward channel. Ayoade innovated on the APF (Authentication Processing Framework) to stop thieves from changing the data or information in the tag, but it cannot totally defend all kinds of attack. In the market there is a tag that can provide a code to protect the data in the tag which costs more, but the data cannot be completely secured. Protecting the data in the tag without being changed remains a challenging issue [13]. The purpose of this work is to use LabVIEW to innovate a system that can integrate RFID and database of the products in a lab equipment tracking system to improve the efficiency of the equipment management.

2.4 SOFTWARE DEVELOPMENT REQUIREMENT

This part will explain about LABVIEW and Microsoft Access software. Students are needs to provide justification for the software and hardware needed for the implementation of the project include the need for software development and software needs to operate.

2.4.1 LABVIEW

Laboratory Virtual Instrumentation Engineering Workbench (LabVIEW) is a high-level programming language with Graphical Language developed by National Instruments. It can support interfaces such as GPIB, USB IEEE1394, MODBUS, SERIAL, PARALLEL, IRDA, TCP, UDP, Bluetooth, NET ActiveX, SMTP, etc. LabVIEW is usually used for data acquisition, instrument control, and industrial automation on all kinds of platforms including Microsoft Windows, various flavors of UNIX, Linux, and Mac OS. The version used in this work is version 11.0 (32-bit).

LabVIEW is built for the design, simulation, modification, and compilation of digital instrumentation systems. The basic entity of the resulting program is the virtual instrument (VI) that consists of executable code controlled via a graphical front panel on the screen similar to a real instrument. In contrast to conventional programming languages, LabVIEW is programmed on the basis of block diagrams and front panel elements. These elements are connected by means of a wiring tool. The main application areas are data acquisition, system management and the simulation of a digital signal processing system. In cases where real input/output connections are required, IEC, VXI and MXI compatible equipment with serial links or plug-in boards for the PC can be accessed via available drivers. After having tested a virtual instrument, the graphical language built from an application, compiles standalone executable code. The complied

code is executed with a speed comparable to normal compiled C-programs. The execution code may also contain communication calls for different types of supported platforms. A test executive, available in diagram source code, can be added in order to support tests and modifications at runtime.

Also, the LABVIEW provides an easy-to-use graphical environment that permits the system operators to process easily the collected data, using complex data-processing algorithms, without detailed knowledge of the data-acquisition system design. LabVIEW can integrate the RFID system and the database [13]. The interface of LabVIEW can help us to find out in and out of the lab equipment.

There are 2 familiar software that related to RFID technology which are LABVIEW and Visual Basic. There are few advantages of using LABVIEW instead of Visual Basic:

- User friendly interfaces
- Fast data transfer to the database
- Reusability and readability of codes for future developers
- A lot of references compare to Visual basic
- Efficient control

2.4.2 MICROSOFT ACCESS

Microsoft Office Access, previously known as Microsoft Access, is a database management system from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software-development tools. It is a member of the Microsoft Office suite of applications, included in the Professional and higher editions or sold separately. On May 12, 2010, the current version of Microsoft Access 2010 was released by Microsoft in Office 2010; Microsoft Office Access 2007 was the prior version. MS Access stores data in its own format based on the Access Jet Database Engine. It can also import or link directly to data stored in other applications and databases. Software developers and data architects can use Microsoft Access to develop application software, and "power users" can use it to build software applications.

Microsoft Access requirements:

- Manage small amount of data
- Deployed in Microsoft Windows
- Single-User Application

2.5 RELATED WORK

This section describes previous projects regarding lab equipment tracking system. Data equipment record is important to increase the efficiency of lab equipment management. Thus, many researchers have been discovered in this area to improve and replace the traditional way using paper with the current RFID technology. In relation, there are many kinds of development that are related to RFID utilization to maximize potentials and application in the daily life.

Liza Roziayanti bt Yusri designed medical equipment using RFID technology. Medical Equipment Management in Hospital Using RFID is a system based on web development using object-oriented analysis, while programming language used was Multi-user Structured Query Language (mySQL) for the database and LabVIEW software as the Graphical User Interface and as the platform to do editing work in database [14].

Hanisah bt Hamid designed RFID Based Systematic student's attendance Management system. This system should reach regarding security and privacy are maintaining data security, preventing counterfeiting, preventing illegitimate access, preventing unwanted recognition and tracking, and coping with denial of service . Therefore, the use of RFID can be more expanded. This system can analyze automatically the student attendance by recording the student attendance and summarizing the percentage of attendance every student for one semester. By using this method, the student attendance will take fast and efficiently recorded [15].

2.6 SUMMARY

Based on studies done on the existing system, there are some problems that could be improved. The developed system has some aspects of the improvements to the existing weakness especially for the management of the lab equipment that used at present. With the technology and equipment that have been studied, the development of this system was more simple and realistic. In chapter 3, the discussion will be more focused on system development methodology. This section covers the methodology of selected studies, comparative research methodology, and the selected research methodology in detail and analysis of system requirements.

CHAPTER 3

METHODOLOGY

3.0 INTRODUCTION

Early planning is very important to launch the system development work and ensure the success of a system. A software tool should be developed in phases to the development of software development tasks were carried out on a systematic approach. These phases are also functions as a systems development life cycle. The methodology is a combination paradigm, rules, policies, procedures, regulations, standards, techniques, tools, languages and other methods used to analyze and details the requirements and system design. The selection of appropriate development methodology can help simplify the process of system development. Among the major activities that must be addressed during the planning system is carried out to identify the life cycle of the system, methodology, methods, techniques and appropriate equipment or software used and the analysis of system requirements specification.

3.1 SYSTEM OVERVIEW

Figure 3.1 Block diagram of the reader and transponder of RFID system

Figure 3.1 was show block diagram of the reader and transponder of RFID system. Lab equipment tracking system consists of software and hardware as illustrated in figure above. In overall, this system only uses the RFID tags and reader as hardware part to transfer data to computer. Hardware set was setup without hard programming. But, for the software, all functions need to be programmed.

