UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Intelligent Vehicle Parking System of all shopping complex in Malaysia with Radio Frequency Identification (RFID)

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Electronic Industry) (Hons.)

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DECLARATION

I hereby, declared this report entitled “PSM Title” is the results of my own research except as cited in references.

Signature **:……**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology Industrial Electronic (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRACT

Nowadays shopping complex has become the popular location for leisure activities to people in Malaysia. The efficient car parking payment system is one major factor that can affect the shopping experience in the shopping complex. To replace the time consuming manual processing of parking ticket and improve the read range of the current reader, intelligence vehicle parking system of all shopping complex in Malaysia is proposed using Radio Frequency Identification (RFID) technology. Radio Frequency Identification (RFID) is an automatic identification method that data or information stored on the RFID tags can be retrieved remotely. This project is able to provide convenience for both user and car park owner in terms of automatic payment and vehicles quantity control in the car park. The time for user to enter and exit the car park will be shortened by implementing this system. CCTV will be used for surveillance to monitor the condition of the car park. This system uses microcontroller to be the central control of interfacing with RFID reader various sensors. 125 kHz RFID reader and RFID card are chosen to implement this parking system.

ABSTRAK

Pada masa kini kompleks membeli-belah telah menjadi lokasi popular untuk aktiviti riadah untuk penduduk di Malaysia. Sistem bayaran tempat letak kereta yang berkesan adalah salah satu faktor utama yang boleh menjejaskan pengalaman membeli-belah di kompleks membeli-belah. Untuk menggantikan masa yang panjang untuk pemprosesan manual tiket letak kereta dan meningkatkan pelbagai baca pembaca semasa, sistem letak kereta kenderaan secara kebijaksanaan di semua kompleks membeli-belah di Malaysia dicadangkan dengan menggunakan Pengenalan Frekuensi Radio (RFID). Pengenalan Frekuensi Radio (RFID) adalah satu kaedah pengenalan automatik dengan data atau maklumat yang disimpan di tag RFID boleh diambil dari jauh. Projek ini dapat memberi kemudahan kepada kedua-dua pengguna dan pemilik tempat letak kereta dari segi bayaran dan kawalan kuantiti kenderaan secara automatik di tempat letak kereta. Masa untuk pengguna untuk masuk dan keluar dari tempat letak kereta akan dipendekkan dengan melaksanakan sistem ini. CCTV akan digunakan untuk pengawasan demi memantau keadaan tempat letak kereta. Sistem ini menggunakan pengawal mikro untuk menjadi pusat kawalan antara muka dengan pembaca RFID pelbagai sensor. 125 kHz pembaca RFID dan kad RFID dipilih untuk melaksanakan sistem letak kereta ini.

DEDICATIONS

This report is dedicated to my beloved parents who educated and supported me throughout the process of doing this project.

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CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter discussed about the background, problem statements, objectives and limitations of the project.

1.1 Background

1.1.1 Vehicle's parking system of Shopping Complexes in Malaysia

There are total of 200 malls in Malaysia where the malls that currently under construction or opening after 2016 are not included. (wikipedia) [1] Majority of malls were built in urban areas such as Selangor and Kuala Lumpur which have large population of citizens or hot spot of tourist attraction. Profit gained from tourism is one of the sectors that can provide main income for our country. Thus, there is increasing demand of shopping complexes as well as the parking spaces for the customers. Most of the malls in Malaysia now provide two options for customers where they can pay their parking fees through parking tickets or they can also use Touch & Go cards. If customers choose to pay via parking tickets they should receive one ticket upon entry of parking lots and have to pay the amount of parking fees by inserting the ticket that obtained earlier to the ticket vending machine. The ticket vending machine will calculate the amount of money needed to be paid by customers according to the parking duration. The paid tickets are withdrawn and have to be inserted once again to open up the barrier upon leaving the parking lots.

Another alternative method is using the Touch & Go card. Touch & Go cards of customer must have considerable amount of balance before being used to scan it upon entry and when leaving the parking lots. The range of signal is limited. Thus, Radio Frequency Identification (RFID) technology is proposed replace the current payment method.

