INVENTORY MANAGEMENT SYSTEM USING RFID FOR FSKKP LABORATORY IN UMP

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ABSTRACT

The laboratory for the computer system and network engineering also known as the FSKKP laboratory items are prone to be missing without any surveillance because it is impossible for the lecturers to monitor all of the students' behavior when they are using the items in the laboratory and when they are done using it or steal it. Besides that, the missing items in the inventory cannot be tracked or found once again either it is totally being stolen by any students or misplaced without the usage of RFID tags for each items. There are also difficulties faced by the staffs in organizing these expensive items accordingly due to the functions that are almost similar to any other items. The inventory inaccuracies are one of the factors that lead to the development of this system. Therefore a system had been proposed to use the RFID and improve the security of the items placed in the laboratory. Study on this system is made to build a system that benefits the two main users which is the staffs and students. This research also is done to proof the concept of using the RFID for the increase of security.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The RFID (Radio Frequency Identification) is one of the applications that are designed to track a metal tote. The RFID tag consists of two main parts which is and it can be read by reader via Radio Frequency link. It can be very miniature as thick as a sheet of paper. The demand on the usage of RFID tags is increasing from time to time and might one day eliminate the usage of barcodes. This is because when it compares to barcodes, RFID tags can support about 512 bits or more characters where else barcode is only limited to 20 characters. In additional, by using the RFID tags, it can tell the story of where that product was born, where it has been and where it is going and it may also contain an alert notice of when to drop the product retail price for example. There are two main RFID (Radio-frequency identification) known as the passive and active RFID tags.

These RFID tags differ from each other by many features such as their frequencies range, their ways of functioning, lifetime, the endurance, prices, the capacity

of data that can be programmed and many other features. Passive RFID tags is known to be without any internal power supply which means the device is quite small in size

which only commercially available in the form of embedded sticker or under the skin and simply consists of a single IC and antenna coil which is usually flat. Therefore the electrical current induced in the antenna by the incoming radio frequency signal provides just enough power for the CMOS integrated circuit in the tags to transmit all the responses as well to support power up since it does not require any usage of battery power. Somehow it can be divided into four different frequencies range to receive different channels such as Low Frequency (LF) with the range of 30kHz to 300kHz, High Frequency (HF) with the range of 3MHz to 30MHz, Very High Frequency (VHF) with the range of 30MHz to 300MHz and lastly is the Ultra High Frequency (UHF) with the range of 300MHz to 3GHz. The lifetime for passive RFID tags is known to be around 20 years or more.

As for the active RFID tags, it has the longest communication range of any tag. In addition, it had the capability to perform independent monitoring and control, capability of initiating communication and as well as performing the diagnostics. Active RFID has got the highest bandwidth. It is known to be equipped with autonomous networking where it can determine the best path of communication. It is known that more information can be written into it including the read and write distances that are greater. It can be connected to sensors for example they could measure and log information such as temperature. Lifetime for the battery is about one to seven years of range. The active transponders found in active RFID tags can communicate in very long ranges up to several hundred kilometers. All the RFID tags mention above work in the way when the signal is reflected which cause the alarm to be triggered.

Therefore, the project that will be developed is known as the Inventory Management System for FSKKP Laboratory in Universiti Malaysia Pahang Using RFID (Radio Frequency Identification). It is a system that is used to detect and store the data of the items that is purchased by Computer System and Software Engineering Faculty in Universiti Malaysia Pahang. By using this system, the faculty itself can prevent any expensive items that are prone to be missing from being stolen again. Besides that, the items in the inventory system can easily be tracked by the staff in order for them to organize the laboratory in a much better way according to the types, size and functions of each item. It can also prevent and reduce the inventory inaccuracies.

1.2 Problem Statement

There were several factors that bring to the development of this inventory management system for FSKKP laboratory in UMP. One of the factors is the laboratory items are prone to be missing without any surveillance because it is impossible for the staffs to monitor all of the students' behavior when they are using the items in the laboratory and when they are done using it or steal it. Besides that, the missing items in the inventory cannot be tracked or found once again either it is totally being stolen by any students or misplaced without the usage of RFID tags for each items. There are also difficulties faced by the staffs in organizing these expensive items accordingly due to the functions that are almost similar to any other items. The inventory inaccuracies are one of the factors that lead to the development of this system.

1.3 Objectives

- To enable any of the expensive assets that is belong to the FSKKP laboratory from being stolen by any irresponsible individual or either being misplaced.
- To enable the staff save their time in organizing the laboratory inventory where they can easily divide or classified each items accordingly depends on its sizes, functions and also type by using the RFID tag.
- To let the students easily identifies which items in the laboratory are suitable for them to use for their assessments.

1.4 Scope

This system is build mainly for all the staff and students of the Faculty of Computer System and Software Engineering in Universiti Malaysia Pahang.

and several others are a new way of controlling information and material flow especially suitable for large production networks.

