COUNTING AVAILABLE PARKING SPACE USING IMAGE PROCESSING

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ABSTRACT

Nowadays, peoples are facing problem to find an available parking space in parking lot due to the tremendous increase of occupancy of cars. When driver enters a certain parking lot, the driver takes a long time just to find an available parking space. A Counting Available Parking Space using Image Processing (CAPSuIP) has been developed to solve the problem that driver faced with low cost. CAPSuIP use image processing to detect of existence of the car and also provide information such as number of available parking space and the location of that parking. The system captures image using surveillance camera and process the image to counting available parking space. The system use a modified Software Development Life Cycle (SDLC) to plan, analyze, design, development and testing. Techniques of image processing have been embedded in each phase of methodology. This system gives information about the location of available parking space and the number of available parking space. It will be benefit to all drivers when enter a parking lot.

ABSTRAK

Pada masa kini, pemandu kenderaan menghadapi masalah untuk mencari ruang meletak kereta disebabkan peningkatan penggunaan kereta yang sangat meluas. Apabila pemandu memasuki kawasan tempat letak kereta, pemandu biasanya akan mengambil masa yang lama hanya untuk mencari ruang kosong untuk meletak kereta. Sistem Mengira Ruang Parking Kosong menggunakan Pemprosesan Imej (CAPSuIP) dibangunkan untuk mengatasi masalah yang dihadapi oleh pemandu dengan menggunakan kos yang rendah. CAPSuIP menggunakan Image Processing untuk mengesan kewujudan kereta dan menyediakan maklumat seperti jumlah ruang tempat letak kereta yang kosong. Sistem ini menggunakan kamera yang dipasang di bangunan dan imej itu diproses untuk mengira ruang kosong yang ada di tempat letak kereta. Model *Software Development Life Cycle (SDLC)* yang diubah digunakan untuk merancang, menganalisa, merekabentuk, membangunkan dan mencuba system ini. Teknik-teknik pemprosesan imej telah diterapkan dalam setiap fasa dalam metodologi. Sistem ini memberikan kerana ianya dapat memberikan maklumat bilangan kekosongan tempat letak kereta kenderaan kepada semua pemandu apabila memasuki tempat letak kereta.

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LIST OF ABBREVIATIONS

3D	-	Three Dimensional
CAPSulP	-	Counting Available Parking Space using Image Processing
CCTV	-	Closed-Circuit Television
COINS	-	Car-Park Occupancy Information System
FPGA	-	A Field-Programmable Gate Array
RFID	-	Radio Frequency Identification
RGB	-	Red, Green, Blue Color of Image
SDLC	-	Software Development Life Cycle
UCSD	-	University of California, San Diego
UINT8	-	8-Bit Unsigned Integer
USB	-	Universal Serial Bus
WSN	-	Wireless Sensor Network

CHAPTER 1

INTRODUCTION

This chapter will briefly describe about the Counting Available Parking Space using Image Processing (CAPSuIP). This chapter also will discuss the problem statement, objectives, and scopes of the system and also organization of the thesis.

1.1 Introduction on Image Processing

Image Processing is an image may be defined as a two-dimensional function, f(x, y), where x and y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinate (x, y) is called intensity or gray level of the image at that point. When x, y and the intensity values of f are all finite, discrete quantities, the image called a digital image. The field of digital image processing refers to processing digital images by means of a digital computer.

A digital image is composed of a finite number of elements, each of which has a particular location and value. The elements are called picture elements, image elements, pels, and pixels. Pixel is the term used mode widely to denote the elements of a digital image. [1]

1.2 Introduction on the System

Nowadays, car is very important to everyone especially for who are works. People are willing to make installment to get own car. When talking about metropolitan, then traffic jam always occur because of numbers of vehicles are so high. Thus we cannot deny the existing of the cars in our daily life. Whenever we go out by car, we are facing problem to find an available parking space due to the tremendous increase of occupancy of cars.

The analogy is when driver enters a certain parking lot, the first thing that the driver do is looking forward of some sign to telling that the parking lot is fully occupied, partly occupied or vacant. The driver also do not know how many are there and where to find a parking division for his/her car. Some of parking divisions may remain unoccupied even the total occupancy is high. This will causing ineffective use of parking divisions as well as traffics jams around the entrance of parking lot. Therefore, by offering drivers with relevant information on the parking lot during entering a parking lot becomes an important issue.

The proposed system called as Counting Available Parking Space using Image Processing (CAPSuIP). This system proposes a method of detecting the existence of parked vehicles by processing the image of the parking lot taken by a surveillance camera and then counting the available parking space which is display in front of entrance of parking lot.

