# DESIGN OF AUTOMATED PAYMENT SYSTEM USING RFID TECHNOLOGY

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# DESIGN OF AUTOMATED PAYMENT SYSTEM USING RFID TECHNOLOGY

by

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# ACKNOWLEDGEMENT

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| AIDC | Automatic Identification and Data Capture |
| ATM | Automated Teller Machine |
| Auto-ID | Automatic Identification |
| AVDC | Automatic Vehicle Detection and Classification |
| AVI | Automatic Vehicle Identification |
| CMOS | Complementary Metal-Oxide-Semiconductor |
| DCV | Destination-Coded Vehicle |
| EEPROM | Electrically Erasable Programmable Read-Only Memory |
| EPC | Electronic Product Code |
| GPS | Global Positioning System |
| IC | Integrated Circuit |
| ID | Identification |
| IEEE | Institute of Electrical and Electronics Engineers |
| IR | Infrared |
| LED | Light Emitting Diode |
| MIT | Massachusetts Institute of Technology |
| PARC | Palo Alto Research Center |
| PDI | Product Identification Device |
| PIN | Personal Identification Number |
| PSA | Personal Shopping Assistant |

RF          Radio Frequency

RFID        Radio-Frequency Identification

SMS         Short Message Service

SQL         Structured Query Language

TVES        Toll Violation and Enforcement System

UHF         Ultra-High Frequency

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# SISTEM PEMBAYARAN AUTOMATIK MENGGUNAKAN TEKNOLOGI RFID

## ABSTRAK

RFID, atau nama sebenarnya Pengenalan Frekuensi Radio merupakan suatu alat identifikasi menggunakan gelombang radio. Antara aplikasi RFID yang sedang berkembang ialah sistem pembayaran automatik. Sistem pembayaran yang efisyen perlu supaya pengguna tidak mengalami sebarang kesulitan semasa membeli-belah. Tujuan utama projek ini dijalankan adalah untuk mereka bentuk sebuah sistem pembayaran automatik menggunakan teknologi RFID untuk menjimatkan masa pengguna dan menjadikan sistem pembayaran lebih efektif. Perkakasan utama yang diperlukan untuk menghasilkan sistem ini ialah pembaca RFID, tag RFID yang mempunyai nombor identifikasi, dan antena RFID. Setiap tag berserta number identifikasi yang tersendiri akan dilekatkan pada barang-barang jualan. Pembaca RFID akan membaca data yang terdapat pada tag ketika membuat pembayaran. Komunikasi bersiri digunakan untuk menghubungkan pembaca RFID dengan komputer. Pembaca RFID diprogramkan mengikut ketetapan yang sesuai untuk membolehkannya membaca nombor identifikasi pada tag. Program grafik digunakan untuk memaparkan jumlah harga pembelian. Pegguna juga diberi peluang untuk membuat pembatalan barangan pembelian atau meneruskan pembayaran untuk memudahkan pengguna. Tempoh masa yang diperuntukan ketika menggunakan teknologi RFID dapat dijimatkan sebanyak 63.12% berbanding menggunakan sistem biasa yang diguna pakai pada masa kini iaitu sistem pengesan bar kod.

# ABSTRACT

RFID which is also known as Radio Frequency Identification is a kind of identification device which uses radio frequency to operate. The RFID application that is widely used is an automated payment system. An efficient payment system is needed to ease the user during shopping. The main purpose of this project is to design an automated payment system using RFID technology which can help to shorten the queue during payment hence make the payment activity become more effective. The main hardware needed for this system are RFID reader, RFID tag, and RFID antenna. Every tags with their own ID number will be attached to every items. The RFID reader will work by reading the data on the tag during payment activity. Serial communication is used as a communication between RFID reader and PC. RFID reader will be set according to the requirements so that it will be able to read the tag. A graphical user interface is used to show the detail of the cost. The user also able to make choice if they want to cancel any item after scanned or continue with payment process. The time taken during payment system using RFID technology is able to be saved by 63.12% compared to normal system currently used which is barcode scanner system.

# CHAPTER 1

# INTRODUCTION

## 1.1    Research Background

RFID is one of the hottest technology used in the world of automatic identification and data capture (AIDC). This RFID technology used the help of radio waves to identify physical objects automatically and it is one of the automatic identification (Auto-ID) technology. RFID is fundamentally based on wireless communication which form part of electromagnetic spectrum. This RFID technology has been utilized in many other industries such as animal tracking, health care improvement and warehousing.