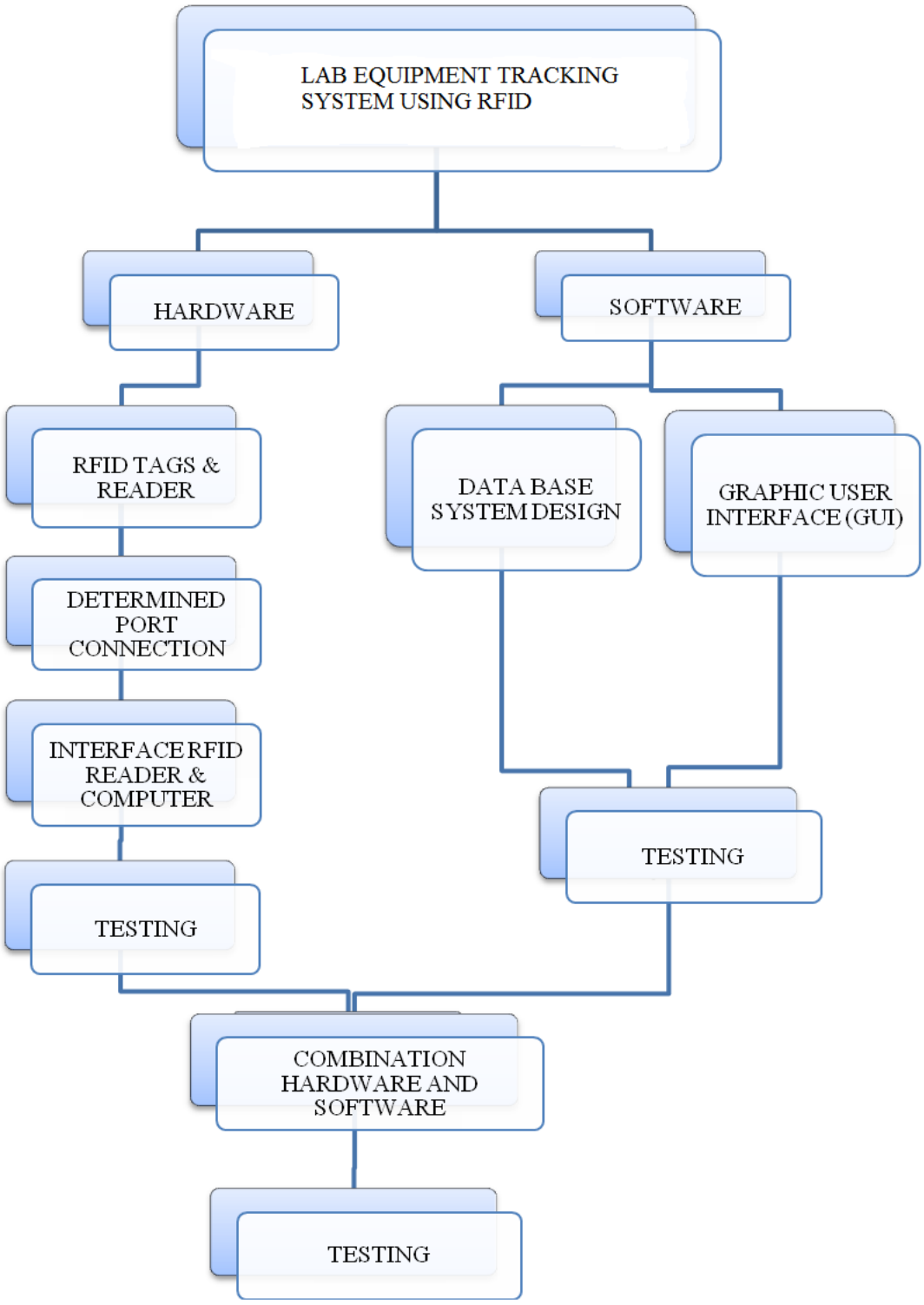

Figure 3.2 The design flow of the system

The system development was focused separately in terms of

i) Hardware Design
ii) Software Development.

Figure 3.2 was illustrated the design flow. The figure depicts that the hardware and software were developed separately, and were tested before combined to fully implement the system. There were three testing altogether. The test of hardware was carried out to ensure that the setup was successful. The software was tested to ensure that all functions work as intended. In the final test, the system was already integrated into the portable hardware, and it was aimed at testing all functions on RFID reader. The design and development of hardware and software are described in the following subsections. They involve RFID tag, RFID reader and lastly software part.

3.2 SUMMARY OF THE PROJECT

Implementation and works of the system was summarized into the flow chart as shown in figure 3.2 below:

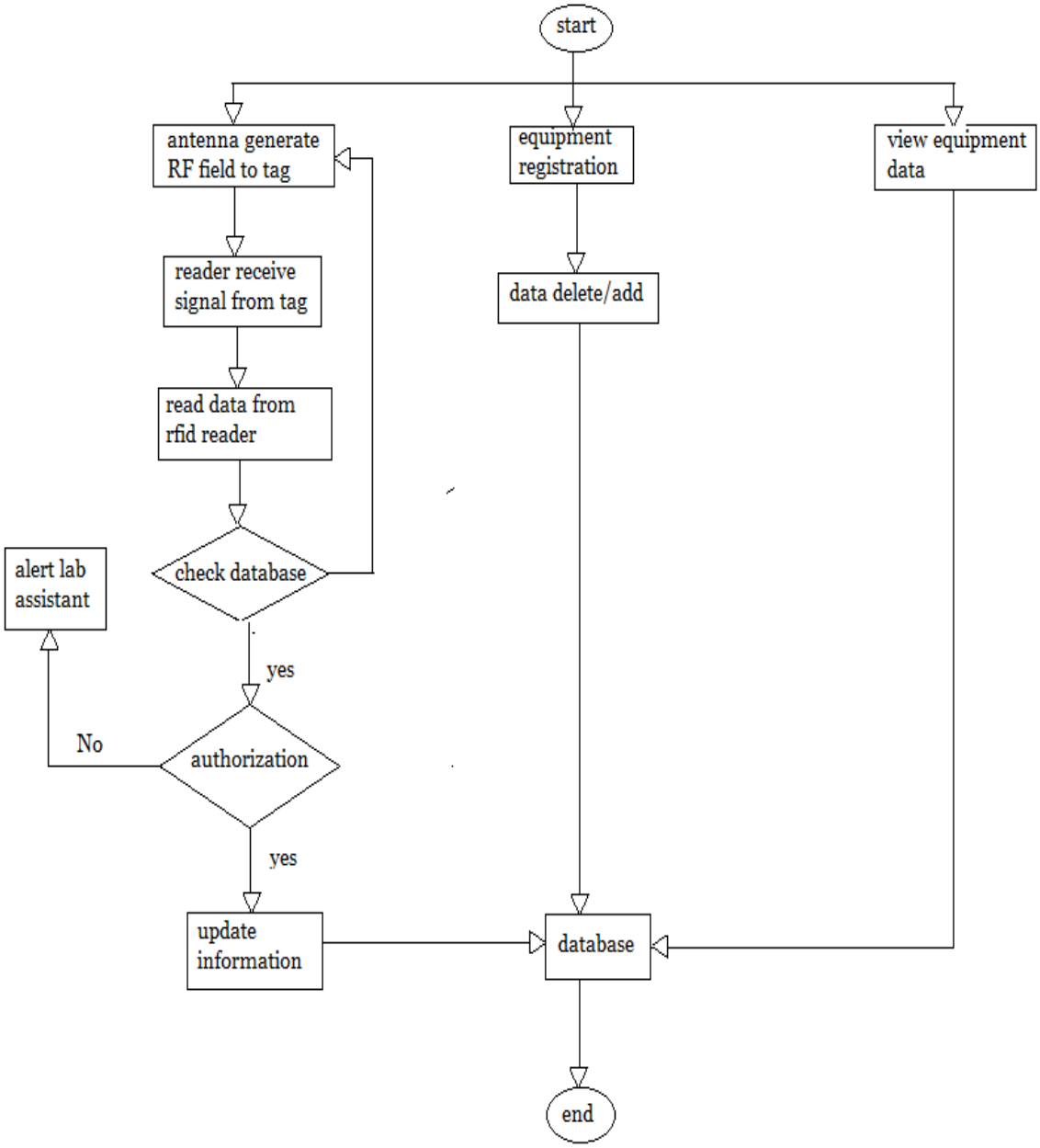

Figure 3.3 Flow chart of the system

The flow chart is divided into three parts to enable RFID connection, equipment registration and data viewing. Figure 3.2 shows the flowchart of lab equipment tracking system. For the first part the connection between RFID card and the reader will sync with the database for the authorization from lab assistant before updating the information from the database. This including the transferred made by the lab assistant.

