UNIVERSITI TEKNOLOGI MARA

COMPARATIVE STUDY ON RFID, HOTSPOT
AND CAR PLATE SCANNING METHOD: FOR
INTELLIGENT PARKING MANAGEMENT
SYSTEM

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LIST OF ABBREVIATIONS

RFID   Radio Frequency Identification

RF   Radio Frequency

Wi-Fi   Wireless Fidelity

IPS   Intelligent Parking System

VMS   Variable Message Signs

HAR   Highway Advisory Radio

MHz   Megahertz

LPR   License Plate Recognition

DLL   Dynamic Link Library

IR   Infra-Red

VLP   Vehicle License Plate

ANN   Artificial Neural Network

WLAN   Wireless Local Area Network

NIC   Network Interface Card

GPRS   General Packet Radio Service

IEEE   Institute of Electrical and Electronics Engineers

AP   Access Point

DNS   Domain Name System

VPN   Virtual Private Network

UPC   Universal Product Code

AIDC   Automatic Identification Data Capture

EPC   Electronic Product Code

LF   Low frequency

UHF   Ultra High Frequency

HF   High Frequency

VHF   Very High Frequency

ISM   Industrial-Scientific-Medical

EAS   Electronic Article Surveillance

IC	Integrated Circuit
PTS	Post och Telestyrelsen
LAN	Local area Network
CEPT	Conference of Postal and Telecommunications
CSMA	Carrier Sense Multiple Access
ISO	International Standard Organization
OCR	Optical Character Recognition
PC	Personal Computer

ABSTRACT

Intelligent Parking Management System technology that enables efficient use of parking will be increasingly important as a growing population places ever-growing demands on existing transportation infrastructure. While the problems of parking shortages are well recognized, the cost of providing additional capacity is frequently prohibitive. Intelligent Parking Management System may provide a sensible means to effectively increase parking capacity, while simultaneously reducing demand by enabling parking service operators to charge market rates depending on time of day. The potential benefits of Intelligent Parking Management System are it can improve security for both car park operators and car park users, flexible access control to easily accommodate visitors and delivery vehicles, improve traffic flow during peak periods and others. The Intelligent Parking Management system using Radio Frequency Identification (RFID) and hotspot technology is the advanced parking technologies to manage existing parking spaces at a shopping complex to increase effective capacity and transit access. Smart parking systems implemented worldwide have been found to reduce delays and improve convenience of parking (Shaheen, 2003). The car plate scanning implement also can reduce vehicle stolen problem and increase the security of parking area more competently. Although this is a new technology in Malaysia, the RFID application is world wide accepted by other country. The research method is a primary data which is gathered through a literature review and on line web on RFID, hotspot and car plate scanning method. Through this research, the writer found that passive RFID tags is more cost effective than active tags. It also the most preferable tag by other researcher. Although there are some obstacles to implement RFID and hotspot technology, during investigation, the writer found that there are four solutions can be put into practice: implement reference tag to amplify the passive tag signal to have greater length of coverage, utilize hybrid RFID tag design that is protocol-compatible with existing Institute of Electrical and Electronics Engineers (IEEE) 802.11 or Bluetooth standards as well as existing Radio Frequency (RF)-tag standards, the arrangement of antenna and RFID tag and use RFID reader with Wireless Fidelity (Wi-Fi) 802.11 interface to detect RFID tag. Finally, the proposed network architecture for the Intelligent Parking Management System is designed.

CHAPTER 1

INTRODUCTION

This chapter provides the background of the study. It also gives details of the research questions, objectives, significant, scope and limitation of the study.

1.3 Overview

Increasingly, parking is becoming an important aspect of transportation planning. Many areas have seen explosive growth in the number of visitors and customers as the result of urban revitalization, uptown development and the general trend toward increased mobility of our society. As a result, localities are conducting studies on parking supply management (Louisell et al., NA).

Intelligent parking management systems are highly specific application that uses precise signing scheme that can include information on current parking inventory and parking facility locations. While entering the gate, a camera will capture picture and scan the car plate number and embedded the information into the ticket assigned to the vehicle owner. This ticket is using Radio Frequency Identification (RFID) technology. It uses a semiconductor (micro-chip) in a tag or label to transmit stored data when the tag or label is exposed to radio waves of the correct frequency. RFID is used because it is non line of sight naturally, the tags can be read in various substances such as snow, fog, ice, paint and crusted grime.