1.1.2 History of RFID

Radio Frequency Identification (RFID) is an emerging technology which gained popularity in this communication age and headed towards a ubiquitous computing world. The roots of RFID technology can be traced back to World War II where it was used for airplane identification. The discovery of this technology was found by Germans to identify which planes belonged to the enemy and which were a country's own pilots returning from a mission. (Violino, 2010) [2] Later Scottish physicist Sir Robert Alexander Watson-Watt developed a secret project IFF (Identify Friend or Foe) by the British. The IFF system was the first active RFID system. Each British plane had transmitter placed on it. When signal was received from radar station on the ground, it began transmitting a signal back that identified the aircraft as friendly. RFID works on the same basic concepts. Transponder receives the signal sent by the host. The signal initiates or either reflects back a signal from transponder's power and broadcast a signal from its own power source or built-in battery, such as the batter in responding antenna or tag. (Eric C Jones, Christopher A.Chung, 2008) [3]

In 1948, "Communication by Means of Reflected Power" by Harry Stockman became the first of the research works that explored public with RFID. The problems related for researching about reflected power communication and the possible application of this technology are discussed. In Harry Stockman's research, he predicted that "considerable research and development work has to be done before the remaining basic problems in reflected-power communication are solved, and

before the field of useful application is explored." (Landt, catlin, 2001)[4] Advances of technology in the development of communication network, computing and integrated circuit are the keys for RFID being widely utilized in the future.

1.1.3 Concept of RFID

RFID system uses radio waves to exchange data between RFID transponders, or tags, and interrogators or reader. RFID readers are devices that perform the interrogation of RFID tags. The primary function of the tag is to transmit data to the rest of the RFID system. RFID technology uses radio wave portion (9 kHz - 3000 GHz) of the electromagnetic spectrum but RFID technology only uses 4 segments of radio wave spectrum. The four segment are 125-134 kHz (Low Frequency), 13.56 MHz (High Frequency), 433 & 860-960 MHz (Ultra High Frequency) and 2.4 & 5.8 GHz (Microwave).The basic principles of RFID are, the tag enters RF field of reader, the RF signal powers the tag, the tag transmits data and ID. Next, the information is captured by the reader, reader sends the data to computer, the computer sends data back to reader, and reader will transmit data back to tag.

1.1.4 Automatic Identification system

Identification plays an important role in our lives. Identification is essential in operations and business. Examples of this application are barcode technology used in groceries identification and credit cards used for payment. There are several techniques can be used for this purpose such as contactless smart cards, proximity cards and radio frequency identification (RFID). An Auto-ID technology is anything that collects data about the objects and enters that data into a database without human intervention. (Mark Brown, Sam Patadia, Sanjiv Dua, 2007) [5] Auto-ID faces huge demand in identification of people, animals and products in order to achieve the transition of communication field towards wireless.

1.2 Problem Statement

Current manual payment method contributes to the problem of time consuming manual processing of receipts or parking tickets of the car park in shopping complex. This phenomenal is very common nowadays especially on public holidays where shoppers have to queue up to pay the parking fees. Furthermore, shoppers often find inconvenience to wind down the window or move closer to insert the parking tickets. Besides that, authorized car park owner also faces problem in finding out the quantity of available parking spaces in the car park. For the Touch & Go payment method, users only able to have free reload from manual transactions over a few counters available in the area. Users will be charged an additional fee of RM0.50 and RM1.00 at Cash deposit Machine when reload at the ATM or through reload agents. Thus, frequent shoppers who are the users of Touch & Go or Smart card still prefer to use cash for parking fees payments to avoid reloading the Touch & Go or Smart card.

1.3 Objectives of Project

1. To build up the circuit for the RFID system.
2. To obtain the best range or distance of the detection of the RFID tags with the reader.
3. To improve the time efficiency of car park payment processing in shopping complex.
4. To monitor the quantity of vehicles in the car park of shopping complex.