The second part is the equipment registration. For new equipment, it must register into the database by having serial id number from the tag to store in the database. But for the old equipment that need to remove from the lab just delete all the information from the database.

The third part is to view the equipment information from the database. This part is important for the checking purpose. When it come to auditing, this system make it easier to check the equipment beside to check daily transferred of the lab equipment.

3.3 STUDIES ON METHODOLOGY

The methodology development is the focus of discussion in this third chapter. The selection of appropriate methodology in the development of this system is very important to the smooth development of the next system. The methodology was selected will explain how the system will be developed in various phases of specific such as the planning phase, requirements analysis, design, testing, and maintenance.

This phase is the basic phase in system development life cycle and should be developed based on the specific model. Two categories model for the methodologies was discussed that are the waterfall model and the rational model Unified Process (RUP). Different models have different phase sequence specific. Studies on the suitability of the methodology needs to be done so that the phases and the framework of system development can be implemented.

3.3.1 STUDIES ON WATERFALL MODEL

This approach is called the Waterfall Model as starting with the early stages of planning and continuing in sequence on the level of analysis, design, coding, testing and maintenance. Waterfall model is one of the earliest methods used in the early stages of software engineering and its use is widespread due to its project management tools. Basically, this model will start at the phase of analysis and statement of need and will continue in sequence to the system and software design phase, implementation phase and testing unit, integration and system testing phase, and finally, operation and maintenance phase. The next phase cannot be started until the previous phase has been completed. Project management activities become easier as the time to start and end of a phase can be clearly defined.

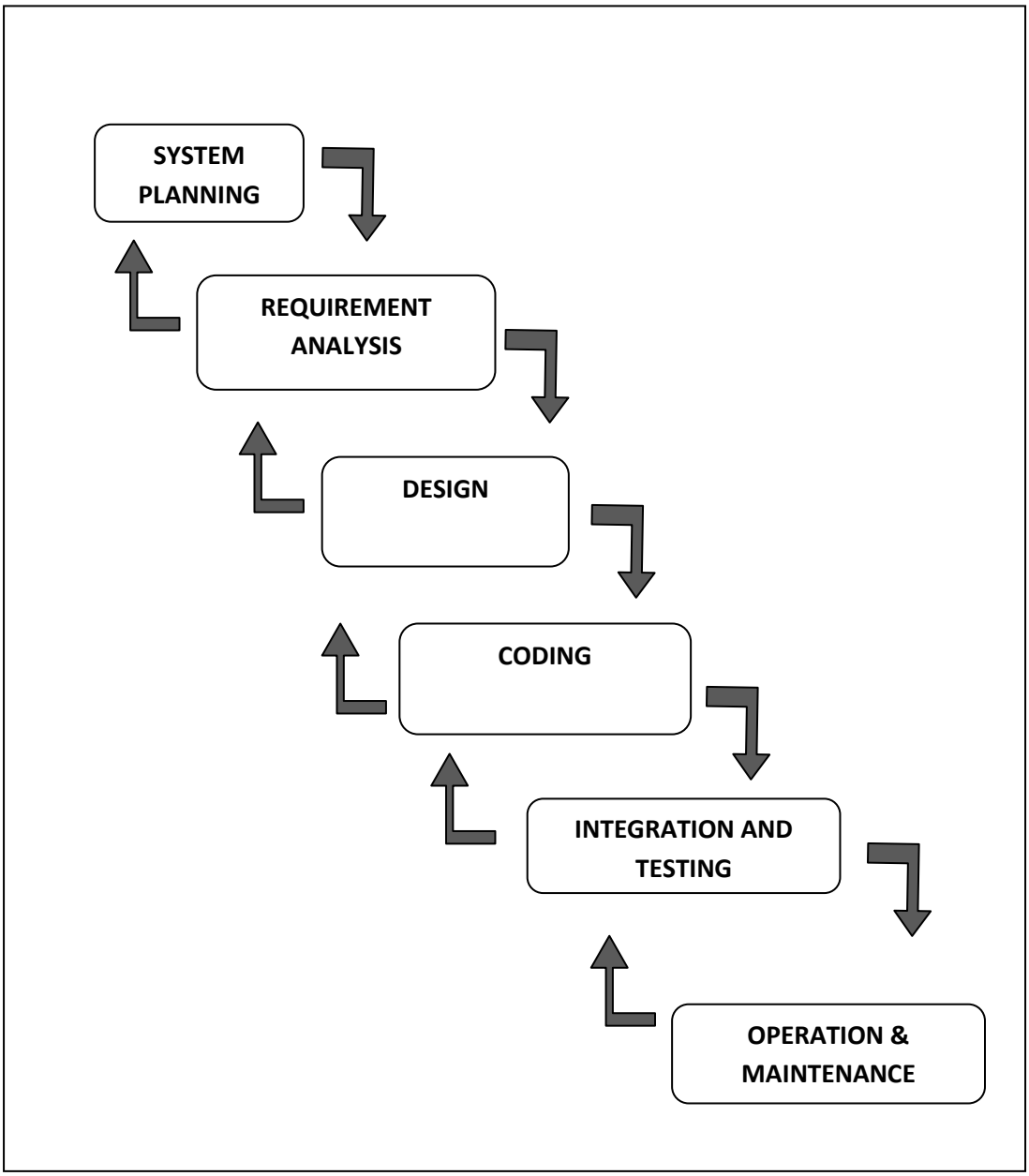

Figure 3.4 SDLC Waterfall Model

Here are details on the phases in the waterfall model:

i. System Planning

Observe that the initial stage of the planning system is the system development process. In this stage, a preliminary study involving a major objective, scope, cost, schedule and staffing needs are determined.

ii. Requirements Analysis

Consult with customers and users of systems performed to determine the system requirements, such as services, constraints and goals that the system has been developed. This requirement will be stated later in more depth and will act as system specifications.

iii. Design

This phase involves the design of the overall framework. Features and basic design of the system are identified and relationships established.

iv. Coding

During this phase, the coding will begin to produce a set of program or a number of programs. Testing the unit will test and verify that each unit meets the required specifications.

v. Testing

Separate program units or programs that have produced and tested as a complete unit of the system to determine whether or not the system requirements are met. After testing, the system that was completed will be sent to the customer.

vi. Operation and maintenance

In this phase, the complete system was installed to the client and used in practice. System maintenance will be done to correct any errors and problems that are not found in the early stages of testing during the development of the system. Function and service system will also be updated with the new requirements that required the customer.

Software development activities occur linearly from one phase to the next phase. This means that the phase of analysis can be done only after all activities in the planning system was completed properly. Activity in the design phase cannot be done so long as the analysis phase has not been completed, and so on.

The results of a phase of work will influence the next phase. Therefore, it should be reviewed and evaluated before proceeding to the next phase. For example, a user requirements specification will be produced at the end of the requirements analysis phase. Specifications must be confirmed by the user before it is made input to the design phase. The error occurred on the specification requirements although it will cause a major error in the system design. The problem will become more difficult to repair if the design is not exactly used as input to the coding phase.