The system employ images, since all area in the parking lot can be observed with relatively few camera. Other than that, the system is compact and the cost is not is not expensive. The image of a parking lot is taken by a surveillance camera set at some height in the parking lot.

1.3 Problem Statement

There are some reasons why Counting Available Parking Space using Image Processing (CAPSuIP) is developed. The problems that have been identified are stated below:

i. Driver needs some relevant information before entering the parking lot such as the current available parking spaces in the parking lot.

ii. There are current system used in parking lot but the method used is based on the detection by installing a certain sensor on each division; the other is to detect cars through images of the parking lot taken by surveillance cameras. In the method with the sensor, the cost rises as the number of parking divisions because a lot of sensors are required corresponding to each parking divisions.

iii. Driver might be takes time to find available parking space in parking lot. Imagine if the parking lot has many number of parking divisions and driver will through all parking divisions just to find an available parking space.

1.4 Objective

Objectives of the Counting Available Parking Space using Image Processing (CAPSuIP) to be developed are to:

i. Capture and detect existence of vehicle at parking lot using image processing technique.

ii. Count, display available parking space and the location of the available parking spaces in parking lot.

1.5 Scope of the Project

There are a few scopes that have been identified in order to develop the system. The scopes of the systems are:

i. This system is just a prototype system using image processing techniques.

ii. Using image that captured from external webcam 5Megapixels and using model simulation.

iii. The position of the parked vehicle is correct.

iv. The location of case study of the system is at Universiti Malaysia Pahang (UMP) parking lot which is block Z. Location consists of five space of parking block.

v. The system can be used in daytime only without have a strong shadow.

1.6 Organization of the Thesis

This thesis consists of six (6) chapters. Each chapter describe as below:

First chapter is to provide a brief overview of the entire project include objective of the project, scope and problem statement.

Second chapter is to presents the background of the system including the overview of the current system, the existing systems and proposed system.

Third chapter is to discuss of methodology used for the application development. It includes and depict on the system development life cycle including the software as well as the hardware specification for the implementation and development.

Fourth chapter is an implementation which is discuss about the process involved along with the sources code and also the interface of the system.

Fifth chapter is to discuss about achieved result of the system, constraints of the system. This chapter also will describe the further research to improve the system.

Sixth chapter is a conclusion which is summarizes the project that has been developed.

CHAPTER 2

LITERATURE REVIEW

This chapter will briefly defines some similar ideas about current system, existing system, technique or algorithm that used and comparison on advantages and disadvantages between existing systems. Figure 2.1 shows the overview of flow of chapter 2.

