RFID-ENABLED POINT OF SALE TERMINAL

MUHAMAD FADHLI BIN MUHAMAD FADZIL

This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honors

Faculty of Electronic and Computer Engineering
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To my beloved father and mother

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ABSTRAK

Projek Terminal Cawangan Pembayaran menggunakan gelombang isyarat radio ini adalah salah satu daripada teknologi yang digunakan untuk menggantikan sistem kod bar untuk mengenal pasti harga dan maklumat sesuatu barang. Pengecaman gelombang isyarat radio adalah salah satu sistem automatik yang berkesan untuk menyimpan dan mengeluarkan data melalui alat yang dipanggil sebagai RFID tag dan penghantar. Sekarang ini, barang di pasaraya menggunakan sistem kod bar yang mengandungi maklumat dan di imbas untuk menyemak maklumat. Sistem ini juga adalah peningkatan daripada sistem kod bar yang sudah lama digunakan kepada RFID yang mana menggunakan radio frekuensi untuk memaparkan maklumat. Projek ini terdiri daripada dua bahagian iaitu pembangunan perkakasan dan pembangunan perisian. Bahagian perisian dibangunkan untuk memberikan satu permukaan yang mesra pengguna dan mudah digunakan. Bahagian perkakasan pula terdiri daripada RFID tag dan pengesan yang diletakkan pada produk. Gabungan kedua-dua bahagian ini menghasilkan satu sistem yang dapat memberikan pengesanan dan memberikan harga dengan hanya melalukan barang pada pengesan.

ABSTRACT

This project of Point-of-Sale Terminal Based on Radio Frequency Identification (RFID) technology can replace the use of barcode to detect the prices and information of item purchased. RFID is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. Nowadays, products in the supermarket used the barcode system which contains the information and been scan for check the information. This project is upgrading the barcode system that been used previously to a RFID which used the radio frequency to display the information. This project consists of two parts which is development of software and hardware. The software development is to provide the friendly user interface and easy to use. The hardware part contains the RFID scanner and the tags that been put at the products. This combination of two part produce a system that can scan and give all the information can be detected by just pass through.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

An RFID tag is an object that can be applied to or incorporated into a product, animal, or person for the purpose of identification using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader.

Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a (RF) signal and can also be used for other specialized functions. The second is an antenna for receiving and transmitting the signal. A technology called chipless RFID allows for discrete identification of tags without an integrated circuit, thereby allowing tags to be printed directly onto assets at lower cost than traditional tags.

Today, a significant thrust in RFID use is in enterprise supply chain management, improving the efficiency of inventory tracking and management. However, a threat is looming that the current growth and adoption in enterprise supply chain market will not be sustainable. A fair cost-sharing mechanism, rational motives and justified returns from RFID technology investments are the key ingredients to achieve long-term and sustainable RFID technology adoption.

1.2 PROBLEM STATEMENT

There are several problems with the current barcode system:

1. The first problem is the scanner cannot recognized the product information when the barcode on the product broken or has been scratch.
2. The customers then need to wait for the staff to find the information and price for the product.
3. Another problem is on the detection hardware which it must show direct and properly showing at the barcode.

1.3 OBJECTIVES

There are 3 objectives for this project:

i) To develop working model of Point-of-Sale (POS) Terminal Based on Radio Frequency Identification (RFID) technology.
ii) To used the hardware for the system that consists of RFID reader.
iii) To design the software for the system that provide user-friendly interface and database that stores information.

1.4 SCOPES OF WORK

This project is divided into two parts, the hardware and software development. Hardware device is consisting of RFID reader while the software is providing user-friendly interface and database that can store information.

CHAPTER 2

LITERATURE REVIEW

2.1 RFID IN POINT OF SALE (POS)

Radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. RFID tags are often envisioned as a replacement for UPC or EAN barcodes, having a number of important advantages over the older barcode technology. They may not ever completely replace barcodes, due in part to their higher cost and in other part to the advantage of more than one independent data source on the same object. The new EPC, along with several other schemes, is widely available at reasonable cost.