During phase and maintenance, the system has been used by the user. If there are any errors in the system, the error should be corrected. Apart from improving the error, if there are additional functions in the system that has been completed, the repetition of several phases or all phases to be done to enable the system to function as intended.

An advantage of waterfall model is the documentation that was produced during each phase of system development. Typically, the waterfall model has been used when the customer needs and the system has been known and understood as a whole. Priority use of waterfall model is also suitable for implementation of small projects and medium-sized sub-systems to larger systems.

3.4 COMPERATIVE STUDIES

Each model has been investigated the advantages and disadvantages respectively. The selection of an appropriate process model is essential to facilitate the development of the system without any problems. Therefore, the selection of models will be based on the effectiveness of the methodology and the methodology of the model capability to make a more effective system development.

Waterfall process model is one of the most widely used models for the earliest models produced. Advantages of waterfall model are the documentation will be produced at each phase of system development. Typically, the waterfall model will be used when the customer needs and the system has been known and understood in depth. Priority use of waterfall model is also suitable for implementation of projects of small and medium-sized sub - system of a larger system. Disadvantages of this process model, it is necessary to complete the previous phase before entering the next phase. With in other words, the next phase cannot be implemented until the previous phase is not realized. As a result, delays occurred because the jobs will require a determination to

complete the first phase and this model does not allow the implementation of two different work phases in time. This will give problems to the development of systems to be developed.

3.5 ANALYSIS OF SYSTEM REQUIREMENTS

To develop this system, analysis of system requirements such as hardware and software needed to process development and use the system to run smoothly. In addition to the specification of input and system output should be determined before the system can be developed.

3.5.1 JUSTIFICATION HARDWARE

Hardware required in the development of the system is follows:

(i) Personal computer

- Processing of Pentium dual-core processor
- 1.2GB RAM of memory
- Hard disk: Minimum 10 GB free space
- Input Device: Mouse, keyboard and CD drive
- Output devices: monitors

(ii) Hardware RFID as follows:

Figure 3.5 RFID reader and RS232 cable

This is an easy to use, straight forward RFID tag reader. Come with USB for power and DB9 for sending tag's ID to computer through RS232. LED and buzzer as read operation indicator.

Features:

- Low cost solution for passive RFID tag reader
- Support 125KHz RFID passive tag
- 9600 baud rate through RS232 standard
- Fully powered from 5V of USB connection
- Buzzer as audio indicator for read operation
- Red and Green LED as visual indicator for power and read operation
- Come with USB cable (for 5V power) and DB9 standard RS232 socket (female), ready to be plug in to desktop computer with serial port
- 2cm reading range

Figure 3.8 RFID Card

Description:

RFID Proximity Card is a very thin, truly credit card thickness of proximity passive card. It has very flat surface to print any photo ID directly on both sides of card with a direct image or thermal transfer printers.

3.5.2 JUSTIFICATION SOFTWARE

Software justifications that will be applied in this development process system as follows:-

software	Function
Windows 7	Pc operating system
LABVIEW	Create GUI and block diagram
Microsoft Access	Create database
Hyper terminal	Com port setting

Table 3.5: Software justifications

3.5.3 INPUT SPECIFICATION

Input specification for this lab equipment tracking system using RFID involved input from equipment into system. Equipment that consist RFID tag would be detected by RFID scanner and ID from tag would be sent to the system for process. This system would still have interface for access by administrator. Through this interface, the administrator can enter data related to the system such as type of equipment, date of equipment registration and others. Each equipment will have their own information and the information can be updated by the administration.

3.5.4 OUTPUT SPECIFICATION

There are several outputs that will be accessible from this system. When RFID reader scans the RFID card, this system will display equipment information that being transferred. When the staff log in into the system, the can know all the equipment transferred activity in all the UMP labs. For any unauthorized transferred, will notice administrator to take an action.

3.6 SOFTWARE PART

A software part containing modules was designed to read from a contactless tag (transponder) or write data to a contactless data carrier using the reader as the interface. The database is developed using Microsoft Access which is integrated with the system and data communicator.

3.7 SOFTWARE IMPLEMENTATION

Implementation of this system was done by using three computer tools. Microsoft Access was used to build the database that stores the equipment data. While Graphical User Interface (GUI) was created by using LABVIEW and to identify com port setting using hyper terminal software.

3.7.1 CREATING DATABASE USING MICROSOFT ACCESS

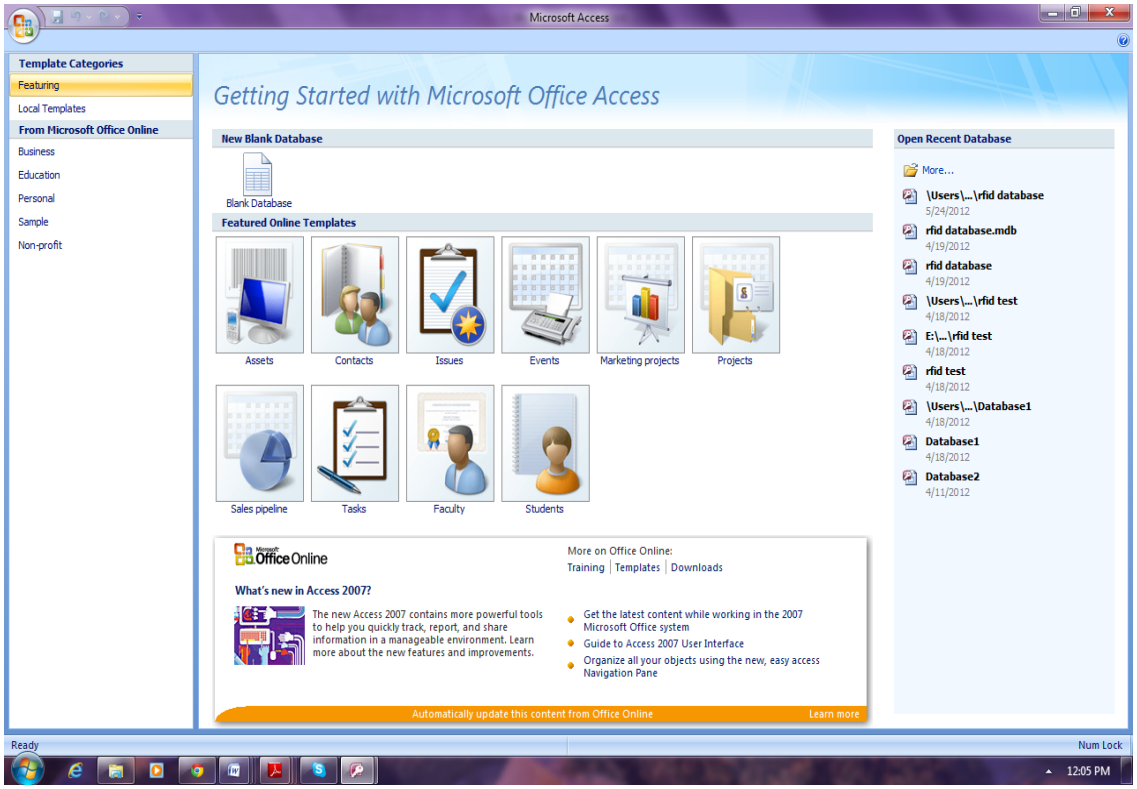

Figure 3.7.1 Mainframe of Microsoft Access

From the view of the mainframe of Microsoft Access, we can see that it is friendly user for those who unfamiliar with this software.

