

PARKING GUIDANCE AND AUTHENTICATION SYSTEM

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Specially dedicated to my beloved parents, brothers, and Yemen.

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ABSTRACT

Whenever the number of parking lots became large the problems related to parking management became more complicated. The most two important problems that related to large parking places are: First, the long searching time for available lots, especially at the peak time. The second problem is the unauthorized-parking situations. Nowadays, there are parking guidance systems that guide the drivers toward the available lots. As a result, reduce the searching time for available lots, as well as reduce the congestion in that parking area. However, these systems do not solve the problem of unauthorized-parked vehicles. This study aims to combine along with guidance system, a mechanism to verify the legality of vehicles parked at authorized-parking lots. Therefore, this study will focus on two modules which are the detection module and the identification module. In the detection module, wireless sensors such as ultrasonic and y-axis magnetometers have proven their ability in detecting vehicles. And in the identification module, active RFID including both tag and reader are very suitable for this purpose. This project has significant implications for large institutions, by making the parking lots that allocated to their staff within the same customer parking area. In addition, it reduces the required manpower for managing that parking area.

ABSTRAK

Apabila bilangan tempat letak kenderaan semakin meningkat, masalah berkaitan pengurusan tempat letak kenderaan menjadi bertambah merunsingkan. Dua masalah terbesar yang selalu dikaitkan dengan jumlah tempat letak kenderaan yang banyak adalah: Pertama, tempoh yang panjang bagi mencari tempat letak kenderaan yang masih kosong, terutamanya ketika masa sibuk. Masalah kedua berkaitan dengan meletakkan kenderaan di tempat yang tidak dibenarkan yang dikhususkan bagi kenderaan yang berdaftar. Hari ini, terdapat sistem yang membantu memberi arahan kepada pemandu ke kawasan letak kenderaan yang masih kosong. Perkara ini telah membantu mengurangkan masa mencari tempat letak kenderaan malah mengurangkan kesibukan di kawasan tempat letak kenderaan. Bagaimanapun, sistem ini tidak membantu menyelesaikan masalah yang kedua berkaitan meletakkan kenderaan di kawasan yang tidak dibenarkan. Kajian ini bertujuan untuk menggabungkan sistem pandu arah bersama sistem untuk pengesanan kenderaan yang meletakkan kenderaan di kawasan yang telah didaftarkan. Oleh itu, fokus kajian ini terbahagi kepada dua modul iaitu modul pengesanan dan modul pengesahan. Di dalam modul pengesanan, sensor tanpa wayar seperti ‘ultrasonic’ dan ‘y-axis magnetometers’ telah membuktikan keupayaan mereka dalam mengesan kenderaan. Bagi modul pengesahan, ‘active RFID’ termasuk ‘tag’ dan ‘reader’ adalah alat yang paling sesuai digunakan bagi tujuan ini. Projek ini sangat memberi kesan kepada institusi besar yang menggunakan kawasan yang sama bagi tempat letak kenderaan untuk pekerja dan pelanggan mereka. Tambahan lagi ia juga mengurangkan penggunaan tenaga kerja manusia bagi tujuan pengurusan tempat letak kenderaan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
1	INTRODUCTION	1
	1.1. Introduction	1
	1.2. Problem Statement	3
	1.3. Objectives	4
	1.4. Scope of the Study	5
	1.5. Summary	6
2	LITERATURE REVIEW	8
	2.1. Introduction	8
	2.2. Parking Guidance Systems	9
	2.3. Vehicle Identification Using RFID	10
	2.4. Wireless Sensors (Ultrasonic and Magnetometer)	12
	2.4.1. Detection Algorithms	13
	2.4.1.1. Algorithm for y-axis magnetometer sensor	14
	2.4.1.2. Algorithm for ultrasonic sensor	16
	2.5. Magnetometer Sensors	17