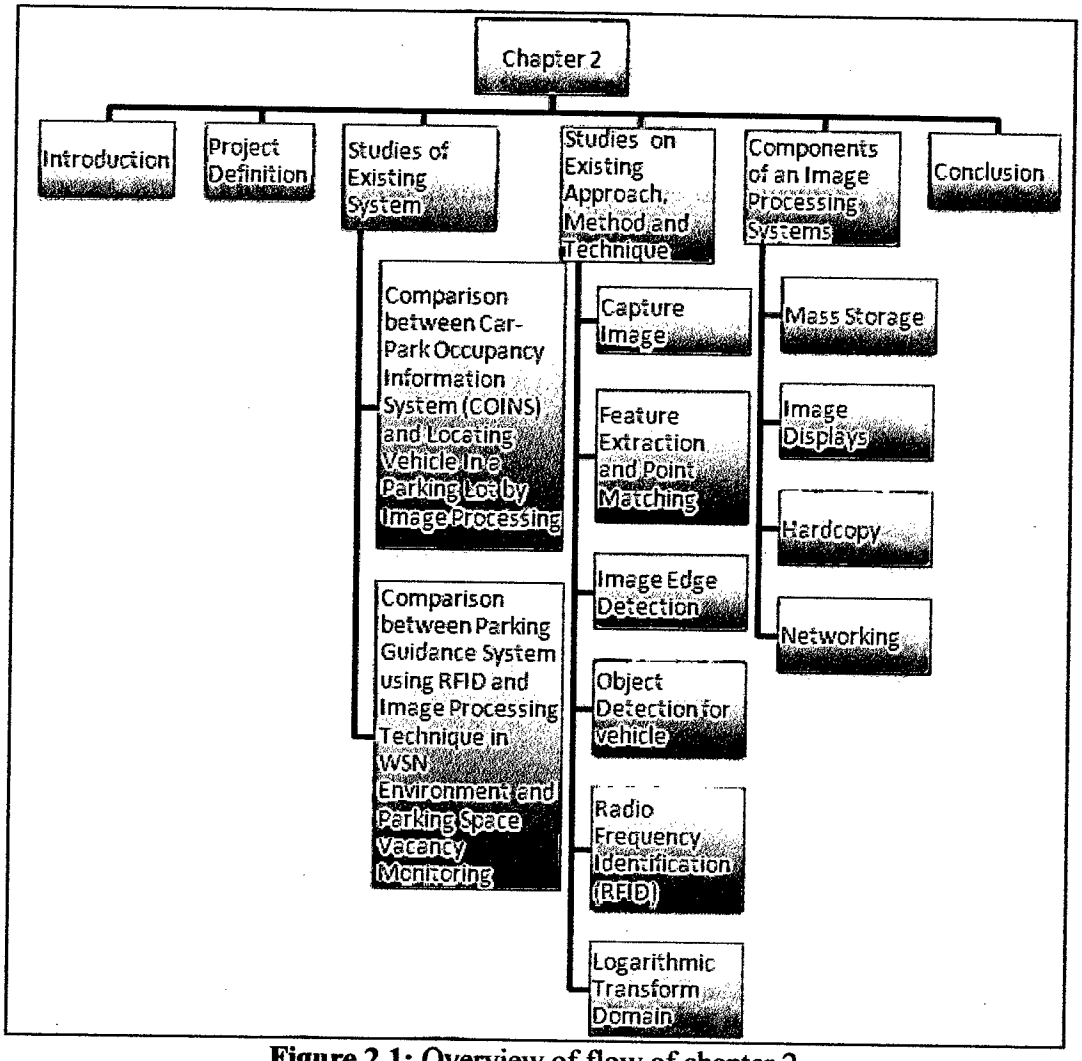

Figure 2.1: Overview of flow of chapter 2

2.1 Project definition

Counting Available Parking Space using Image Processing (CAPSuIP) is prototype system that detecting the existence of parked vehicles by processing the image of a parking lot taken by surveillance camera. After that, system will count how many available parking lot spaces each division and display it in front of entrance parking lot.

Image Processing defines as analysis of a picture using techniques that can identify shades, colors and relationships that cannot be perceived by the human eye.

Image processing is used to solve identification problems, such as in forensic medicine or in creating weather maps form satellite pictures. It deals with images in bitmapped graphics format that have been scanned in or captured with digital cameras. Image Processing also defines as any image improvement, such as refining a picture in a paint program that has been scanned or entered from a video source. [2]

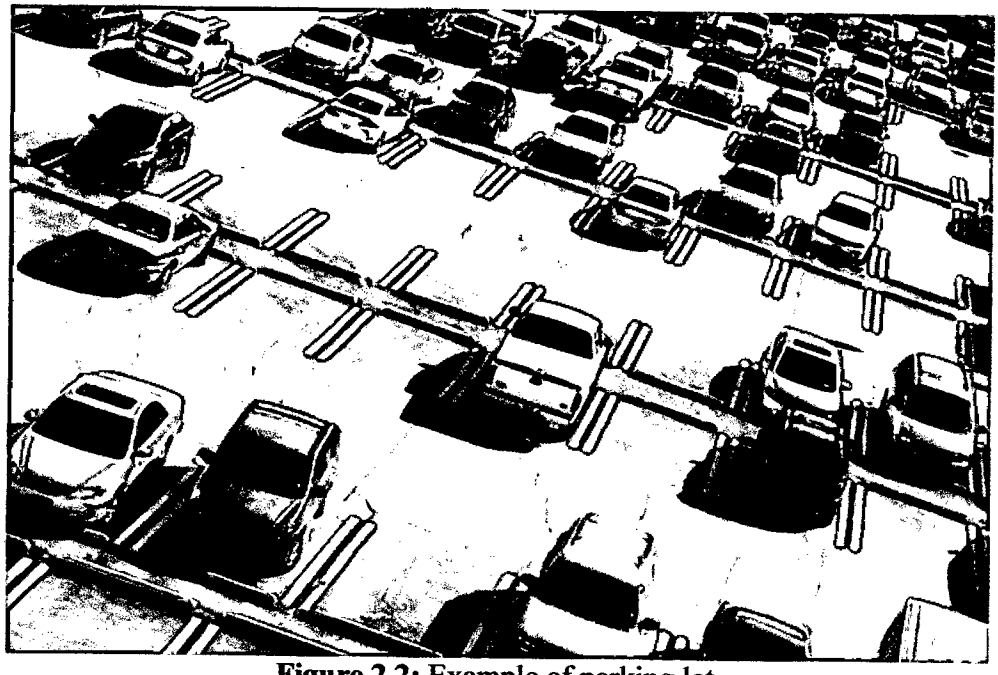

Figure 2.2: Example of parking lot

Figure 2.2 shows the example of parking lot. In this figure, there are available parking spaces to drivers parking their cars. This prototype system will process the image to get available parking space in parking lot.