Next are the RF readers or transceivers, a device which includes an antenna to read and or write data to RFID tags. Last component is the communication system which is defines as radio frequency and a protocol to transmit and receive data from tags. Tag readers interrogate tags for their contents by broadcasting an RF signal. Tags respond by transmitting back resident data, typically including a unique serial number. RFID tags have several major advantages over optical barcode systems. Tag data may be read automatically, without line of sight, through non conducting materials such as paper or cardboard, at a rate of several hundred tags per second and from a range of several meters. Since tags typically are silicon based microchips, functionality beyond simple identification may be incorporated into the design. This functionality might range from integrated sensors, to read/write storage, to support.

Three basic example of RFID tags are active RFID tag, passive RFID tag and the semi-passive or semi-active tags. Active RFID tag usually had the highest range of radio frequency transmission. However it needs the power of a battery which lasted for at least of seven years depends on the usage of its battery and it is much expensive than other types of RFID tags. Active RFID is large in sizes and therefore it much more fragile and prone to damages. By the way, as for active RFID, the information that can be written into it is more compared to other RFID tags same goes for the read and write distances which is greater range and be connected to sensor. In additional, active RFID tags have both on tag power source and an active transmitter which offer a superior performance.

As for the passive RFID tags, it can be read in very short distance and some can be read at the distance of three meter or even more. This type of tag can be read for a long time without the need of batteries. Since it came in a smaller size, the resistance to any corrosion and physical damage is much higher and easily concealed. Lifespan of the passive RFID is known to last about 20 years and above. Passive tags have the most potential for lowest cost making them suited for mass single use application.

Another RFID tags is the semi passive or semi active tags. It can achieve a longer range compared to passive but lower than active tags. It is cheaper if compared to the active RFID tags. Memory capacity for the input to be written into it is almost the same with active RFID tags. RFID tags are interrogated by readers which in turn are connected to a host computer. In a passive system, the RFID reader transmits or store data. Active tags may periodically transmit a signal, much like a lighthouse beacon, so that data may be captured by multiple readers distributed throughout a facility. The reader is equipped with antennas for sending and receiving signals a transceiver and a processor to decode data.

All these three RIFD tags stored their information in the library. In this library, the information stored is usually known as an encoded configuration. Each tag also contains a microchip on it with an antenna. RFID can be used in many application and usage for example it can be use as asset management and retail sales, payment by mobile phones, promotion tracking, access management, transportation payment (toll roads), public transit (bus, rail, subway), machine readable travel documents, airport baggage tracking logistics, museums, tracking sports memorabilia to verify authenticity, animal identification and tracking, human implants, inventory management system, library management system, car park management system and other application. The figures below show the example of the types of RFID tags.