1.4 Scope of project

This project would be carried out by implementing the technology of Radio Frequency Identification (RFID) to replace current ways of handling parking payment in shopping complex. The usage of RFID tags would be optimizing for vehicle parking payment purpose. Although there are many areas that RFID tags can be used, this project focuses only on all car parks of all shopping complexes in Malaysia. The range of detection of RFID tags with the antenna would be studied. This project would also study the possibility of RFID to be practically implemented in our country by considering the time and cost efficiency as well as the maintenance of this technology required once it is implemented.

The performance of the RFID system on managing the vehicle's parking payment depends upon the following factors:

(a) The operation frequency of the reader
(b) The time taken for the tags to be detected
(c) The power level from the power source

1.5 Project Limitation

The implementation of frequency band of RFID in project is limited to Low Frequency (LF) which is 120 kHz to 150 kHz due to our implementation of car park payment system does not require high frequency operation as it is not cost effective considering the higher power level needed for higher frequency operation. However, operation of 13.5 MHz RFID system would be studied for research purpose. The project would focus on covering the read range of RFID tags but not the speed and sensitivity of the tags. This is due to the car park payment system process only one tag at a time upon car entry and leaving, thus the decoding speed and sensitivity can be kept constant.

Chapter 2
LITERATURE REVIEW

2.0 Introduction

This literature review generally discusses about RFID technology and the communication between RFID reader and RFID tag. The implementation of RFID technology in various fields will also be discussed.

2.1 Introduction to RFID

Radio Frequency Identification (RFID) is the technology that uses radio waves to identify people or objects automatically. The implementation of RFID technology is developing rapidly in various applications such as healthcare, information technology, logistics, animal tracking, transportation, aviation and others. The most common method of identification is to assign a serial number on a microchip that is attached to an antenna that creates identity for a person, object or information. The major components in RFID technology are transponder (RFID tags), transceiver (RFID reader) and antenna. The identification information can be transmitted to a reader with antenna. The reflected radio waves get from the RFID tag is converted into digital information by reader which will then being transferred to the computer databases for further operations. The RFID tag stored unique identification information that can be linked to the database to retrieve data. Figure 1 shows the communication of RFID operation with the central base system.