RFID is a system which consists of RFID tag which made up of a microchip, RFID reader and an antenna. The chip is able to store unique serial number with many other information based on the tag's type of memory. The antenna transmit information from the chip to reader and larger antenna gives longer read range.  The reader will send out electromagnetic waves and these waves are received by the antenna. The RFID tag that was placed at the product may provide the information of the product such as type of item, quantity, manufacturing date, expiry date and the price. Other than that, the RFID tag is used to analyze customer's purchased information. The RFID technology may become a viable solution for smooth payment system.

In this project, an automated payment system for shopping purpose is developed by using the RFID technology. Today, payment system plays an important role especially when making payment at grocery stores and hypermarkets. Most of the time, these places are crowded and full of people and caused long queues at the billing counters. This is one of the reason why an automated payment system is needed to be implemented. With the help of RFID technology, the billing payment will help in saving the customer's time and reduced the long queues.

## 1.2    Problem Statement

It is a waste of time when we need to wait for long queue every time we want to make payment at grocery stores and hypermarkets. This scenario often happen especially during weekend and festive season. The bar code scanner technology that is used in payment system nowadays sometimes not efficient. This is because some problems occurred during scanning the item's barcode such as the wet barcode is difficult to be read, the fade off barcode's ink is unable to be read and the scanner must be placed very near to the item's barcode. These problems caused the queue during payment is becoming longer and the payment process will be slow.

Current barcode scanner technology used infrared technology which can only read the barcode in a very short range. To overcome this problem, a payment system using RFID technology is designed. Studies on various RFID system need to be done in order to find the best solution for this problem. Various test also need to be done to test the effectiveness of the RFID technology on improving the current payment system.

**1.3     Objectives of Research**

An automated payment system using RFID technology is proposed in this project. The objectives of this project are:

1. To develop a smart electronic billing system using RFID technology.
2. To investigate and study the efficiency of proposed system in terms of improving the current payment system.
3. To characterize and analyze the proposed system with RFID technology real implementation.

**1.4     Scope of Research**

The main focus of this project is to develop an automated payment system by using RFID technology. In this project, the idea of shopping billing system using RFID technology is chosen since the scope of automated payment system is too general. The flow of the project is divided into two which are hardware part and software part.

The hardware part focus on the usage of RFID tag and reader. Whereas, the software part will focus on how the data is load by using GUI, how the data will be send to the billing server for payment purpose and how to keep the data in the database.

**1.5    Thesis Outline**

This **"Automated Payment System Using RFID Technology"** project will be explained in all 5 chapters starting from introduction until conclusion.

**Chapter 1** briefly described on the project introduction, problem statement, objectives, scope of projects and thesis outline.

**Chapter 2** provide explanations on the literature review on relevant previous research that related to RFID payment system.

**Chapter 3** discusses on the methodology for both hardware and software part of the system to full fill the project's objectives.

**Chapter 4** is focusing on designing and implementing the system which includes discussions based on the result obtained.

**Chapter 5** concludes the overall project starting from the beginning of the project until the stage of making future improvement.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1    Introduction

An automated payment system is a kind of technology that simplify our life. Using the RFID technology in automated payment system is one of the way to make the payment system become more efficient. In this project, a payment system for shopping is chosen since the problem of long queue often happen and this system will help in saving the customer's time. This system is developed by using RF module. A passive RFID tag is placed on the shopping item and the RFID reader is used for payment purposed. The list of shopping items will be displayed on the screen. The knowledge of RFID and software is needed in order to generate this system.

## 2.2    RFID Development System

Long time ago, the scientists believed that the universe in created by using electromagnetic energy. Hence, producing the theory of Bing Bang. Due to this theory, the RFID technology is also said to be produced by using electromagnetic energy as the energy source. The Bing Bang concept could be the start of the RFID technology development. Based on the Manhattan project which is located at Los Alamos Scientific Laboratory in 1992, RFID is shown as a combination of radio broadcast technology and radar. Sir Robert Alexander Watson-Watt invented the modern radar system in 1935 for future development of RFID. The paper entitled "Communication by Means of Reflected Power" (1948) by Harry