	2.6. Ultrasonic Sensors	19
	2.7. Radio Frequency Identification	20
	2.8. Summary	21
3	Research Methodology	22
	3.1. Introduction	22
	3.2. The Overall System Design	23
	3.3. Detection Modules	24
	3.4. RFID Tag Module	25
	3.5. Detection Algorithms	26
	3.6. Summary	28
4	System Design	29
	4.1. System Design Overview	29
	4.2. Definition of Parking Guidance and Authentication System	30
	4.3. Software Design of Detection Module	33
	4.3.1. Detection Module Process Description	33
	4.3.2. Flowchart of Detection Module	35
	4.3.3. Ultrasonic Sensor for Detection Module	37
	4.3.3.1. HC-SR04 Ultrasonic Sensor Pinout Description	38
	4.3.3.2. Interfacing HC-SR04 to the Detection Module	38
	4.3.4. Wireless Communication for Authorization Purpose	41
	4.3.4.1. The main features of nRF24L01 module	41
	4.3.4.2. Pinout I/O Description of nRF24L01	42
	4.3.4.3. Operational modes of nRF24L01 module	43
	4.3.4.4. Air data rate of nRF24L01	46
	4.3.4.5. RF channel frequency	46
	4.3.4.6. Signal power control	47
	4.3.4.7. nRF24L01 on-air packet format	47
	4.3.4.8. nRF24L01 SPI operation	48
	4.3.4.9. nRF24L01 SPI timing	49
	4.3.4.10. Using nRF24L01 for Authorization purpose	50
	4.3.5. Detection Module Communications	52
	4.3.5.1. RS-485 serial communication	52
	4.3.5.2. MAX485 driver for RS-485	53

4.3.5.3.	Interfacing MAX485 to the detection module	54
4.3.5.4.	Detection module protocol	54
4.4.	Hardware Design of Detection Module	57
4.5.	Software Design of Tag Module	58
4.5.1.	SW-420 Vibration Sensor Module	58
4.5.1.1.	Working principle of SW-420 module	59
4.5.1.2.	Interfacing the SW-420 module	60
4.5.2.	Flowchart of Tag Module	61
4.6.	Hardware Design of Tag Module	61
4.7.	Software Design of Data Collector	62
4.7.1.	Flowchart of Data Collector	63
4.7.2.	Protocol between data collector and software	65
4.7.3.	LED Matrix Display	67
4.7.3.1.	The main features of MAX7219	67
4.7.3.2.	Pinout I/O description of MAX7219	67
4.7.3.3.	Interfacing MAX7219 to the data collector	69
4.8.	Hardware Design of the Data Collector	70
4.9.	Parking Management Software	71
4.9.1.	Monitoring Parking Area	72
4.9.2.	Configuring the Parking System	73
4.9.3.	Analyzing the System	75
5	Results and Discussion	76
5.1.	System Evaluation Overview	76
5.2.	Evaluation of Detection Module	77
5.2.1.	Evaluation of detecting the presence of vehicles	78
5.2.1.1.	Measuring the distance using HC-SR04	78
5.2.1.2.	Measuring the beam angle of HC-SR04	81
5.2.2.	Evaluation of authorization process	83
5.2.3.	Evaluation of Detection Module-Data Collector Protocol	85
5.3.	Evaluation of tag module	88
5.4.	Evaluation of the Data Collector	90
5.4.1.	Evaluation of Data Collector-Software Protocol	91
5.5.	Evaluation of the Parking Management Software	93

6	Conclusion and Results	95
	6.1. Conclusion	95
	6.2. Recommendations	96
	REFERENCES	97

LIST OF TABLES

TABLE NO.	TITLE	PAGE
4.1	Status table of detection module	35
4.2	HC-SR04 ultrasonic sensor pinout I/O description	38
4.3	nRF24L01 wireless transceiver module pinout I/O description	42
4.4	nRF24L01 operational modes configuration	44
4.5	nRF24L01 output power configurations	47
4.6	ShockBurst packet format	48
4.7	SPI commands format	49
4.8	Detection module supported commands	55
4.9	The data collector supported commands	66
4.10	nRF24L01 wireless transceiver module pinout I/O description	68
4.11	nRF24L01 wireless transceiver module pinout I/O description	70
5.1	Experimental results of ultrasonic sensor	81
5.2	Timing of Tag Module Power Management	89

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	The network hierarchy of the PGIS	9
2.2	The raw data obtained from various wireless sensors.	13
2.3	The flow chart of min-max algorithm	14
2.4	The flow chart of min-max algorithm	15
2.5	Detection algorithm for ultrasonic sensor	17
3.1	The overall system design	24
3.2	The design of detection modules	25
3.3	The design of RFID tag modules	26
3.4	Preliminary results of magnetometer detection algorithm	28
4.1	Architecture of parking guidance and authentication system	31
4.2	The networked detection module	32
4.3	Vehicle Authentication Process	32
4.4	Detection Module Flowchart	36
4.5	HC-SR04 Ultrasonic sensor.	37
4.6	Ultrasonic sensor working principle.	39
4.7	Detection Module Flowchart	40
4.8	nRF24L01+ wireless transceiver module.	41
4.9	nRF24L01 wireless transceiver module pin diagram.	42
4.10	nRF24L01 state diagram.	45
4.11	nRF24L01 SPI timing and operation.	50
4.12	Detection module authorization process.	51
4.13	RS-485 Network topology.	53
4.14	MAX485 module.	53
4.15	Flowchart of detection module-data collector protocol.	56