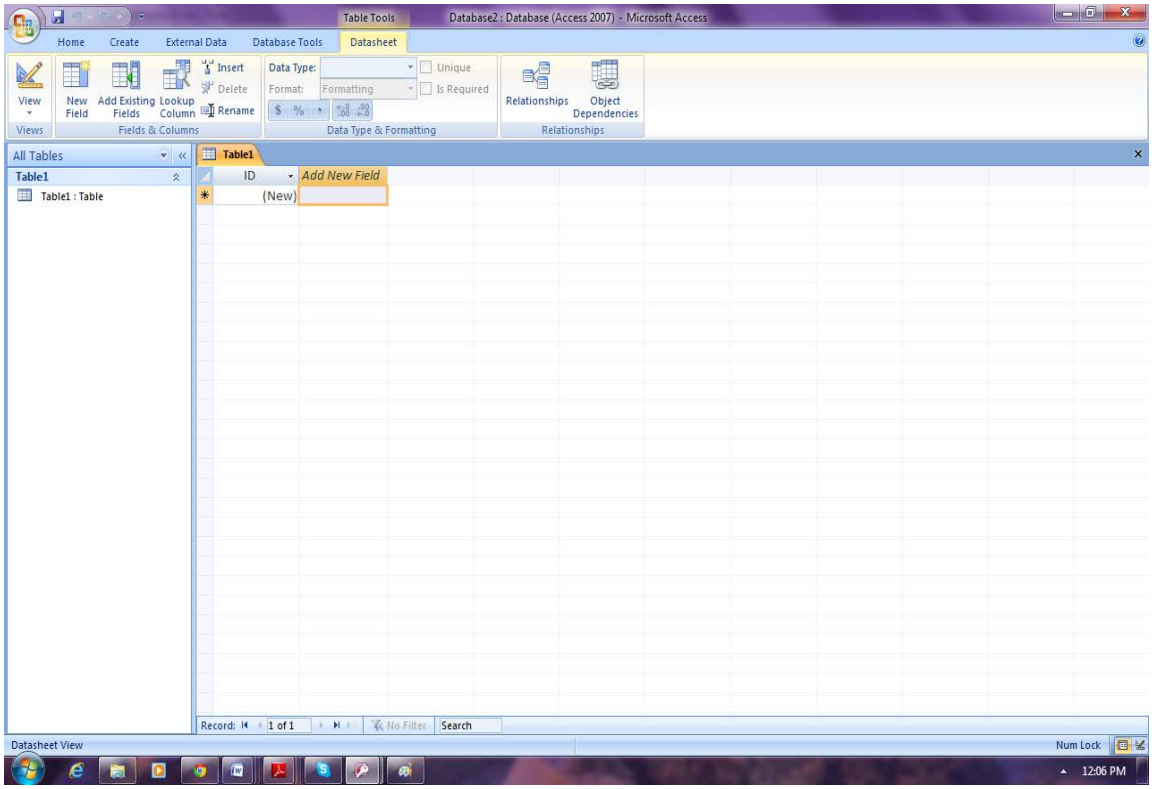

Figure 3.8 Blank database in Microsoft Access

Equipment information

ID	lab equipme	rfid tag num	equipment in	equipment (	time	date	lab name	staff incharg
1	multimeter	0008215668						
2	supply voltqge	0008210864						
3	oscillascope	0008210448						
(New)								

Figure 3.9 Database create

Figure 3.6.3 show the example of the database that had been created for the lab equipment information.