Stockman. He is one of the first who worked exploring RFID. This paper showed the content on problems of researching reflected-power communication and predicted that the cost economics of RFID type technologies would spur in another 30 years. In the beginning of 1960s, the commercial activities started and found the sensormatic and Check-point during the late of 1960s. At this stage, the existence of tag was detected. They are made inexpensively and support antitheft system. This technology has become the first widespread technology of RFID. After the existence of tag, the development of patents for RFID tag begin by Mario W. Cardullo and Charles Watson in 1973 from U.S. The first U.S. patent is an active RFID tag with rewritable memory which was received by Mario W. Cardullo while Charles Watson received a patent for passive transponder. In 1970s, the idea of putting a transponder in a truck and readers at the gates was developed for tracking nuclear purposed. In the year of 1970s, a tagging system for cow tracking is implemented. The purpose of this system is to track the amount of hormones and medicines that were given to the cows. A passive RFID system by Los Alamos used 125 kHz radio waves and this low-frequency transponders is still used in cows until now. After that, the RFID technology continued its development to electronic vehicle identification designed in 1973 and an electronic toll collection system in the mid of 1980s. The electronic toll collection is developed in United States. In 1992, Harris County Toll Road Authority combined the toll collection and traffic management system in Houston. In 1999, the Auto-ID Center is established at the Massachusetts Institute of Technology (MIT). David Brock implement a low-cost RFID tags in products so that these products can be tracked in supply chain. After this development until the year of 2003, the passive RFID tagging system gained industry acceptance [1].

### 2.2.1 Tagging System

The history of tagging system started with the development of cow tracking system which has been implemented by Los Alamos in 1970s. After that, the tagging system is improved by its functionality and the size of the tag is also reduced. These improvements were done applying low voltage and low power CMOS logic circuit to the tag. The advancement of technology caused to tag to be made of custom CMOS integrated circuit with combination of discrete components in 1980s. At this stage, the antenna size may be determined by the size of the tag. The tagging technology continues in 1990s where Schottky diodes are fabricated on the regular CMOS integrated circuit causing the tag to be consist of only one integrated circuit. Today, the tag can be obtained in many sizes and shapes. It can also be in a form of sticky labels that can be attached on an object. The tagging system of RFID technology has been used in parking system, toll payment system and also library management system [2].

Tagging system helped in finding information and accessed data. It can be helpful by providing better customer service through product identification such as in library or shopping mall. The RFID tagging system improved the accuracy and timeliness of information in supply chains. Besides, tagging system can be used to prevent theft. In some stores, tagging system is used by the employee to track their products and monitor the customer. In University of Hyderabad, RFID tagging system is used during convocation to prevent fraud behavior. Luggage is tracked by using tagging system in the airport. The security is provided to the customer by having this RFID system. In the library, the employee productivity can be increased and able to provide faster customer service when tagging

system is implemented. Users can found the material needed easily and are provided with privacy secured account [3].

In order to encode the information to the tag's memory, the programming is needed. The reader will read the programming in the tag. Usually the tag is programmed by creating the description and quantity of the product, expiry date of the product, and the product's ID number. All the information needed to be programmed depends on the product and used of the tagging system [4].

RFID tagging system also used in movement tracking. In hospital, this tagging system is used for tracking newborn baby to prevent misidentification of babies and tracked for babies kidnapping. Hospital also use tagging system to store information of surgical and track hospital equipment. In kindergarten, a tagging system is used for the children to check their attendance and track their movement in school [5].

### 2.2.2   Swapping System

There are many types of RFID tags available to be used. Card type RFID tag can be used by scanning or swapping the tag to the RFID reader. Swapping system of RFID tag is usually used for payment system, library system and also security system. For swapping system, the users need to have their own personal RFID card with different specific ID numbers. The data of the registered users will be stored in EEPROM memory on hardware and will be loaded to software through serial communication. The data is transferred by using RS232 communication. This RFID card operates in two mode systems which are mark mode and identify mode. Mark mode is operated for any users after the card is swapped whereas

the identify mode will only operate on registered users. The swapping system of RFID tag is easy to be implemented. It minimize the time involved and the security of the system is also increased [6].

The swapping system of RFID card is used in the shopping system to save time of the users. For example for shopping in the mall or at petrol station. The RFID card with unique identity is used during payment. The RFID tag is swapped to the RFID reader and PIN number is requested for security and authentication processed [7].