4.16	Detection Module Electronic Circuit.	57
4.17	SW-420 vibration sensor module.	59
4.18	SW-420 adjustable vibration sensor module circuit.	60
4.19	Flowchart of tag module.	61
4.20	Tag module electronic circuit	62
4.21	Flowchart of tag module	64
4.22	Flowchart of tag module	68
4.23	The data collector electronic circuit.	71
4.24	The parking management software.	73
4.25	Tools for configuring the parking system.	74
5.1	Detection module board	77
5.2	Measuring the distance using HC-SR04 ultrasonic sensor	79
5.3	Measuring the distance using HC-SR04 ultrasonic sensor	80
5.4	Measuring the beam width	82
5.5	Experimental results of measuring beam width	82
5.6	Evaluation the authorization process	84
5.7	Evaluation of Authorization Process	85
5.8	Evaluation of detection module-data collector protocol	87
5.9	Tag Module Board	89
5.10	The operating mode of the data collector	91
5.11	Evaluation of data collector-software protocol	92
5.12	The parking management software.	93
5.13	Tools for configuring the parking system.	94
5.14	Secure access to the management software.	94

CHAPTER 1

INTRODUCTION

1.1. Introduction

Parking spaces are one of the most important facilities that must be provided by any large institutions such as airports, educational facilities, malls, stadiums and hospitals. Nowadays, there is a rapid increase in the number of vehicles. As a result, the need to provide more parking spaces became more than ever before. For example, the parking lots in Penang International Airport increased from 800 parking lots to become 2000 parking lots ("Penang International Airport," June, 2012). And also the parking spaces in the airport of Langkawi has been increased from 100 parking lots up to the 500 parking lot recently (Bhattacharya). Furthermore, whenever the institutions are more active, that's mean it needs well managed large parking area. One of the busiest airports in Malaysia is the Kuala Lumpur International Airport. This airport provides around 6000 parking lots ("A Guide to Parking AT KLIA," 2013).

In fact, the problems related to the parking areas will not be ended by increasing it. If we increase the number of the parking lots, it will become like a maze in order to find an available lot. This would result in wasting time for searching an available parking lot. As a result, it will cause a traffic jam in that

parking area, especially at the peak time. Furthermore, we will not take the advantage of that large number of parking lots. However, such these problems can be avoided by using parking guidance systems.

Another problem, which considered as one of the most obvious problems suffered by institutions that have limited parking area, is the situation of unauthorized-parking. For example, if someone parked his car in the parking lot that designated for the employees of that institution. Another example, if one of the staff parked his car in a parking lot that designed for an administrator.

In 1971, it was the first appearance of the parking guidance system in Aachen City, Germany. Du *et al* (2010, August) presented enhanced display optimization techniques of urban parking guidance systems. These systems actually help the driver to find the available parking lots by showing the number of available spaces within each route and zone. So if the zone or route which the driver intends to park in is already full, the system guides the driver to toward another route.

The use of the parking guidance system has great usefulness. These benefits can be classified into two groups: Benefits for the management of the parking area and the second group are the benefits for the vehicle drivers.

Benefits for the management of parking area:

- 1) Getting the optimal use of the available parking lots.
- 2) Facilitate the management of the parking area.
- 3) Obtaining statistics, such as the peak time information, help the management to improve this service.
- 4) No need for a lot of manpower which lead to reduce the operating costs.

Benefits for the vehicle drivers:

- 1) Shorten the required time for searching available parking lot.
- 2) Reduce the stress and the frustration caused by searching for available parking spaces.
- 3) Reducing the traffic in the parking area.

1.2. Problem Statement

According to Caicedo (2010), the problem of wasting time for searching an available parking lot contributes in increasing the pollution of the environment. However, providing drivers the information of available parking lots will dramatically help in solving this problem.