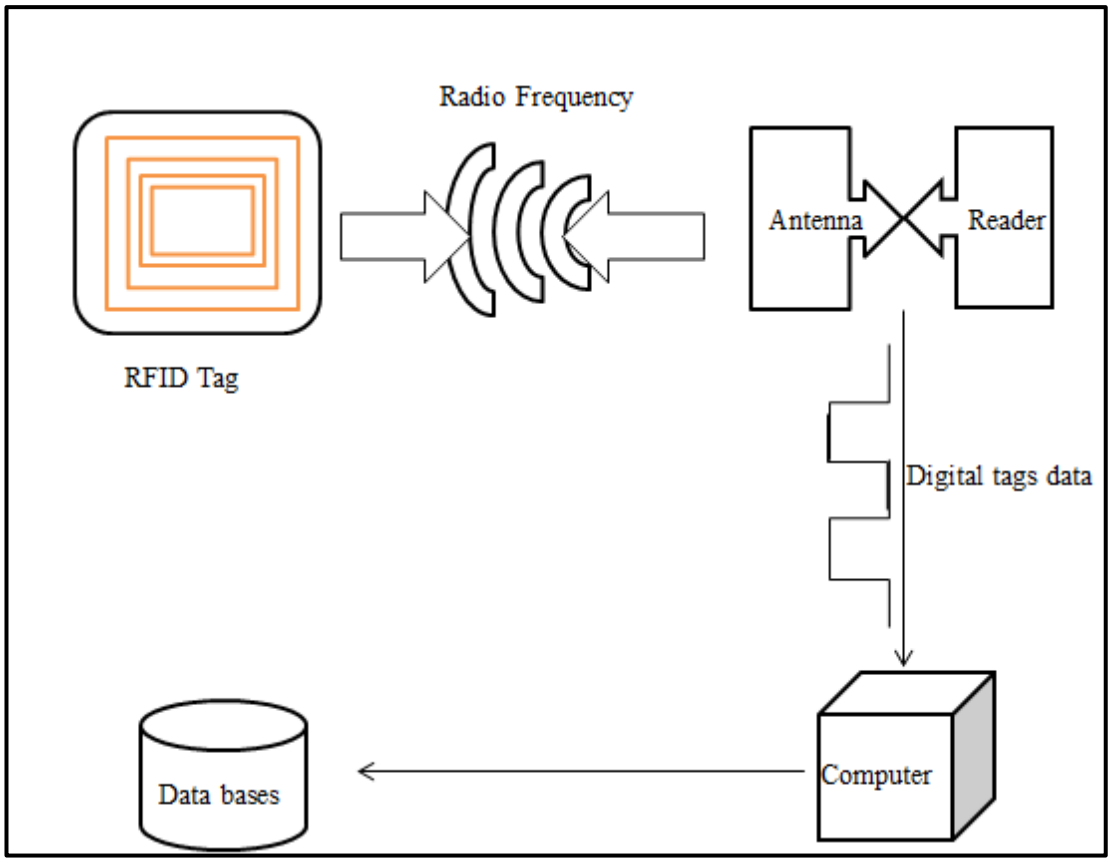

Figure 2.1 RFID working scheme

2.1.1 RFID tag

The function of an RFID tag is to transmit data to the rest of the RFID system. RFID tags or RFID transponders are small and low cost tags that can be attached to items to track or identify the products. Besides that, RFID tags also allow other forms of data collection to be performed. There are three basic parts in RFID tags, which are the electronic integrated circuit, a small antenna within the tag and a substrate to hold the integrated circuit and the antenna together. Cost of the tags is minimized and power required to initiate the tag is also kept as low as possible by reducing the amount of electronic components in the integrated circuit. Antenna within the RFID tag also needs to operate satisfactorily at the operation frequency, for example 125 kHz or 13.5MHz. Since the higher the frequencies the smaller the wavelengths, the higher the efficiency of RFID tags in higher frequencies. [6]

There are three types of RFID tags, which are passive tags, active tags and semi active tags. Table 2.1 shows the characteristics different types of RFID tags.

(a) Passive tags

A passive RFID tags do not contain any power source, an electromagnetic (EM) field must be presence in order for a passive RFID tag to generate and reflect radio signal to a reader or interrogator. Since passive tags need to obtain enough power to generate a response, the passive tag must be inside the interrogation zone. The power received from the reader is sufficient to activate any device in the RFID tag and response to reader with the required data. The overall operation to power a RFID tags is, when the tag antenna receives the EM waves transmitted by the interrogator, the current is induced. The induced current is used by the tags to perform backscatter response to the interrogator by sending an amplitude modulated (AM) signal.

(b) Active tags

Active tags have an on-board power source which battery power is used to supply power to the electronic integrated circuit and the tag antenna. Since the tag is not dependent upon the received power from reader to send the reflected signal, greater distances of detection range can be achieved. Active tags normally remain in sleep mode to conserve the battery power. When the tags enter the interrogation zone, the active tags are activated or being woken up and provides data to the RFID system as requested. The length of operational life of active tag is increased with the ability to constantly stay in sleep mode.

(c) Semi-Passive tags

Semi-Passive tags have the features found in both passive and active tags. Semi-Passive tag uses an internal battery to power up the internal operation of the tag. However, it relies on electromagnetic field power received from the RFID reader to transmit signal to the RFID reader. (Eric C Jones, Christopher A.Chung, 2008)

Table 2.1 RFID tags comparison

	Active tags	Passive tags	Semi-Passive tags
Power Source	Internal to tags	Energy transfer from the reader via Radio Frequency	Internal power source is used power the tag. Energy transferred from the reader via RF to backscatter.
Battery in tag	Yes	No	Yes
Tag power availability	Continuous	Only within field of reader	Only within field of reader
Required signal strength	Very Low	Very high (power the tag)	Moderate (power backscatter)
Available signal strength	High	Very Low	Moderate
Reader Communication Range	Long Range (100m or more)	Short range (up to 10m)	Moderate range (up to 100m)
Sensor Capability	Able to monitor and record sensor input continuously	Able to read and transfer sensor values only when tag is powered by reader	Able to reader and transfer sensor values only when tag receives RF signal from reader