The storage of data associated with tracking items will require many terabytes on all levels. Filtering and categorizing RFID data is needed in order to create useful information. It is likely that goods will be tracked preferably by the pallet using RFID tags, and at package level with Universal Product Code (UPC) or EAN from unique barcodes.[7]

The unique identity in any case is a mandatory requirement for RFID tags, despite special choice of the numbering scheme. RFID tag data capacity is big enough that any tag will have a unique code, while current bar codes are limited to a single type code for all instances of a particular product. The uniqueness of RFID tags means that a product may be individually tracked as it moves from location to location, finally ending up in the consumer's hands. This may help companies to combat theft and other forms of product loss.

Moreover, the tracing back of products is an important feature that gets well supported with RFID tags containing not just a unique identity of the tag but also the serial number of the object. This may help companies to cope with quality deficiencies and resulting recall campaigns, but also contributes to concern over post-sale tracking and profiling of consumers.

It has also been proposed to use RFID for POS store checkout to replace the cashier with an automatic system which needs no barcode scanning. However, this is not likely to be possible without a significant reduction in the cost of current tags and changes in the operational process around POS. There is some research taking place, however, this is some years from reaching fruition.

2.2 HISTORY OF RFID TECHNOLOGY

It's generally said that the roots of radio frequency identification technology can be traced back to World War II. The Germans, Japanese, Americans and British were all using radar—which had been discovered in 1935 by Scottish physicist Sir Robert Alexander Watson-Watt—to warn of approaching planes while they were still miles away.[7] The problem was there was no way to identify which planes belonged to the enemy and which were a country's own pilots returning from a mission.

The Germans discovered that if pilots rolled their planes as they returned to base, it would change the radio signal reflected back. This crude method alerted the radar crew on the ground that these were German planes and not Allied aircraft (this is, essentially, the first passive RFID system). [7]

Under Watson-Watt, who headed a secret project, the British developed the first active identify friend or foe (IFF) system. They put a transmitter on each British plane. When it received signals from radar stations on the ground, it began broadcasting a signal back that identified the aircraft as friendly. RFID works on this same basic concept. A signal is sent to a transponder, which wakes up and either reflects back a signal (passive system) or broadcasts a signal (active system). [7]

Advances in radar and RF communications systems continued through the 1950s and 1960s. Scientists and academics in the United States, Europe and Japan did research and presented papers explaining how RF energy could be used to identify objects remotely. Companies began commercializing anti-theft systems that used radio waves to determine whether an item had been paid for or not. Electronic article surveillance tags, which are still used in packaging today, have a 1-bit tag. The bit is either on or off. If someone pays for the item, the bit is turned off, and a person can leave the store. But if the person doesn't pay and tries to walk out of the store, readers at the door detect the tag and sound an alarm. [4]

Mario W. Cardullo claims to have received the first U.S. patent for an active RFID tag with rewritable memory on January 23, 1973.[7] That same year, Charles Walton, a California entrepreneur, received a patent for a passive transponder used to unlock a door without a key. A card with an embedded transponder communicated a signal to a reader near the door. When the reader detected a valid identity number stored within the RFID tag, the reader unlocked the door. Walton licensed the technology to Schlage, a lock maker, and other companies.

The U.S. government was also working on RFID systems. In the 1970s, Los Alamos National Laboratory was asked by the Energy Department to develop a system for tracking nuclear materials.[7] A group of scientists came up with the concept of putting a transponder in a truck and readers at the gates of secure facilities. The gate antenna would wake up the transponder in the truck, which would respond with an ID and potentially other data, such as the driver's ID. This system was commercialized in the mid-1980s when the Los Alamos scientists who worked on the project left to form a company to develop automated toll payment systems. These systems have become widely used on roads, bridges and tunnels around the world.

At the request of the Agricultural Department, Los Alamos also developed a passive RFID tag to track cows.[7] The problem was that cows were being given hormones and medicines when they were ill. But it was hard to make sure each cow got the right dosage and wasn't given two doses accidentally. Los Alamos came up with a passive RFID system that used UHF radio waves.

Later, comanies developed a low-frequency (125 kHz) system, featuring smaller transponders. A transponder encapsulated in glass could be injected under the cows' skin. This system is still used in cows around the world today. Low-frequency transponders were also put in cards and used to control the access to buildings.

