Smart Parking ManagementSystem in Malaysia

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Abstract:

An efficient parking system is one of the features of a smart city. One of the problems faced by drivers around the world is a bad experience to park their vehicle, especially when related to time constraints. A traditional parking reservation system needs human interaction. However, the increases in car usage over the years make it challenging to implement the parking reservation manually. This forces the innovation to develop a system that can automatically identify a specific car for specific parking space through their vehicle registration number. However, the number of online parking reservation system in Malaysia is very minimal and still need to be carefully studied. Numerous studies and project conducted for an online parking reservation system are focused on the reservation process without giving the attention of ways to secure the reserved parking spot. Thus, in this project, a Smart Parking Management System is proposed to give a better experience to the driver in their quest to park their vehicle. The outcome of this project is a mobile application that allows the driver to make a reservation of a specific parking space and provide grant access by using plate number recognition based on the vehicle information that has been registered in the system for a specified duration. The system will improve the overall quality of services given by the organization that providesparking services.

Keywords: *Smart Parking Management System, Parking Reservation, License Plate Recognition,*

I. INTRODUCTION

Smart Parking Management System main purpose whichto efficiently managea parking lot with concern of security and time has been a popular research and innovation focus in recent years. This is due to smart parking management systems capability of providing extreme level of convenience to drivers [1].It makes the process of searching car parking spaces easier. Study done by Boston Consulting Group (BCG) in 2017 called "Unlocking Cities" shown that in average, drivers in Kuala Lumpur spends 25 minutes searching for a car parking space. This increases the demand of a smart parking management system which utilizes a smarter and a more fluid process to reduce the hassle and frustration searching an uncertain parking space.

Even though the ability to owns a personal parking spaces or higher priority parking spaces (through season pass) has been implemented since years ago, the ability to book a parking spaces in advance through online or mobile application is not currently widely implemented. Numbers of mobile application which allows its users to view parking space vacancies have been also commercialized which lessen the time taken to search for an empty parking spaces but this is not sufficient. In recent years, more online reservation system are being researches but creates a gap which can be improved

such as the security of reserved parking space which most of the previous study left unspecified.

In addition, a traditional parking reservation system needs human interaction. Generally, a parking reservation is made by informing the authority of the parking area. They will then block the parking space from other visitors. The parking is unblocked once the one who made the reservation are recognized by the person in charge of the parking area. However, the increases in car usage over the years makes it challenging to keep implementing a parking reservation system which are managed and monitored by humans. Human managing parking reservation has a limited productivity and bigger chance of error compared to a fine tuned machine or systems. This forces the innovation to develop a system which can automatically identify a specific car for specific parking space through their vehicle registration number to improve the efficiency of the system.

Besides that, the number of online parking reservation system in Malaysia is very minimal as compared to conventional parking reservation system. The number of online reservation parking system only made up a very small percentage. Although online parking reservation system is getting its recognition in recent years, it is still need to be carefully studied to give its users the best experience they could have. In Malaysia, there are several parking space reservation applications have been commercialized. These applications require user confirmation to grant access to the parking space when they have arrived at their reserved parking space.

Moreover, numerous studies and project conducted for online parking reservation system focuses on the reservation process itself without giving the attention of ways to secure the reserved parking spot. A reserved spot should be only accessible to its owner. The security of a reserved bay needs to be ensured by not letting other drivers to park at a reserved bay.

Thus, this study proposes a smart parking management system which able to utilizes the Vehicle License Plate Recognition Systemwith the reservation and season pass as its key features.The proposed system aims to add value in solution for the gap that existed in previous studies.

II. LITERATURE REVIEW

The trend of recent parking management system focuses on reservation system. Reservation features allow drivers to select and book their selected parking spaces in advances [6] – [14]. This ability to pre-occupy a parking spaces give drivers a better parking process experience by minimizing the time drivers has to spend searching for a parking space. Reservation system involves parking availability detection system and also interfaces commonly in a form of mobile application [4] – [12].

In India, all the parking management system proposed a reservation features in the system. As a country which has one of the highest numbers of contribution in parking management system researches, India has set the parking reservation features as a standard of an efficient parking management system [6] – [10]. One flaw of most research implementing this feature is the lack of reservation security. Among compared researches, only one research [9] provide reservation security through drivers' facial and also plate number recognition to ensure the right vehicle claimed the reserved parking spot.