This system is also used by the employer of an organization for entranced access. All the employee will be provided with RFID card with different ID numbers which is used as an identity card. The employee needs to swap the card at the main entrance before entering the building. This is to prevent any non-authorized which are not related to the organization to simply enter the building without permission [6].

### 2.2.3 Wireless System

RFID technology is provided with wireless identification and tracking ability. RFID is also a wireless sensing application and provides wireless power transmission at UHF. Wireless RFID technology is implemented in order to develop more convenient system [8]. The frequency ranges of UHF band are 433 MHz, 865 – 956 MHz and 4.25 GHz. The main means of transmission is the wave backscattering. The higher frequencies provide longer read range and will be easier to build direction-selective devices [9]. Backscattering principle is applied for wireless power transmission and is a more reliable communication link. Besides, backscattering principle is the key to modulation. The tag-to-reader communication is

enabled to modulate the reflected power. The independence presented to the transponder's antenna is varied [10]. The power produced by the backscattered is used to deliver energy for data transmission from the tag [11]. Figure 2.1 shows the backscattered signal in wireless system.
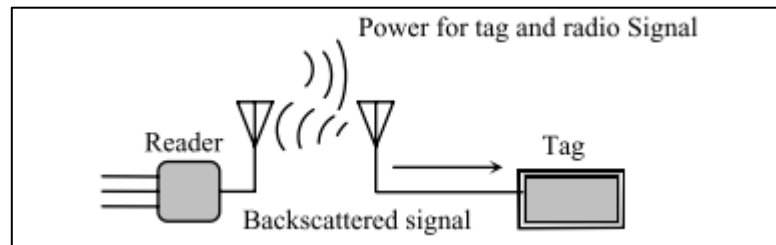


Figure 2.1: Backscattered signal [11]

## 2.3    RFID Overview

RFID technology is one of the way used to identify object or people by using radio waves. Identification is possible due to the unique numbers that stored information in the microchips. This usage of microchip is much simple than bar codes since it can be read automatically without scanning manually. RFID is a technology that enables identification from distance and it is not required for straight line scanning like bar codes. Basically, this RFID technology works by transferring the data stored in the RFID tag using the reader. An antenna received at signal transmitted by the reader. This basic concept clearly showed that RFID system composed of three main components which are RFID tag, RFID reader and antenna [12]. Figure 2.2 shows the basic components of RFID system.
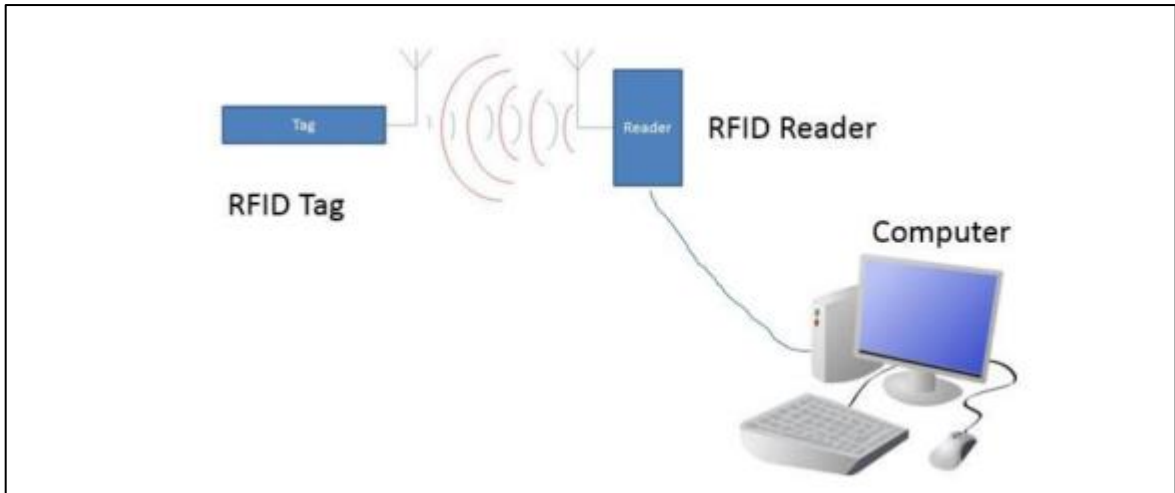
Figure 2.2: The working of RFID [13]

## 2.3.1 RFID Tag

RFID tag is a component that made up of microchip with an antenna whereby this microchip is able to store information of that particular item using radio waves. RFID tag can be placed at product, animal or person depends on its usage. The tag's antenna worked by receiving electromagnetic energy from the RFID reader's antenna. The microchip in the antenna is able to modulate the waves and convert the waves into digital data. The tag sends the radio waves back to the reader by using the power from the reader's electromagnetic field. The reader finally picked up the tag's radio waves and the frequencies are interpreted [12].