2.2 Studies of Existing Systems

For research purpose, here are stated four examples of the applications to be compared in term of operational features. Below are list of similar existing systems:

i. Car-Park Occupancy Information System (COINS)

ii. Locating Vehicle in a Parking Lot by Image Processing

iii. Parking Guidance System using RFID and Image Processing Technique in WSN Environment.

iv. Parking Space Vacancy Monitoring.

2.2.1 Comparison between Car-Park Occupancy Information System (COINS) and Locating Vehicle in a Parking Lot by Image Processing

Nowadays, drivers always face difficulty of finding available parking lot while entering into a huge parking area. A Car-Park Occupancy Information System (COINS) [3] is developed to be a viable solution to reduce the amount of time needed to search for a vacant car-park lot especially in a huge parking area. With this system, images captured by a surveillance camera were processed in real-time to identify the occupancies of the parking lots. This occupancy information is further processed by a central control unit and distributed to display panels located at strategic locations at the parking area. The drivers can easily find a vacant parking lot based on the information displayed on the panels. Motivation for developing this system came from the fact that minimum cost is involved because image processing technique is used rather than sensor-based techniques. As surveillance cameras are readily available in most car parks, this technique is much cost effective than installing sensor on each parking lot.

Locating Vehicle in a Parking Lot by Image Processing[4] is more concern to propose a method of detecting the existence of parked vehicles by processing the

image of a parking lot taken by a surveillance camera. Whenever driver wants to park a car at a parking lot, how to find a proper parking division there causes a serious problem. The objective of the present article is in providing drivers with such information as the lot is fully occupied or relatively vacant, where unoccupied parking divisions are found, and so on. The images employed, since all areas in the parking lot can be observed with relatively few cameras, the system is compact, and the cost is not expensive. The image of a parking lot is taken by a surveillance camera set at some height in the parking lot.

The relevant issues are how to cope with both temporal and spatial changes in illumination, how to discriminate shadows from vehicles, how to cope with occlusion, and how to cope with various surface reflectances of vehicles and so on. To cope with these issues, the input images transformed to the gray levels with log-transform, extracts edges and counts the number in each parking division, and then decides if each division is occupied or not. The recognition rates for a set of images taken at various moments of a day were well above 95 %.

2.2.2 Comparison between Parking Guidance System using RFID and Image Processing Techniques in WSN Environment and Parking Space Vacancy Monitoring

Parking Guidance System using RFID and Image Processing Techniques in WSN Environment [5] describes a novel approach to developing a Parking Guidance System within the car park in a Wireless Sensor Network (WSN) environment in order to help alleviate the frustration and problem in finding vacant parking space. The system utilizes the existing CCTVs installed in the car park coupled with FPGA device in detecting the vacant spaces which will in turn be assigned to the patron using the shortest path algorithm based on both the point of entrance to the car park and building. The patron is then guided to the specified location by referring to the map printed on the parking ticket. Besides that, an RFID tag is also attached to the parking ticket to uniquely identify the assigned parking space of the patrons and will be used to remind patrons of the parking location during payment.

Whereas, Parking Space Vacancy Monitoring[6] is propose a stereo-vision based system that deal with instances with severe vehicular occlusion. In this system, multiple cameras are used to monitor the vacancy status of the P502 parking spaces on University of California, San Diego (UCSD) campus.

Figure 2.3: An example of severe vehicular occlusion in the scale model

Figure 2.3 shows the example of severe vehicular occlusion in the scale model. In this system, a method for monitoring vacancies in parking lots using a stereo camera system presented to create a 3D reconstruction of the scene, which enables us to determine the vacancy status of a particular parking space under vehicular occlusion. Additionally, results for 3D reconstruction using uncalibrated versus calibrated cameras are compared.