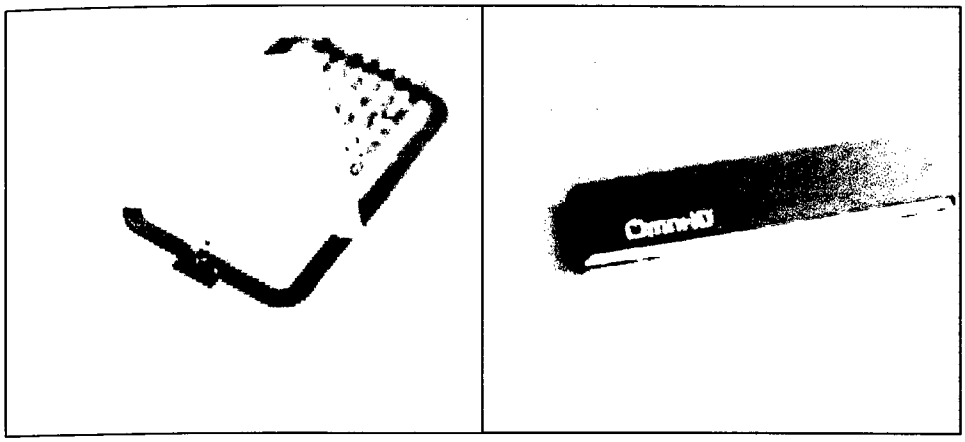

Figure 1: Passive RFID tags

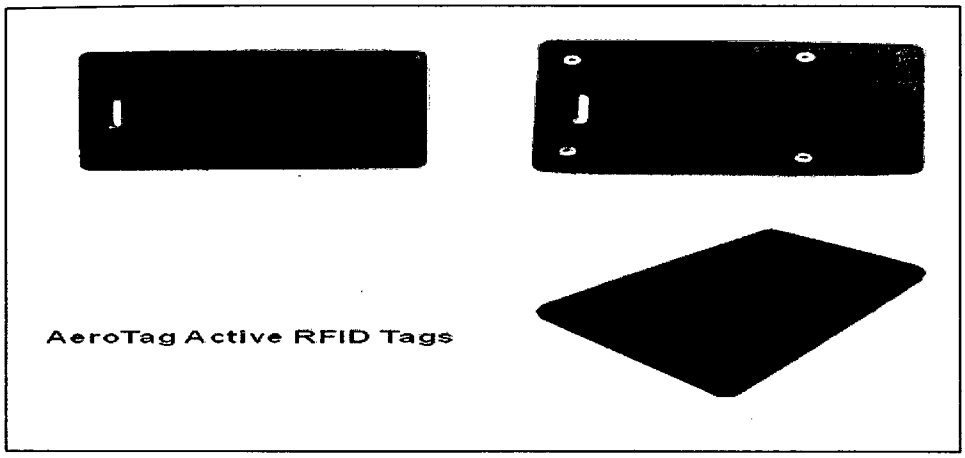

Figure 2: Active RFID tags

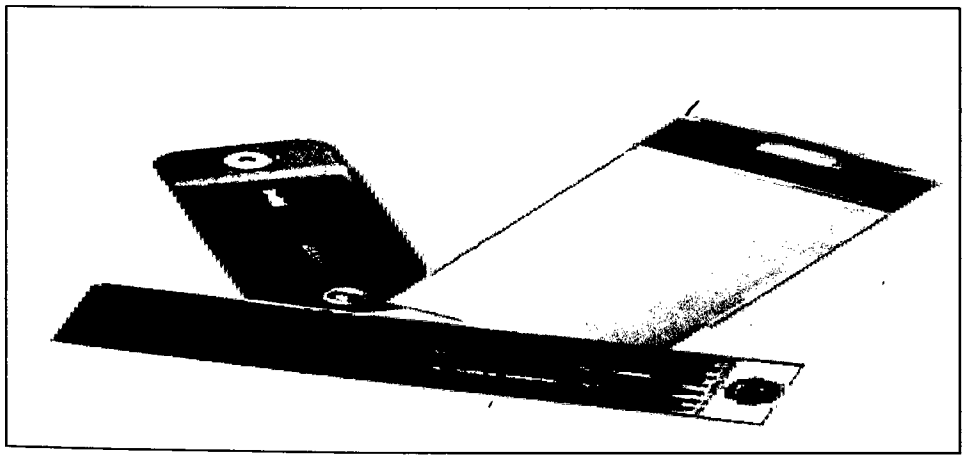

Figure 3: Semi-Passive RFID tags

2.2 Types of RFID Systems

One broad classification of RFID tags is whether they contain a microchip or without microchip. The tags which contain an integrated circuit chip meanwhile the tags without chips are less expensive and store up to 24 bits of information that provides enough memory for a company's internal use for example a ship floor within a warehouse or known as the inventory. To enable the reader to identify all manufactured items, an RFID tag must have enough memory storage to hold the ID number that is designed to identify a massive number of objects and the reader must be able to read multiple tags within its range and in a closer proximity. The chip tag RFID systems enable data such as a serial number or product code to be stored and transmitted by portable tags to readers that process the data according to the needs of a particular application.

Currently small chips are available which are able to stored up to 96 bits of data which is enough to include a manufacturer's name and one of trillions of unique numbers that can be assigned onto each product that they produce. These RFID tags can be classified into a more specific kind of tags according to the characteristic they possess.. It can be further divided into three types of tags. The first is the read only tag which is the identification is encoded at the time of manufacturing and not rewritable. Second is the write once read many tags (WORM) which are programmable ones at the user end but did not possess the ability to rewrite them later and lastly is the read or write tags which have the ability to modify the information from time to time.

There are existing system that is known to be implementing the RFID technology is the library which are the library management system, airport baggage system, electronic toll collection which can be seen implemented in several country such as Mexico, Pakistan (NADRA), Dubai (used in Motorway), Turkey and other countries, car sharing where Zipcar service uses RFID cards for locking and unlocking cars and for member identification. Besides that, the RFID technologies are also used in public transit which is used throughout Europe particularly in Paris which started in 1995 by the RATP. In South Korea, T-money cards can be used to pay public transit. Also used in order countries for the same reason are Hong Kong, Shanghai, Moscow Metro and other countries. It is also use for product tracking applications which begins with plant based production processes and extends into post-sales configuration management policies for large buyers.