3.8 COM PORT SETTING

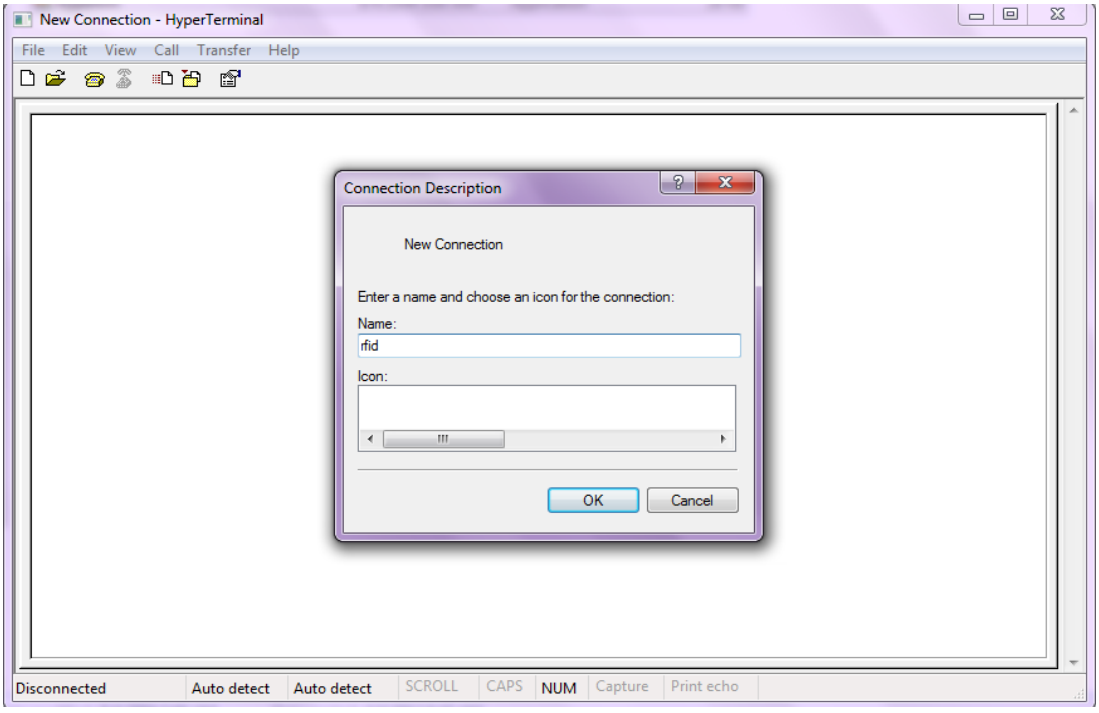

Figure 3.10 Mainframe for hyper terminal

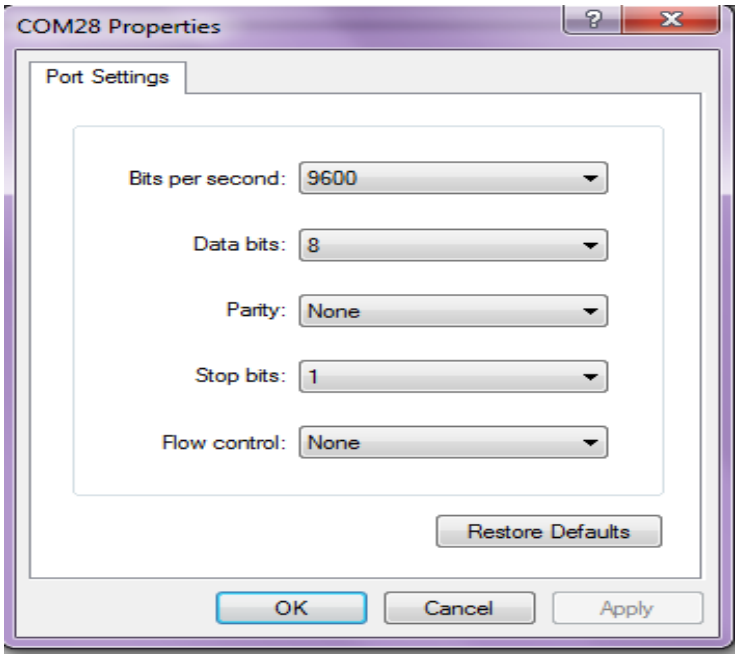

Figure 3.11 Com port setting

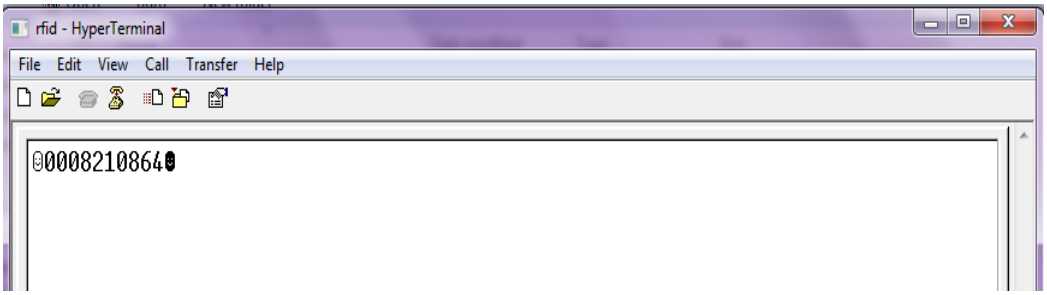

Figure 3.12 Id for RFID card detected

From the entire figure above com port setting is important to determine which port that RFID reader had been connected to the PC. If the wrong port had been programmed in LABVIEW software, the programmed will appear an error. Com port setting need to be done all over again for a new setup to syncing with the LABVIEW programmed.

CHAPTER 4

RESULT AND DISCUSSION

4.0 INTRODUCTION

By using this system, lab equipment management becomes more efficient and quickly done. Equipment that contain RFID card that pass through RFID reader directly send the information to the database. After that, their transferred activity will be recorded in the database. This system will provide more convenience to the staff. Staff only need to log in into database to see equipment information and transferred the equipment without filling any form. All the data automatically update from the reader to the database.

4.1 DATABASE

Database is the information involved in the lab equipment tracking system using RFID. In this system development process, Microsoft Access has been used to build database and tables involved. Data and information such as type of equipment had been showed in previous chapter.

4.2 SYSTEM FUNCTION

The “Lab equipment tracking system using RFID” is an application for this project’s database server. This application maintains the in and out equipment in the lab record against unique IDs assigned to RFID card holders and also provides facility to add or edit the equipment information in database table.

4.3 LAB EQUIPMENT TRACKING SYSTEM USING RFID MAIN FEATURES

- This system will continuously read data which is provided by the RFID reader.
- It maintains the equipment information in database made on Microsoft Access.
- It maintains equipment information against unique Ids. The infromation has various fields such as:
    - Type of equipment, date, time, staff in charge and lab name.
- It maintains the daily record of transferred.

4.4 FRONT PANEL FOR RFID RADER

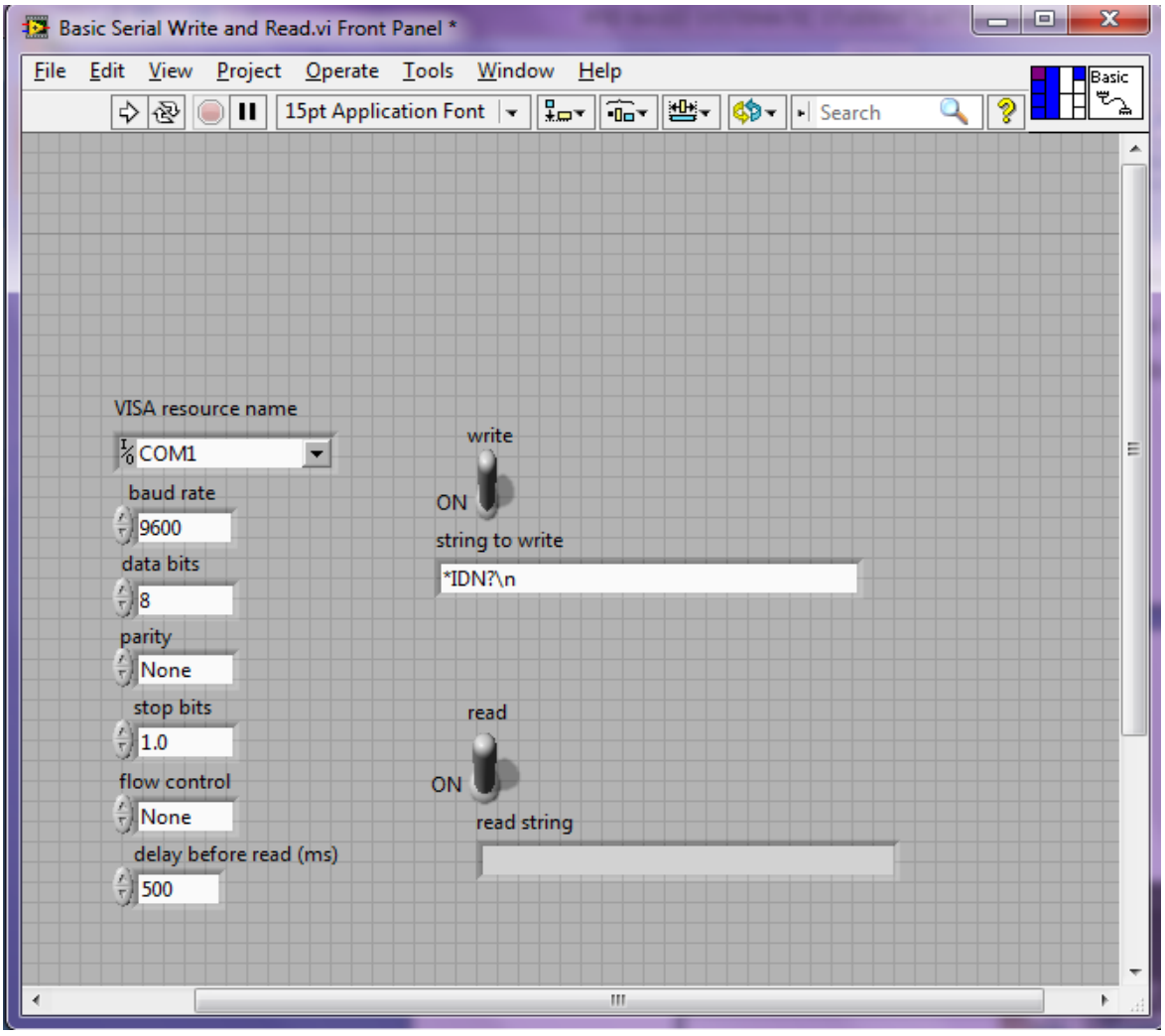

Figure 4.1 Front panel for RFID

From this panel will be the GUI for RFID reader setting. The serial number of RFID tag will appear in read string box. RFID reader setting will be set according to the reader specification. For example, the baud rate for this project reader is 9600 kb, data bits is 8 and so on.