A larger unit ID is supported in RFID tag compared to bar codes. Many different tags can be located in the same general are without human assistance when RFID system is implemented. RFID tag can be divided into two main classes which are active and passive. Power source is required for Active RFID tag since they used energy stored in the integrated battery. This causes the tag's lifetime become limited by the stored energy.

Active RFID works in ultra-high frequency (UHF) band and broadcast their own signal for the transmission of information stored. One type of Active RFID tag is transponder which conserve battery life since they do radiate radio waves until a signal is received by the reader. Other than transponder, other type of Active RFID tag is beacons which are not powered on by the reader's signal.

Battery is not required for the Passive RFID tag which caused the tag to have an indefinite operational life and the size is a bit smaller. A passive RFID tag consists of an antenna, a semiconductor chip and some fore of encapsulation. Passive RFID tag works at low frequency, high frequency and ultra-high frequency (UHF) band. This Passive RFID tag is usually used in many applications and can be packed in many ways depending on its application requirements. Due to its usage in many applications, the tag is usually embedded in devices so that it will be resistant to high temperature of chemicals [14]. Figure 2.3 shows the RFID tag.



Figure 2.3: RFID tag [12]

### 2.3.2　Passive RFID Tag

The passive RFID tag has been implemented in Brazil for transportation industry due to its convenient size and affordable market price. The price is cheap and can be purchased by everyone. In the year of 2013, this passive RFID tag is used for RFID-based ETC System [15]. This passive tag does not need power source to operate its function. It depends on the EM waves to supply power to the on-board IC. The DC voltage produced by the diode will boost out the logic unit and memory unit of this passive tag. The transparent windshield type of passive tag has long lasting characteristics and is operated at low frequency [16].

### 2.3.3　Active RFID Tag

Active RFID tag is unlike passive tag. In order for active tag to operate, a power is needed. The energy is delivered from the tag as data transmission. Active tag is more secure since it has the ability to prevent duplicate tag and data between tag and reader. Active tag carries a function which able to communicate with other peer [11]. This active tag which act as transponder has been implemented by aircraft to identify national origin. The other function of active tag in daily life is the vehicle detector. The tag will act as LoJack device which is attached to the vehicle and GPS is used to locate the stolen vehicle. Active tag used power supply and has a high market price which is impractical for retail trade [14].