2.3 RFID WORKING CONCEPT

An RFID system consists of a tag made up of a microchip with an antenna, and an interrogator or reader with an antenna. The reader sends out electromagnetic waves. The tag antenna is tuned to receive these waves. A passive RFID tag draws power from the field created by the reader and uses it to power the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader, which converts the new waves into digital data.

RF signals are electromagnetic waves classified according to their wavelength frequency. The most commonly recognized ranges are low (LF), high (HF), ultra-high (UHF) and micro-wave (uW). Current RFID technology uses frequency ranges from 50 kHz to 5.8GHz. The higher the frequency, the higher the throughput or rates of data transfer.[7]

Like a barcode system that uses an optical signal reader or scanner to interpret data contained in a barcode, an RFID system uses an RF reader to receive radio frequency signals from RFID devices containing stored data. Unlike barcode systems, RFID systems do not require line of-site to read the RF tags. This along with the ability to read many tags at once is the major factor driving interest in RFID technology.[4]

An RFID device such as a tag or label contains data, much more data than a barcode, which uniquely identifies the item it is attached to. Stored data can include; a description of the item, manufacture date, time the item passed a certain point in the supply chain, serial number and much more.

2.4 RFID TAGS

An RFID tag is defined as active if a battery inside the tag housing provides power to the tag or the tag is connected to an external power source. A tag is defined as passive if it has no battery. In applications that use passive tags, RF energy from the interrogator powers tag circuits. The choice of active versus passive tags has consequences for overall system cost, initial tag cost, tag life, and battery life.

Passive tags have a lower overall cost due to low-cost tags and long tag life. The lifespan of passive tags is indefinite because the tag has no battery. The choice between active tags and passive tags is related to other system design issues. Active tags can support higher data rates and higher chip processing speeds, but passive tags also support data rates and chip processing speeds that are suitable for high-performance applications such as toll. Active tags can support user interfaces (lights and LEDs), but tag interfaces reduce battery life. A disadvantage of passive tags is that some countries do not allow sufficient interrogator power and suitable RF frequencies to support the range necessary for some high-performance applications.[4]

Active tags have a higher overall cost if cost of ownership includes battery changes. Battery life is a primary concern for reliability and for cost of operation. In toll applications, for example, battery outages, which can cause RFID transactions to be processed as violations, are expensive and time-consuming both to users and toll road operators. Battery life depends on the battery capacity and the long-term average power drain. An overall view of tag cost must assess tag replacement costs for tags with fixed batteries or battery replacement costs for tags with user-replaceable batteries.

2.5 RFID FREQUENCIES

Typical RFID System Frequency Ranges:

• Low Frequency (125 KHz) has a maximum read range of up to 20 inches

• High Frequency (13.56 MHz) has a maximum read range of up to 3 feet
• Ultra-High Frequency (868 MHz – Europe) (915 MHz – US) has a read range of 20 feet or more
• Microwave Frequency (2.45 GHz) has a read range of up to 1 meter as a passive tag or longer range as an active tag.[4]

Frequency refers to the size of the radio waves used to communicate between the RFID system components. Just as you tune your radio to different frequencies in order to hear different radio stations, RFID tags and readers have to be tuned to the same frequency in order to communicate effectively. RFID systems typically use one of the following frequency ranges: low frequency (or LF, around 125 kHz), high frequency (or HF, around 13.56 MHz), ultra-high frequency (or UHF, around 868 and 928 MHz), or microwave (around 2.45 and 5.8 GHz). It is generally safe to assume that a higher frequency equates to a faster data transfer rate and longer read ranges, but also more sensitivity to environmental factors such as liquid and metal that can interfere with radio waves.[7]

There really is no such thing as a "typical" RFID tag. The read range of a tag ultimately depends on many factors: the frequency of RFID system operation, the power of the reader, and interference from other RF devices. Balancing a number of engineering trade-offs the Parallax RFID Reader Module's antenna was designed with a specific inductance and "Q" factor for 125 kHz RFID operation at a tag read distance of up to 1¾" – 3" inches.

2.6 RS-232

In telecommunications, RS-232 (Recommended Standard 232) is a standard for serial binary data signals connecting between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. A similar ITU-T standard is V.24.[8]