4.5 BLOCK DIAGRAM FOR RFID READER

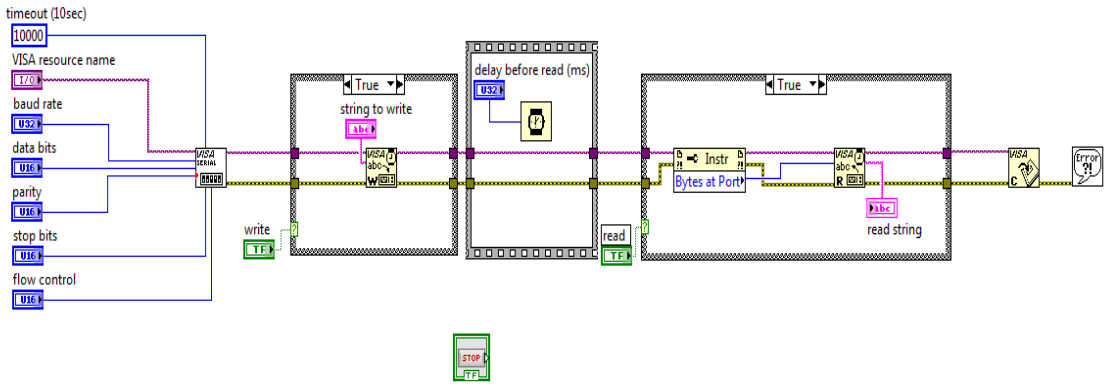

Figure 4.2 Block diagram for RFID reader

In this high level block diagram show the process control of the RFID reader. There are 3 case structures to complete the flow.

- The first one is write case structure. This case structure is to write the information data from the RFID tag to the database table. All the information will automatically update.
- The second case structure is delay case structure. This case structure will create the delay before read the data.
- The third case structure is read string case structure. This case structure will read the RFID tag that pass through the reader. The id of the card will appear in the front panel box.

4.6 FRONT PANEL FOR THE DATABASE

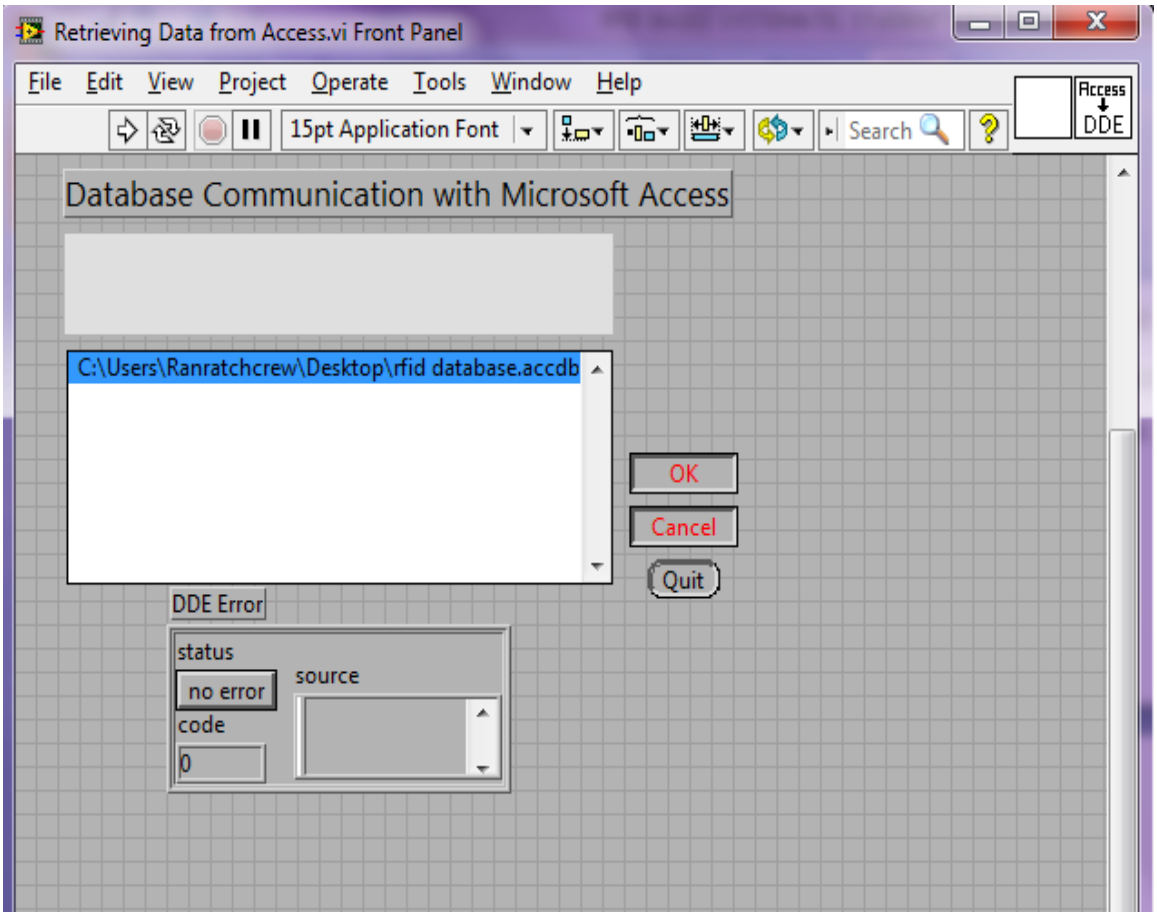

Figure 4.3 Database front panel for LABVIEW

From figure 4.8, it shows the database front panel from the lab view. This front panel will drive the user to get into the database that had been created from Microsoft Access. The error box is to notify the user about the wrong path of the database.

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4.7 BLOCK DIAGRAM FOR DATABASE

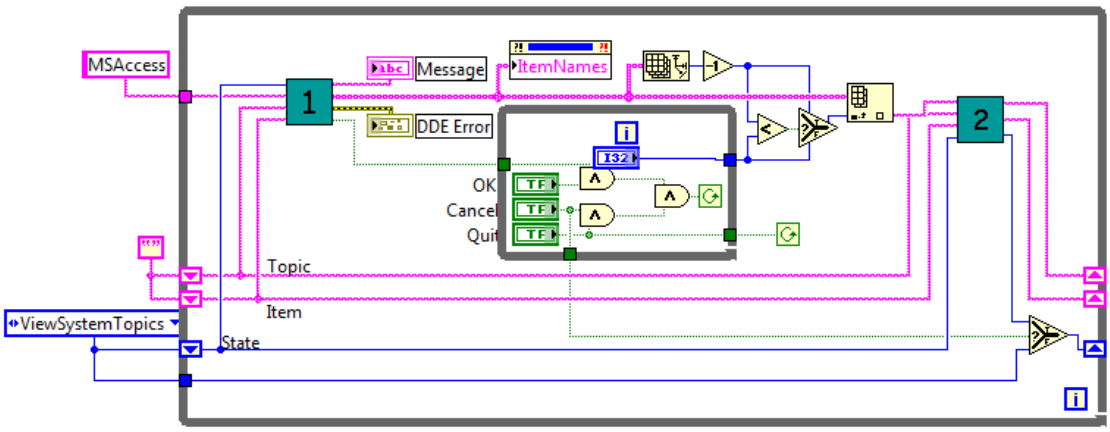

Figure 4.4 Database block diagram

Figure 4.9 shows the block diagram for the database. This block diagram is created to connect to the Microsoft Access database and to update the information about transferred activity from other lab. All the equipment that passes through RFID reader will send the information to this block diagram from RFID block diagram and automatically updated.