Other existing system that uses this RFID technology are product tracking, Casino chip tracking, IT assets tracking, transportation and logistics, animal identification (widely used to track farm animals for example goats, lamb and others), RFID tracking and tracking for meatpackers, hospital operating rooms, RFID mandates (Wal-Mart), passports, museums, race timing, lap scoring, ski resorts, human implants (especially for hospital patients)

2.3 Limitations of RFID systems

The major disadvantage when using the RFID technology is its high cost. Besides that, the other limitation is the reader collision. The signal from one reader can interfere with the signal from another where coverage overlaps and this is known as the reader collision. In order to avoid this kind of problem is by using a technique called time division multiple accesses (TDMA). In simple terms, the readers are instructed to read at different times rather than both trying to read at the same time. This will ensures that they do not interfere with each other. But it means any RFID tag in an area where two readers overlap will be read twice. It is very difficult to standardize them. This is supported by (Elisabeth,Zsolt,Peter,Laszio; 2005) when it stated that the sparse standards still leave much freedom in the choice of communication protocols and the format and amount of information stored in the tag.

Tags collision is one of the limitations found in RFID systems. This problem occur when reader have the difficulties in reading a lot of chips at the same time. Tag tend to clash when more than one chip reflects back a signal at the same time which resulted in a confuse reader. Different vendors have developed different systems for having the tags respond to the reader one at a time. Since they can be read in milliseconds, it appears that all of the tags are being read simultaneously. This shows the faulty or deficiency when using the RFID technology. Although it is one of the smart application, still it has many disadvantages when it comes to invulnerabilities. (Elisabeth,Zsolt,Peter,Laszio; 2005) Tags may be damaged during usage and the tag is not completely invulnerable and the causes of damage may vary from type to type.

Last but not least is the lack of standard in the tags used by inventory RFID vendor which are not compatible even when they conform to the same standards only seek electronics compatibility between tags and readers. The pattern of encoding information and the software that possesses the information differs from vendor to vendor therefore a change from one vendor's system from the other would require retagging all items or modifying the software.

2.4 Proposed system

The prevention on the lost and misplacement of certain inventory items especially for the computer faculty in UMP should be made since there is many valuable items cost thousands of ringgits. The valuable items and tools include the fiber optic fusion splicer kit with its parts, optical time domain reflectometer (OTDR), optical distribution frame and other fiber optic passive component, cordless electric screwdriver, wall driller and many other tools. Therefore RFID (Radio Frequency Detection) is most effective to be used to manage the inventory system because it saves time and much accurate.

According to the article from Decision Makers' Direct, RFID collect accurate and real-time and communicate it radio waves. A typical RFID system has three components, tags, reader and RF unit. The RF reader sends out RF waves that are received by the RF tag within the reader's range. The tag in turn, sends information back to the reader, also in the form of RF waves. Then the RF reader transfers this information to RF unit. The usage of RFID tags can also relate it to the reduction of inventory shrinkage. The item in the inventory system is continuously monitored and the inventory shrinkage including thefts and misplacement of any items can be avoided using RFID technology. Sorting all the items and picking an item to be use in the FSKKP inventory store might take some time as to identified the types and functions of each items because several item might look similar to each other. RFID systems however ease the process of sorting and picking a particular tools and items needed for the staffs, lecturers and even students as it captures real-time, accurate information about the item availability in host computer database.

A Chandec, S Dhekane, N Hemachandra_ and N Rangaraj (2005) state that since RFID tags are read by its radio frequency transmission, it does not have to be in any

particular position to be able to read it. This might resulted in a much effective way to manage the inventory system. The availability of real-time data has a major influence on the optimal ordering quantity and the optimal time of promotion decision. An information system, viewed from an infrastructural and managerial perspective, has various elements such as identification and collection of relevant data elements, communication and processing of the data at regular intervals.

RFID technology is an emerging trend in this field and is mainly used for product identification, collection and communication of relevant data. This paper considers an RFID-based methodology for inventory control of perishable item in the laboratory of FSKKP. The objective of perishable inventory management is to obtain optimum monitors considering the useful life of the item. In the literature, inventory models have been formulated for perishable products subjected to the various demand conditions and life considerations. The problem in a continuous review framework, considering all costs concerned with monitoring, organizing, borrowing, returning and segregating the laboratory items.

2.5 RFID system representation

A tag is presented by the RFID tag which is placed on the items or tools in the inventory at a suitable spot for easy access. This tag is equipped with a programmable chip and an antenna. Each paper thin tag contains an engraved antenna and a microchip with a capacity of at least 64 bits or more. The read or write tags are used in this system (passive tag).

The reader has the function on reading the tag that passes through the field where the information is stored on the chip in the tag is interpreted by the reader and sent to the server which will be communicating with the integrated library system. The server in the other hand checks the circulations database and determines whether the item is found and available in the laboratory inventory for the student to use these items. Functions of each item will also be shown for better identification of the items needed. There are several station to be passed. These stations are divided into three stations. The first station is processing station where the item data such as the name and function is being written on the tag. Second is the circulation station where the items are return back after being used. Last station would be the check-in station where the item is checked to observe any changes that have being made on the tag.

The antenna is known to produce radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader which control the system's data acquisitions and communication. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. It