Each level install with hotspot which is used to detect empty parking slots based on the ticket assign to the vehicle owner. The vehicle owner should not bring along the ticket to the mall. If this happen, the hotspot will assign that the parking slot is empty and available to other customer. It is important to understand the hotspot environment in order to deploy a configuration that meets the users' requirements. There are three key factors that determine what type of hotspot environment to create: the physical size of the location, the number of simultaneous users, and the types of usage expected.

If they want to leave the parking, the camera will scan again the car plate number to check whether it is synchronized with the ticket given. Beside that, the car park management operator can check whether the driver is the appropriate person based on the previous picture taken.

1.4   Background of The Research

Most of the vehicle owners are facing problem to allocate parking spaces in shopping complex. They will go round looking for parking spaces and finally caught in a huge traffic jams both inside.and outside the car park. This is especially so during special events such as sales or festivals. Unfortunately to the driver if the parking rate is based on time. According to police statistic as depicted in Table 1.1, the amount of vehicle that has been stolen is increasing. This is maybe because lack of awareness from the vehicle owner and shopping complex.

Table 1.1: Statistic Vehicle Stolen For Year 2000-2004 (Source:
http://www.rmp.gov.my/rmp03/statjsjindeks04.htm)

Vehicle	2000	2001	2002	2003	2004
Lorry and van	3698	4306	4570	5551	4892
Car	7278	8520	8544	8537	8624
Motorcycle	45903	47223	47137	50212	51560

To prevent this from happen, intelligent parking management systems is developed with various features as stated above:

i.   Centralized monitoring system.
ii.   Parking Database to monitor available parking slot.
iii.   Color and Car Plate Capture, extraction or recognition.
iv.   Radio Frequency Identification (RFID).
v.   Empty space information is displayed on the monitor while entering the gate.
vi.   Hotspot is used to detect empty parking spaces by detecting RFID frequency and update it with the database so that it can preview available slot on the screen to the customer.

Centralized monitoring system is the main system of the Intelligent parking management system. This monitoring systems is used to manage and monitor others sub components of the system. All the update information is done here. The parking database records vehicles and owner detail, event log and vacancy info. If the owner forgot where they put the vehicle, they can go to the nearest kiosk available to check the vehicle's position by entering the car plate number.

Hotspot communicates with the centralized monitoring system to update the database regarding available parking spaces. It will detect based on RFID frequency. While entering the gate, a camera will capture the color and car plate number, extract it and recognize it to embed it into the ticket. The car image is capture from video stream to extract and recognize the car color and plate number using Image Processing and Neural Network. The RFID is embedded in the ticket to keep track of the vehicles in the car park. The hotspot detects the RFID signal; the parking slot is assigned as full.

The main purpose of this research is to produce comparative studies on various intelligent parking management systems. This study tries to implement hotspot and

RFID technology in parking management system, which is not yet been used by other country.

1.5 Research Questions

This research study will try to answer the following question:

"What is the specification for hotspot coverage, RFID and car plate scanning method to be implemented in the Intelligent Parking Management System?"

1.6 Objective of The Research

Aim:

To conduct a comparative review on various system implementing RFID technology.

Objectives:

i.   To identify existing Intelligent Parking Management System.

ii.   To investigate the technical specification for hotspot, RFID and car plate scanning method.

iii.   To choose and describe the specification for hotspot, RFID and car plate scanning method to be implemented in the Intelligent Parking Management System.

1.8 Significance of The Research

This research will benefit many parties. Not only to those who always engaged with the Parking Management System, this paper also will benefit vehicle owner. Among the parties that will benefit from this stuff are:

1.8.1 Shopping Complex

This research can be a guideline for shopping complex to apply intelligent parking management system using hotspot, RFID and car plate scan method. In order to achieve this, they have to setup appropriate device and software according to the specification given.

1.8.2 Car Park Management Operator

This study will guide car management operator to provide superior services. As a result, this will attract more customers and thus increase business. The public would not mind paying a little extra for these services as long as their property is protected.