### 2.3.4 RFID Reader

The other name of RFID reader is interrogators whereby it is a device that emit and receive radio signals through antenna coupled to them. RFID reader is able to capture data stored in the tags and also able to overwrite the data on the tags. RFID reader can be found in different type and size. There are variety types of reader antenna which the usage depends on its application. This reader antenna will work together with the RFID reader to read tags by converting the electrical current into electromagnetic waves. Two types of reader antenna are linear and circular polarized antenna. In linear electric field, the antenna can work in longer range and has high level of powers. These specifications enabled the signal to penetrate through different materials. In circular electric field, the antenna has lower power than linear field. The choice of reader type to be used is depends on the range needed for that application. Reader antenna may work in both short and long range. The short range is known as near-field RFID while the long range is known as far-field RFID [14]. Figure 2.4 shows the near-field communication mechanism for RFID tags while Figure 2.5 shows the far-field communication mechanism for RFID tags.
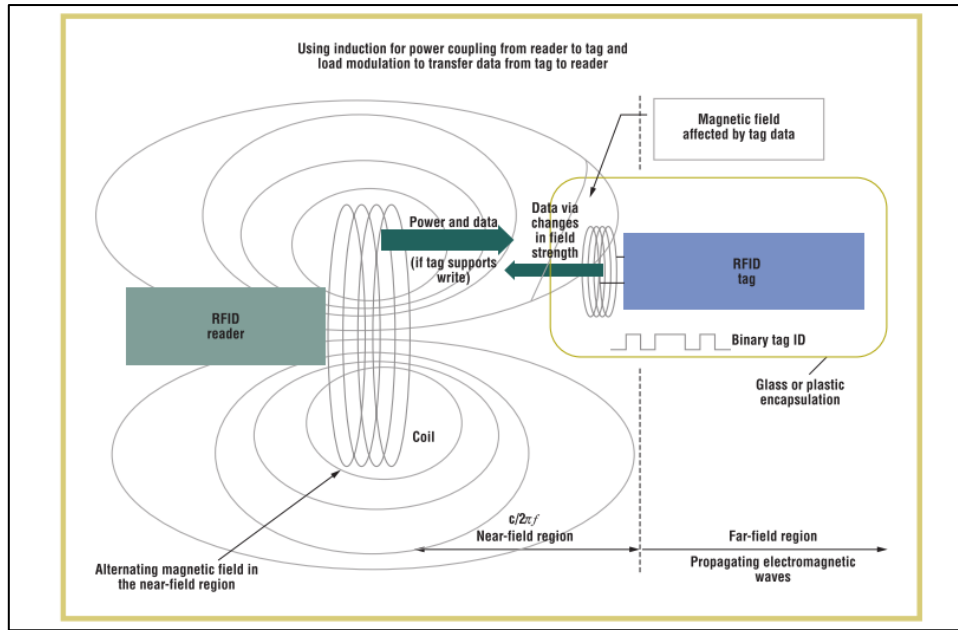
Figure 2.4: Near-Field communication mechanism for RFID tags [14]
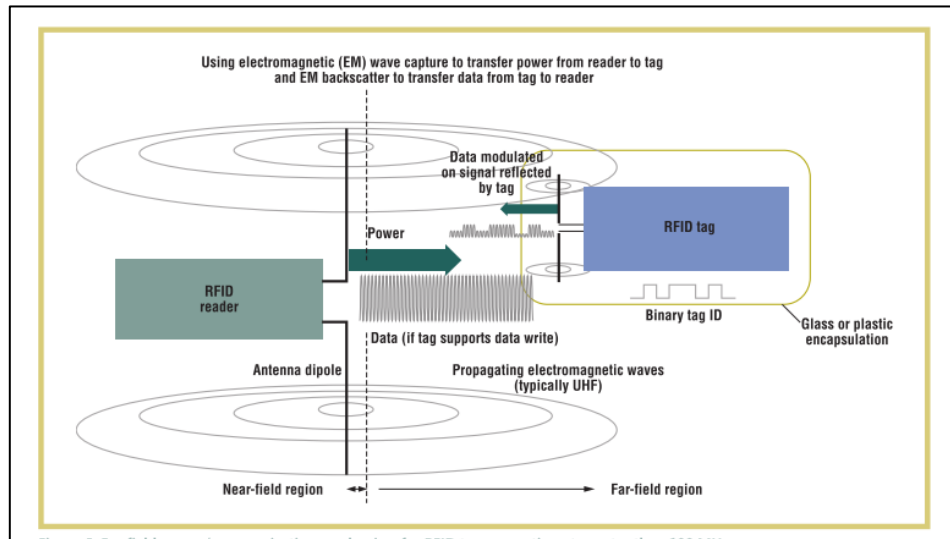
Figure 2.5: Far-Field communication mechanism for RFID tags [14]

RFID reader consists of two interfaces whereby the first one is the communication between the RF interface and the tags so that the tag's identities can be retrieved. The second interface of the RFID reader is communication interface to communicate with the server [17]. Figure 2.6 shows the RFID reader.



Figure 2.6: RFID reader [17]

## 2.4    Application of RFID Shopping System in Community

The concept of RFID technology is initially presented in 1970s but it is unable to commercial the technology since it is too expensive at that time. However, technology of RFID is already in used in certain industries and applications such as in security system, shopping system, library management system and toll system. This technology includes wireless data capture and transaction processing. Improvements of the RFID technology has been made from time to time by developing a cost-effective general-purpose RFID system. Produce cost effective tags for readability improvements [18].

RFID technology helps in speed up the handling of manufactured products and materials. RFID technology is unlike bar codes where it manage to identify items from a distance. RFID tags can be read by the RFID reader through any opaque objects and is applicable in harsh environments. This advancement of RFID technology over bar codes is

more beneficial to community. Due to its cost, the application of RFID technology in community is still limited [18]. In the report of year 2003, the cost of the tags is maximum of 25 cents for high-end products and 5 cents for item-level tagging. Passive and semi-active tags will cost not less than $1 per tag which is not that cheap [9].