This system is able to identify vacancies while differentiating between spaces for different permit holders (faculty versus students). Ideally, the system also able to provide an exact count of the number of available spaces, but it must have to appeal to a statistical notion of vacancy, as certain spots may be too heavily occluded by trees, other vehicles, etc. to be monitored with very high accuracy. This information

will ultimately be integrated with a status dissemination tool, where drivers will be able to query the parking lot status via mobile phone.

2.3 Studies Approach, Method and Technique on Existing System

It is helpful to divide into the two broad categories defined which is methods whose input and output are an image, and methods whose inputs may be images but whose outputs are attributes extracted from those images.

Figure 2.4 show the fundamental steps in digital image processing. This organization does not imply that every process is applied to an image. Rather, the intention is to convey an idea of all the methodology that can be applied to images for different purposes and possibly with different objectives.

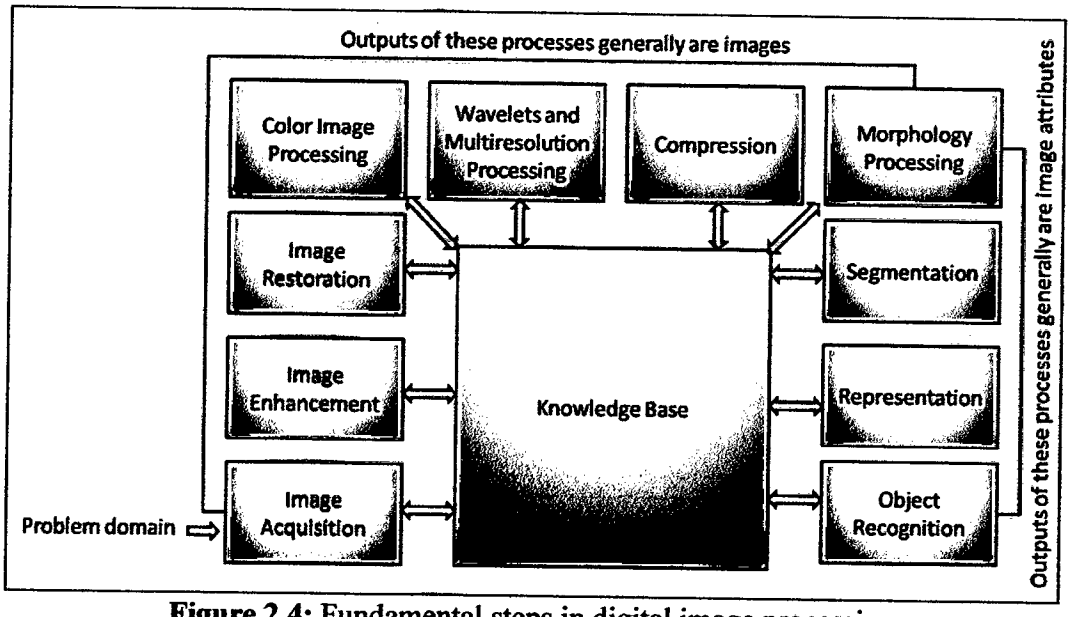

Figure 2.4: Fundamental steps in digital image processing

2.3.1 Capture image

Capturing images are involves in image acquisition which is the first process in image processing. Note that acquisition could be as simple as being given an

image that is already in digital form. Generally, the image acquisition stage involves preprocessing, such as scaling. In Parking Space Vacancy Monitoring, image are taken using camera digital and periodically performing raster scans of the lot at a specified zoom level for sufficient image resolution. Necessary considerations for scanning include image overlap, scan frequency, and scan time.

2.3.2 Feature extraction and point matching

Based on Parking Space Vacancy Monitoring, to extracting features from the parking lot images, Harris and Stephens' [7] corner detection method are used to automatically find corners in pairs of images. Harris corner detection finds interest points based on changes in gradient direction, calculated from the sum of square differences. In stereo reconstruction, one wishes to be able to perform robust feature matching, or automatically find correspondences between interest points in a pair of images, given spurious features and noise in the point sets. The extracted corners are then used for RANSAC-based matching. Random Sample Consensus (RANSAC) [8] is an iterative method for robustly fitting a model in the presence of outliers, leaving us with the in lying matches. First, one finds putative matches of interest points by searching for points of maximal correlation within windows surrounding each point. RANSAC is then used to fit a model with the largest number of inliers, discarding spurious correspondences [9].

2.3.3 Image Edge Detection

Car-Park Occupancy Information System use image edge detection to separates the shadow and object. More edge information is found on object compare to shadow. The Sobel operator as shown in figure 2.5, which approximates the first derivative, was used to detect edges[10].