1.8.3 Vehicle Owner

This research will simplify vehicle owner to find empty parking slots at a shopping complex through monitor available at the entrance. This monitor shows vacant parking. Moreover, there is an extra security because the ticket assigned is synchronizing with the car plate number. While entering the gate, a camera will recognize the plate number and embedded it into the ticket. If the owner wanted to leave, the camera will check whether the ticket is synchronize or not with the car plate number.

1.8.4 Insurance Company

This research will be valuable to the insurance company where it can reduce the amount paid to claimants arising from stolen vehicles in indoor car parks through first-class safety.

1.8.5 People Who Are Interested To Develop Parking Management System

This research will be the best reference for peoples who are interested in developing intelligent parking management system. This pioneer research implementing hotspot and RFID will be valuable data to the new investor and

1.9 Scope of The Research

This comparative study will be done on various intelligent parking management systems available around the world. This research is focusing for indoor parking such as at the shopping complex. Wrapping up this research documents is the best specification for hotspot coverage, RFID and car plate scanning method together with the best hardware and software to implement it. This research will be a good guideline to people who are interested in implementing this system.

1.10 Limitation of The Research.

Limitations of the research are:

i. This idea is new in Malaysia. Therefore, there are lacks of information regarding parking spaces in shopping complex and intelligent parking system available.

ii.   If the vehicle owner brings the ticket to the shopping mall, the hotspot will not detect that the parking spaces has been occupied. This will cause problem to other user while searching for empty parking slot.

iii.   The vehicle owner have to put the ticket in a save place in the car. As RFID is line of sight, they can put it even under car seat.

iv.   Good maintenance is compulsory in order to manage the system accurate and precisely.

v.   The camera did not capture the driver face clearly. This will cause problem to the car management operator to detect whether the driver is legal or not.

CHAPTER 2

LITERATURE REVIEW

The literature is a valuable resources and an important storehouse of knowledge and thinking about a topic or area. This chapter will discuss more about all of the information related to tHe research study. It covers the research on Intelligent Parking Management system available, hotspot and RFID technical specification and car plate scanning method.

The literature review in this paper is based on books, journal articles, on-line documents and web search covering the areas on Intelligent Parking Management system available, hotspot and RFID technical specification and car plate scanning method.

2.7 Intelligent Parking Management System

With decreasing parking supply and increasing enrollment and shopping complex staff numbers, they are beginning to realize the importance of properly allocating available parking. Intelligent Parking Management Systems can provide the positive guidance necessary to help shopping complex's customers find available parking quickly and safely. It is common for the owner of a vehicle to take a ticket at the entrance of a car park or insert a membership card. The ticket or the card allows the driver to enter.

There are many studies regarding Intelligent Parking System Crowder and Walton (2001) provide technical report on Intelligent Parking System (IPS) for the University of Texas reallocates parking and reduce congestion and illegal parks. It provides university way finding, which can complement IPS. Variable Message Signs (VMS) have been considered by the university to provide way finding and parking information.

2.7.1 Intelligent Parking Management System Issues

Intelligent parking management solutions can take on a range of configurations based on the specific problem being addressed. According to Louisell et al. (2005) in general, the parking problems can break down into two broad categories: lack of information on the availability of parking spaces at a specific location and lack of information on what facilities are available and what is the best routing to get to them.

2.7.1.1 Parking Availability

Systems are deployed to continuously monitor the number of available spaces at each participating parking facility. This information is fed to a centralized computer that generates messages for deployment through any number of media ranging from general broadcast media services to highly specific messages to specific addressees. The messages can be delivered to parking patrons via the worldwide web, specialized TV stations, Highway Advisory Radio (HAR) systems, VMS devices, subscription e-mail services or potentially to onboard navigation systems and in-vehicle signing systems installed in privately-owned autos. Parking information provided in these formats can be useful in pre-trip planning and reroute to the attraction to be visited.

2.7.1.2 Parking Location and Routing.

Information systems are populated with data on the location of parking facilities, the number of spaces they have, the hours of operation, the cost of parking, nearness to major attractions and directions from major points of access. This information can be accessed in pre-trip planning via the worldwide web or can be included in onboard navigation system or in-vehicle signing system packages. In addition, this information can be embedded in effective signing concepts that provide en-route travelers with trailblazer information as they approach major attractions.