Another similarity among compared parking management system is that all the proposed systems opting for a cost efficiency in implementing the parking system. This approach is usually done by minimizing cost in component used by the system in design phases. Common choices for vehicle detection sensors are ultrasonic sensors and infrared light sensors which are inexpensive. Micro-controllers of choice among these researches are Raspberry Pi and Arduino. Raspberry Pi, even though cost higher than Arduino, have the ability to mount higher number of sensors and multitask

making it a cost efficient micro-controller. These choices of components results in a low cost of implementation for the parking management system.

However, onefeature in parking management system that has less implementation is the use of Image Processing Technique [3], [9], [11], [13] – [15]. This feature associate with security features of a parking system. Image Processing Technique usually implemented in parking management system in a form of plate recognition system which only allows selected vehicle with selected plate number to access the parking area or parking space. This feature, most of the time are also used to give access to parking space reserved by drivers. However, this feature does not get much attention from parking space management developers to be implemented in their proposed system. Reasons for this choice are the increased cost of mounting a camera into the parking management system and also the complicated algorithm of the image processing.

Researches on Parking Management Systems share same limitation which is the absent of parking reservation feature. The idea of online parking reservation in Malaysia only comes being in recent years. Most researches in Malaysia focuses on minimizing implementation cost of parking management system. This goal is achieved through optimizing parking system design by using low cost component and efficient power distribution. Two out of three compared researches from Malaysia (Abu et al, 2017; Salman et al, 2018) focuses on parking availability detection. Parking space availability acts as guidance system for drivers to find empty parking spaces which help in lessening the time searching for a parking space. However, reservation system is far superior in decreasing time spent searching for a parking space which is crucial in improving the experience for drivers in a parking system.

Out of three compared research, only one (Rashid et al, 2012) opted for the usage of image processing. This research uses image processing system in a form of Optical Character Recognition to identify plate numbers for automatic time in and time out recording. This type of usage for the image processing technique are not beneficial since its only eliminate the usage of physical tickets which can be more cost efficient when implemented. The usages of plate recognition system are more suitable for security purpose or as a access granting tool.

TABLE I.   FEATURES OF BITPAY

Ref	Features			Data Collection	User Interfaces			Country
	RS	GD	PM		SM	WB	O	
[3]		✓	✓	Ultrasonic Sensor Loop Sensor Camera			Matlab GUI	Malaysia
[4]		✓		Infrared Sensors	✓			
[5]		✓		NA	✓			
[6]	✓		✓	Ultrasonic Sensor	✓	✓		India
[7]	✓		✓	Infrared Sensors	✓			
[8]	✓	✓	✓	Ultrasonic Sensor	✓	✓		
[9]	✓		✓	Camera Ultrasonic Sensor	✓			

	[RS]	[GD]	[PM]	Sensor/Hardware			Software	Country
[10]	✓	✓		Infrared Sensors			Win Desktp Apps	
				Camera	✓			
[11]				Inductive Loop Sensor				
		✓		Camera	✓			Saudi Arabia
[12]	✓		✓	Strain Sensor	✓	✓		China
[13]				Strain Sensor			MatLab GUI	Bangladesh
	✓			Camera				
[14]				Ultrasonic Sensors				
	✓		✓	Camera	✓			
[15]				Camera				New Zealand

[RS] = Reservation [GD] = Guidance [PM] =Payment

III. METHODOLOGY

Proposed System

The proposed system is a Smart Parking Management System which includes mobile application for a parking reservation system and parking spaces with plate number image recognition system. The prototype of the overall parking system will be done in a smaller scale replica/simulation because the system is intended to test the idea of a smart parking reservation using a plate number recognition to grand access.

Smart Parking Management System which includes mobile application for a parking reservation system and parking spaces with plate number image recognition system. The system allow user to make a parking reservation through mobile application. The system only allows its user to retrieves the reserved parking space by matching the plate number in the reservation database. Only vehicle with matching plate number will be granted access to the reserved parking bay. The system compares the image of plate number by in text form by processing it using image processing technique. Fig I shows the system architecture.

The scopes of users for this Smart Parking Management System will include season pass holder and non-season pass holder. The interface of the system will be developed in a form of mobile application for end users uses. Parking sensors, camera and access barrier will be programmed into the system server through Raspberry Pi.