### 2.4.1    Smart Trolley System

One of the application that uses RFID technology is the shopping cart system. Shopping cart system is developed to tracked the purchased products and provide online transaction using RFID. This system is implemented at grocery stores and hypermarket. This system is able to make the checkout process faster and also reduced the operational costs. Every product will be attached with RFID tag that will be read by RFID reader during payment process [13]. The total bill will then be transferred to the pc via wireless RF module. Every shopping cart is implemented with a Product Identification Device (PID) [19]. Many research have been done on this shopping cart system and the first publication is published on 1995. This publication discuss on how to create a Personal Shopping Assistant (PSA) that can be connected to the trolley. This PSA system is created mainly to communicate with the user and shows the user the location of items [20].

There are some customers who think that the incomplete information of the product is a waste and it is not necessary at the billing counter. Due to this problem, a suitable shopping cart is designed to satisfy the customer during shopping. An Automated Billing Trolley is designed to overcome this problem. The billing on trolley might save customer's time and improve the accuracy of the billing [21]. Figure 2.7 shows the smart trolley system.

Figure 2.7: Shopping trolley system [22]

## 2.4.2　Smart Cart with Automatic Billing Using RFID and Zigbee

Smart cart automatic billing system is developed by using RFID and Zigbee to keep tracked of purchased products and also provide online transaction for billing purposed. User will be given suggestions on products they might need based on their purchased history. RFID tag is attached on every products and every shopping cart will have RFID reader and Zigbee attached to it. In this system, a microcontroller, LCD, RFID reader, EEPROM memory and also Zigbee module is developed in the Product Identification Device. This Product Identification Device is a part of the cart. The information of the product and the shopping bill will be displayed on the LCD screen. Characters, numbers and graphics will be displayed on the LCD. RFID retail process will be fast, transparent and efficient with the help of wireless network provide by zigbee.

This smart cart system is more efficient than barcode system. This system has high throughput of read rate while barcode has very low throughput. No line of sight required for

this system while for barcode, line of sight is needed. This system has high durability compared to barcode which is low and can be damaged easily. This system has high security which is hard to be replicated compared to barcode which is easier to be reproduced. Finally, this system has the capability of triggering event while barcode is not able [23].


### 2.4.3   RFID Shopping System

This system is developed to perform self-check out without involving any human working as cashier. Good inventory system is also developed in this system. This inventory system is able to track the mobility of high demand products. Sales pattern of customers can be analyzed in this system. Complete web interface is provided in this system as an advantage for the customer. A robust database is implemented in this system. Due to this, the database is able to be accessed by using other protocols and able to support huge amount of data.

The main components of this system is the touch screen LCD which is used to display information. The touch screen LCD is initialized by using libraries and functions in microcontroller. The RFID module together with antenna is designed to identify RFID tags. Signals are send and received by antennas on both reader and tag. Magnetic card reader is used for swiping the ID card for payment and transaction. Items can be paid inside the shopping cart without taking out items for scanning. FM receiver is included in this system to allow user to listen to FM station while shopping. 3.5mm audio input jack is attached to the headphones for FM receiver. Low cost EEPROM is used to store important information and reduced unwanted data. Fast 12C data transmission connection to microcontroller is utilized by EEPROM [24].

### 2.4.4    Comparisons of Previous Work

A few previous works on the application of RFID in shopping payment system has been done. The specifications shown in previous work helped in designing the effective shopping payment system. Previously, there are no shopping payment system involving both active and passive RFID module has been done. There are system which only involved the specifications of online transaction and product tracker. A system which uses Zigbee as wireless data transferred has been done whereby this system includes the specification of having online transaction, involved the use of memory and has LCD display to show simple tag's details. Based on previous work, the systems used LCD to display tag information using microcontroller. No GUI development is involved. The comparisons on previous work involving RFID shopping payment system is shown in Table 2.1.