There is an article regarding the problem of wasting time in searching available parking lots published in the Washington Post which states that:

Hunting for parking produces more than frustration. Shoup studied a 15-block business district in Los Angeles and determined that cruising about 2.5 times around the block for the average of 3.3 min required to find a space added up to 950,000 excess miles traveled, 47,000 gallons of gas wasted and 730 tons of carbon dioxide produced in the course of a year.

(Halsey, June, 2010)

The parking guidance system alone does not help at all in solving the problem of unauthorized parking. Nowadays, they solve this problem by making all authorized-parking lots in a totally separated area. And control the entrance into that authorized parking area. Wanger and Stratton state that there are many efforts being made to prevent unauthorized-parking problem. Often, the problem of unauthorized-parking becomes serious problematic and may cause a harm to the driver, vehicle or neighbors. The most commonly used workarounds to prevent vehicles entering the authorized parking garages or authorized parking lots through a barrier boom or controlled gate to enter into the parking lots or parking garages. Opening the barrier boom or the gate usually done either manually by the parking supervisor, or automatically by magnetic cards or similar. (Wanger & Stratton, Jun, 2002)

But controlled gates is not preferred and not applied in many institutions and businesses because it requires more spaces. Therefore many institutions resort to put signs show that these parking lots are only for authorized persons. Cope and Allred (1990) states that the increased police enforcement and vertical signs with warning messages decreases the non-authorized parking lots. In many cases, it becomes difficult for the officers to verify the identity of all cars parked in authorized parking lots. And as a result, the lack of oversight simplifies to people to non-compliance for that signs and regulations.

1.3. Objectives

As known, there are a lot of vital institutions and businesses that really need a large parking area. As mentioned above, providing such large parking areas requires two important things:

- 1) Guiding the drivers toward the available parking lots.

- 2) Verify the legality of vehicles that parked in authorized spaces.

The lack of these two points may cause a lot of problems. Therefore, in this project, I will design a system able to guide the drivers toward the available lots and at the same time verify the legality of vehicles that parked in an authorized spaces. The procedure of implementing these two objectives can be described as below:

- 1) Detect the presence of vehicles in the parking lots in order to guide the drivers toward the available lots, though:
 - a. Display the number of available parking lots within each route.
 - b. Discrimination each parking space with a particular light to indicate its status (i.e. Green: free, Red: occupied).
- 2) Verify the legality of vehicles parked at authorized-parking lots (by using active RFID), through:
 - a. Whenever there is an unauthorized-parking situation, the system will send a notification message to the responsible in order to take an appropriate action.
 - b. Discrimination each parking space with a particular light according to its status. (Continuous: authorized, blinking: unauthorized)

1.4. Scope of the Study

In this thesis, I will combine along with guidance system, a mechanism to verify the legality of vehicles parked at authorized-parking lots. Wireless sensors such as ultrasonic and y-axis magnetometers are suitable for detecting vehicles. And active RFID is suitable for authentication purpose. Therefore, this project will pass through three stages

First, Design the detection modules which able to detect the presence of vehicles. In this stage, I will investigate the accuracy and reliability of sensors that able to detect the presence of vehicles such as ultrasonic sensor and y-axis magnetometer sensor. Also I will discuss the appropriate detection algorithm for each sensor.

Second, Design the active RFID modules both tag and reader. Because the parking lots are usually close to each other, the coverage area for the active RFID modules will overlap. This overlapping of the signal, will cause the reader collision problems. According to Engels and Sarma (2002) there are two types of reader collision problems, signal interference and more than one reads of the same tag. In this stage I will address how to reduce such these problems using time division multiple access – TDMA technique (Guangyu & Chien, 2001), and get the readings only at the trigger of vehicle detection.

Finally, develop the parking management software which able to communicate with all networked modules and save the data for the purpose of parking lots analysis and view statistics.

1.5. Summary

This is an introductory chapter that addressed the main problems related to large parking areas. According the problem statement of this project, there are two main problems. Which are the difficulty of finding an available parking lot and the second problem is the unauthorized-parking. Nowadays, there are parking guidance systems that guide the drivers toward the available lots. As a result, reduce the searching time for available lots, as well as reduce the congestion in that parking area. However, these systems do not solve the problem of unauthorized-parking.

In this project, I will combine along with guidance system, a mechanism to verify the legality of vehicles parked at authorized-parking lots. Wireless sensors such as ultrasonic and y-axis magnetometers are suitable for detecting the presence of vehicles. And the active RFID will be used for the authentication process.

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