One of the limitations is that the parking space must be in a closed and secured parking area to ensure the security of product deployed. Open parking areas are prone to higher risk of damaging or theft of equipment deployed. Another limitation of the system is the requirement of internet connection through Wi-Fi services by the user to functions. A parking space without pre-existing Wi-Fi services may need an installation which add to the overall cost
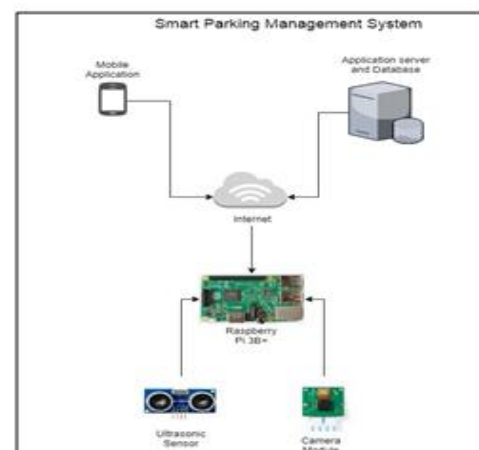

Fig. 1. System architecture

System Features

The system features can be divided into two (2) main modules based ontype of users, Driver and Admin. The following are list of features of each module.

- Drivers (Public and Season Pass Holder) Module
  i.   Register/Login/Manage Account Details
  ii. Request Season Pass
  iii. View Parking Location List
  iv. View Parking Availability
  v.   Make Reservation
  vi. View Parking Current Parking Fee Amount

- Admin Module
  i.   Update Parking Location List
  ii. View/Manage Drivers Information
  iii. Manage Season Pass Holder Application
  iv. View Reservation Log

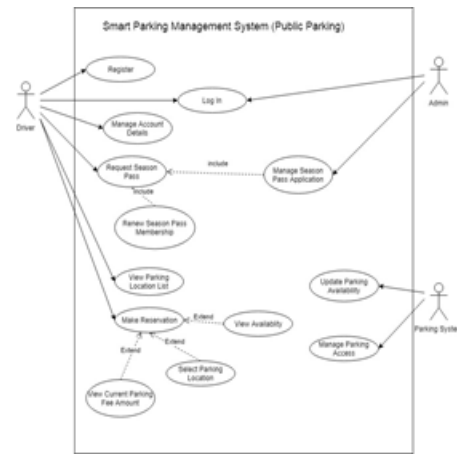The overall system features for each module are presented in the use case diagram as shown in Fig2.

Fig. 2.   Use Case

Use Case Description

Table II describes in detail the use case for each feature of the Smart Parking Management System.

TABLE II.   USE CASE DESCRIPTION

Use case	Brief Description
Login	Any type of user must log into the system. If does not own an account, the system will request them to register.
Register	Users request to register their details into the system. Details include username and password for Login purpose
Manage Account Details	Users request to manage their account details. This use case is used to updates user details. The system will prompt for new information of the user and then store it.
Request Season Pass	Drivers select to request for season pass. System will prompt for information for season pass application and store it for Admin to approve.
Manage Season Pass Application	Admin request to manage the season pass application. System will display list of season pass request for Admin to approve.
Renew Season Pass Membership	Season Pass Holder request to renew the season pass membership. System will alert Admin for them to approve.
View Parking Location List	Driver view available parking location list. System will display list of participating parking location list for drivers to view.
Make Reservation	Driver request to make reservation on selected location. System will prompt the vehicle plate number to complete the reservation.
Select Parking Location	Driver select from list of parking location to view parking location details. System will display the details of the parking location selected by driver.

View Availability	Driver select from list of parking location to view available number of parking bay. System will display number of parking bay available in a parking location selected by driver.
View Current Parking Fee Amount	Driver request to view their current parking fee amount. System will compute the total amount and display to driver current total of parking fee.
Update Parking Availability	Parking System detects number of car parked in a location and updates the system.
Manage Parking Access	Parking System take a plate number image and compares with existing plate number with an active reservation. Parking System will then decide to grant access to the vehicle.

System Flowchart(Parking Reservation)

Fig. 3. System Flowchart

Users are required to log into the system. If the user does not own an account, the system will request them to register. The driver can request to make parking reservation on selected location. First, the system will prompt a request for driver to insert vehicle plate number to complete the reservation. Then, system creates a new reservation record in the database. After that, system displays number of parking bay available on selected parking location list. Driver selects a parking location from parking location list. Lastly, system will notify driver about their reservation status. The overall process for parking reservation process is shown in Fig 3.

IV. CONCLUSION

The outcome is a mobile application which can make reservation of a specific parking space. The parking space are expected to be able to give information of parking availability and also grant access by using plate number recognition according to the vehicle information registered to it at a given time. However, the user also requires an android phone to access the features of the system as well as constant connection to a Wi-Fi Connection.The output of the study will provide an online parking reservation system to be used by public drivers. This will improve the overall quality of services given by the organization or business which to choose to implement the parking service. Lastly, the study also will add values in solving the gap existed in previous online parking reservation study.

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