4.7.1 DATABASE TABLE FROM LABVIEW

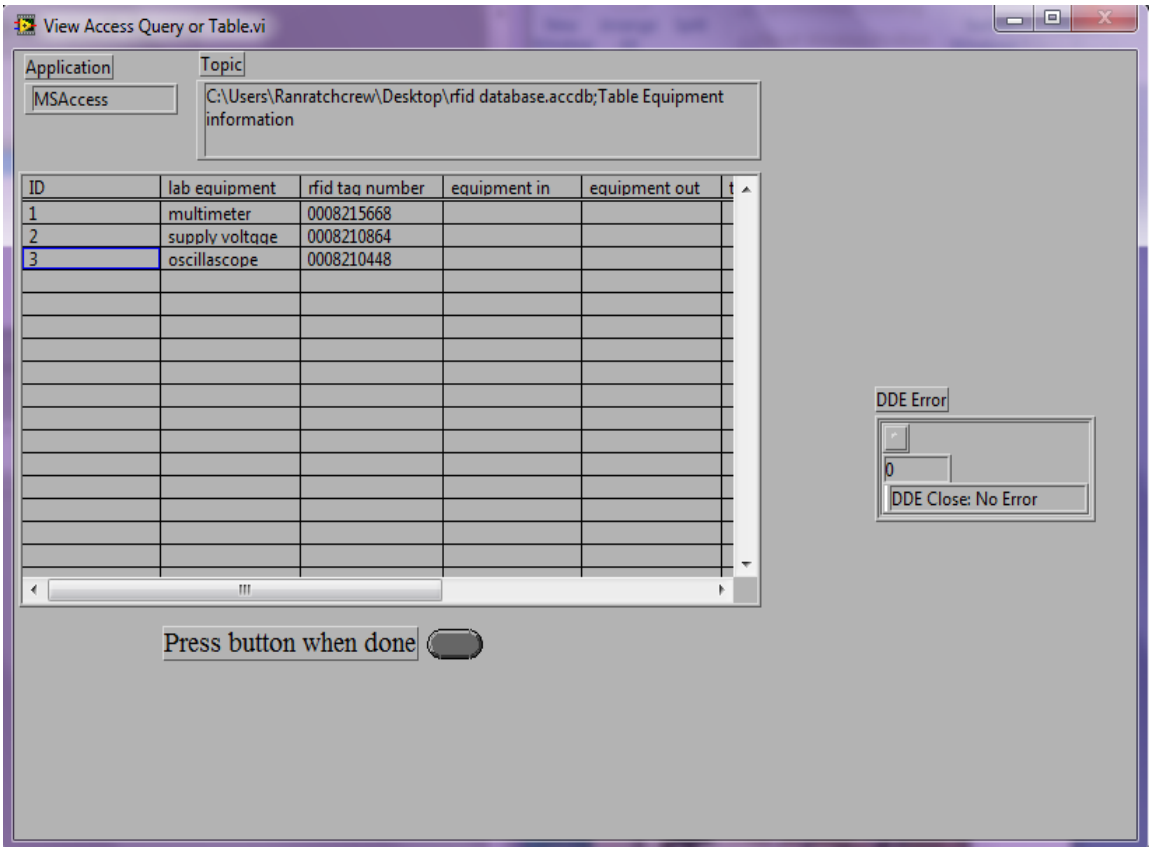

Figure 4.5 Updated information database

From figure 4.9.1 shows the updated information for lab equipment transferred activity. Every equipment that passes through RFID reader will be recorded in this table. For new equipment, it needs to be store the new information in the Microsoft Access database.

4.8 DISCUSSION

The conventional method of recording the lab equipment data is insecure because the lost of the equipment easily covered by eliminate the writing evidence. By using Radio Frequency Identification (RFID) for lab Equipment tracking system is one of the solutions to address this problem. This system can be used to record permanently the equipment data and only can be deleted by administrator. It also needs authentication approval for any transferred activity. Its ability to uniquely identify each equipment based on their RFID tag type of ID card make the process of recording information easier, faster and secure as compared to conventional method. As long as the equipment passes through the RFID reader it will be automatically updated.

The advantage of the system over other similar product available is very vital and can usually affect the consumer decision in choosing a product. The system developed in this project also has some advantages over other similar market products. It is cheaper compare to those systems current in the market. This system was used open source software to develop it. Open source software is free software and user can use it without buying license and it will reduce cost development process.

This system will make the lab assistant work be more easy and the auditing process will be more faster because all of the data had been recorded by the computer. This method also will cause minimum of error because all of the system is computerized.

CHAPTER 5

CONCLUSION

5.0 CONCLUSION

Lab equipment tracking system using RFID has been developed using Microsoft Access for the database and LABVIEW for the block diagram and the interface. All software that use for developing this system are open source and it can reduce cost during development process. In order to have complete system functionality, this system was needed to integrate with RFID database handling system. This will fetch the appropriate information data such as reader ID from RFID database in order to execute the information from the equipment transferred activity.

In a nutshell, this system is able to operate as expected, enhancing equipment monitoring and improve laboratory management. Development of small-scaled RFID-based monitoring system is easy and low cost. In addition, this system offers great features in equipment monitoring and enhances laboratory equipment management. Present RFID reader used is passive type where operating frequency is 125KHz. In future, the proposed RFID reader is may be changed with an active type where it uses higher frequency operating and increase coverage of RFID tag.

5.1 RECOMMENDATION

Future improvement and enhancement can be carried out on various areas to improve the Lab equipment tracking system using RFID. Better designed database, query and integration among the pages could be improving the efficiency of the system. In future, a technique has been to develop using information visualization to graphically render complex, multidimensional tracking system data. So far, this system only can alert staff about the transferred that been made from all the labs. For recommendation, it able to send e-mails to administrator office about any losses of the equipment.

This system also should be able to operate fully automatic. It means that staffs do not have to touch the equipment such as mouse and keyboard. They just have to initiate the software, and do not have to worry about it. After close the software, they only have to see which action was to be taken. This software also can be connected to other flash device that stores data, and data taken from the storage device, not directly from the RFID Tag. This will make tracking system a lot more easy, and the software developed can be used even when staff at their house.

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APPENDIX A

GANTT CHART PSM 2

PSM 2																				
Month		feb 12				mac 12				april 12				may 12				jun 12			
Project Activity/Week		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20
1.0	Literature Review a. Constructing research RFID b. Collecting information about project on thesis c. Preparing detail about project on thesis																				
2.0	Hardware a. Purchasing the component (RFID) b. Understanding the speciation c. Constructing connection follow the manual guide																				
3.0	Submit draft 1																				
4.0	Software Design a. Selecting the best software to be use b. Understanding the software c. Writing programs for the system																				
5.0	Submit draft 2																				
6.0	Project data management a. Preparing thesis and logbook update b. Submit final draft																				
7.0	Submit abstract and presentation slide																				
8.0	PSM 2 Seminar and demo a. Presentation the project to Panel																				
9.0	Submit thesis for binding																				