2.7.1.3 Advantages of Intelligent Parking Management System

Listed below are the advantages of implementing Intelligent Parking Management system:

i.   Can be used to double check that the car is allowed to cross and shorten the time it takes to go through the border, so shortening the typical long queues.

ii.   Car park control and management using automatic license plate recognition.

iii. Access control to authorized users at staff car parks and sensitive sites.

iv.   Maintain current and historical record of vehicles on parking slot.

v.   Improved security for both car park operators and car park users.

vi.   Flexible Access Control to easily accommodate visitors and delivery vehicles.

vii. Can improve traffic flow during peak periods.

viii. Car park usage analysis for management purposes.

ix.   Benefits to the traveler are increased ease of access, reduced time spent looking for parking, and reduced frustration.

2.7.2 Intelligent Parking Management System Setup

In order to take photographs of the car plates, the digital camera was placed in front of the car at one meter away from the front of the car and at a height of 0.5 meter (Chanson & Robert, 2002 and Alias & Mohamad, 1999). Photographs were taken under varying weather conditions ranging from imminent rain and cloudy sky through to very sunny. Some license plates were dirty or damaged while some were very clean.

The Intelligent Parking Management system was carried out by Chanson and Roberts (2002) used Intel Pentium III 733 MHz processor, 256 MB SDRam PC133, a 15 GB 7200 rpm hard drive and a 32 MB TNT2 AGP video card. The photographs that were taken with a Sony digital Mavica MVC -FD71 were 640 pixels wide and 480 pixels high. The software was developed using Borland Delphi 5.

Hoffman (2004) proposed License Plate Recognition (LPR) systems consist of the following units:

i. Camera - Take the images of the car (front or rear side)

ii. Illumination - A controlled light that can bright up the plate and allows day and night operation. In most cases the illumination is Infra-Red (IR) which is invisible to the driver.

iii. Frame grabber - An interface board between the camera and the PC that allows the software to read the image information.

iv. Computer - A PC running Windows or Linux. It runs the LPR application which controls the system, reads the images, analyzes and identifies the plate, and interfaces with other applications and systems.

v. Software - The application and the recognition package. Usually the recognition package is supplied as a Dynamic Link Library (DLL).

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vi.   Hardware - various input or output boards used to interface the external world such as control boards and networking boards.

vii. Database - The events are recorded on a local database or transmitted over the network. The data includes the recognition results and the vehicle or driver-face image file.

The following illustration in Figure 2.1 shows a typical configuration of a LPR system. The application runs on Windows application platform in the PC and interfaces to a set of camera or illumination units which are interfaced by the frame grabber. The application controls the sensors and controls via an input output card that is connected through a terminal block to the inputs and outputs. The application displays the results and sends them via serial communication and via DDE messages to other application. It writes the information to local database or to optional remote databases.
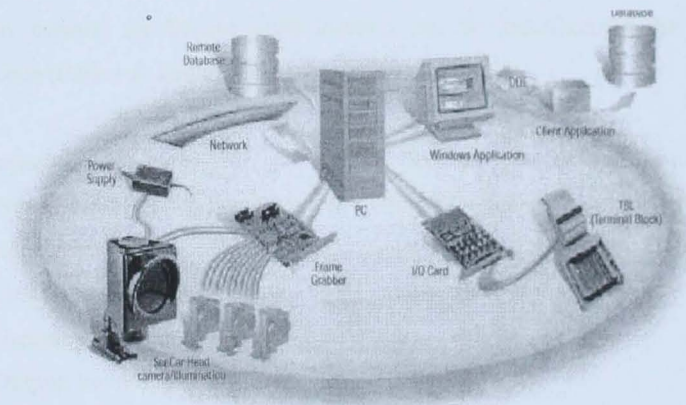

Figure 2.1: **Typical Configuration of License Plate Recognition (LPR)**

2.8   Car Plate Scanning

In order to monitor entering and exiting cars in parking lots and to discharge automatically in toll roads, researches of license plate recognition has been activated.