Table 2.1: Comparisons of Previous Work

|  | Smart Trolley System | Smart Cart with Automatic Billing Using RFID and Zigbee | RFID Shopping System |
|---|---|---|---|
| Online transaction | Yes | Yes | Yes |
| Combination of active and passive RFID module | No | No | No |
| Has memory | No | Yes | Yes |
| Has LCD display | No | Yes | Yes |
| Wireless data transfer | No | Yes | No |
| Product tracker | Yes | No | Yes |
| Development of GUI | No | No | No |

## 2.5    RFID Storage System

An ID called Electronic Product Code (EPC) is stored in the RFID tags to make the tags functioned as object identification. Electrically Erasable Programmable Read-Only Memory (EEPROM) is also available in the RFID tags which is known as data-on-tag approach. Different RFID tag may have different storage limit. For active tags, their memory limit is from 16 bytes to 128 KB while passive tags may have memory only up to 2 KB. Usually UHF passive RFID tags is used in applications since they have 32 KB of memory. Active tags can be used in huge business organizations due to its large memory and the high cost of using it [28].

## 2.6    ZigBee

The other name of ZigBee is IEEE 802.15.4 which is a kind of technology used in automation and remote control applications. ZigBee is design to be low cost, low power consumption and low data rates. The battery life last for several months to several years. The data transfer rates is not as high as Bluetooth and IrDA address which is up to 1 Mbps. Data rates for ZigBee is only limited to 250 kbps on 2.4 GHz ISM band. RFID uses ZigBee technology in tracking and monitoring. ZigBee gives periodic data, intermittent data, and repetitive data in terms of data communication. While in data traffic, the ZigBee can be programmed into beacon or non-beacon mode [29].

**2.7    Database**

A database is a collection of related files. Different models can be used to see how the files are related such as hierarchy model and network model. A database is needed for storing of data. The data will be placed in organizing manner with the help of database. In this world of technology advancement, there are many types of database can be used to ease humans' life which help to keep all the data securely. The most commonly used language for most database is Structured Query Language (SQL) which is easy to learn. People can easily understand on how to perform queries on a relational database. Most popular commonly used database are Oracle, SQL Server, BD2 (from IBM), Sybase, and Informix. The other type of database is Microsoft Access. Microsoft Access is suitable for those who is still new and have no basic on creating a database. The usage of Microsoft Access does not require access of internet or any networks since it is a desktop based program. The weakness of this Microsoft Access is the system can easily crack if multiple users are using at the same time [30].

**2.8    Graphical User Interface (GUI)**

Graphical User Interface (GUI) is something that can be seen every day in daily life. This system is widely used including in our smart phone. GUI is a common way for interacting with computer or electronic devices such as ATM machine, online banking and online shopping. A GUI which is (pronounced 'gooey') is a kind of platform used for communication between human and computers.

GUI is easy to understand because it express the communication in graphic form and the details of the programming language is hidden from the user. A GUI may consist of several graphical icons for communication interaction between human and computers. These graphical icons will show interaction when pointed by user. The programming language behind this event-driven interface will execute some task whenever any interaction is detected. This situation can be seen when the user click on certain icon, the computer will show certain reaction such as open or execute computer programs.

The idea of GUI came from Vannevar Bush who worked at Massachusetts Institute of Technology (MIT) in early of 1930s and later wrote an article on describing *memex* tool in 1945. The article was published in *The Atlantic Monthly*. In 1963, a former student of MIT, Ivan Sutherland wrote his disquisition on Sketchpad, a kind of graphical communication system. Few years before that, the development from the idea of Vannevar Bush is done by Douglas Englebart in 1950s. He was thinking on how to improve human's ability to utilize information with the help of machine. He worked together with his staff and present this idea in 1968 at computer conference at San Francisco. Xerox Star, the first usable GUI that was developed in 1977 at Xerox Palo Alto Research Center (PARC). Due to its high cost, this GUI development become slow and unable to commercial further. Steve Jobs take this opportunity to learn more about this GUI and inspired him to apply GUI in Apple computers. This Macintosh was successfully launched in 1984. In 1980s, many other companies working on creating GUI for their personal company usage.

The most familiar types of GUI is the one that can be found in Microsoft Windows that we are using today such as menus and dialog box. GUI is also used for spreadsheet or tabular interface. They consist of table of cells which may contain text, numbers, formulas, functions and also sometimes may have menus or dialog box too. The most popular GUI components are such as windows, desktop, icons, pointing device, menus, shortcut menus, drop-down menus, toolbars, ribbons, dialog boxes, buttons, and text boxes [31].