International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr-2018 www.irjet.net p-ISSN: 2395-0072

Parking Space Detection Using Image Processing in MATLAB

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Abstract - *The paper aims to present a system for the detection of parking space with the help of image processing technique. With the problems of ever increasing urban traffic congestion and the ever increasing shortage of space, the parking lots need to be well-equipped with parking space detection. The proposed system helps in counting the number of parked vehicles and, identifying the number of spots available. The system detects cars through images instead of electronic sensors embedded on the floors. A camera is installed at a high and fixed position in the parking lot. An image of empty parking lot is taken as reference and then image of parking lot with cars is taken. Both the images are subtracted to find the numbers of parking slots available.*

Key Words: **parking space, image processing, image acquisition, image enhancement, image segmentation, image detection**

1. INTRODUCTION

Nowadays, car has become a necessity; it is no more a luxury especially for the working people. People even purchase car on installments. When talking about metropolitan, then traffic jams have become quite common recently during large number of vehicles. Also, we cannot deny the existence of the cars in our daily life. Whenever we go out by car, we face problems to find an available parking space.

When driver enters a certain parking lot, the first thing that he does is to look for some sign which tells whether the parking lot is fully occupied, partly occupied or vacant. . He also does not know how many parking slots are there and where to find a parking division for his car. Some of the parking divisions may remain unoccupied even when the total occupancy is high. This causes ineffective use of parking divisions as well as traffics jams around the entrance of parking lot. Therefore, by offering drivers with relevant information about the parking lot while entering the parking lot becomes an important issue.

When driver enters a certain parking lot, the driver takes a long time just to find an available parking space. Counting Available Parking Space using Image Processing helps to solve the problem that the driver faces at low cost. The system uses image processing to detect the existence of the car and also provides information such as number of available parking space. The system captures image using webcam and processes the image to count the available parking space. The system uses a modified Software Development Life Cycle (SDLC) to plan, analyze, design, development and testing. The development of this system will use techniques of image processing that will be implemented in each phase of the methodology. This system gives information about the number of available parking space. It will provide benefit to all the drivers when they enter the parking lot. The system uses image processing, since the whole area in the parking lot can be observed with relatively few cameras. Other than that, the system is compact and the cost is not high. The image of a parking lot is taken by a surveillance camera set at some height in the parking lot. [1] MATLAB is used as software platform in this project..

2. PROPOSED PARKING MODEL & METHODOLOGY

The main flow of the framework is shown in the Fig-1. Videos are acquired from the top view of the parking arena with the help of a fixed camera. Video is segmented into frames. Then from each segment a key frame is extracted and further processing is applied on this key frame, to reduce the computational complexity. [3]

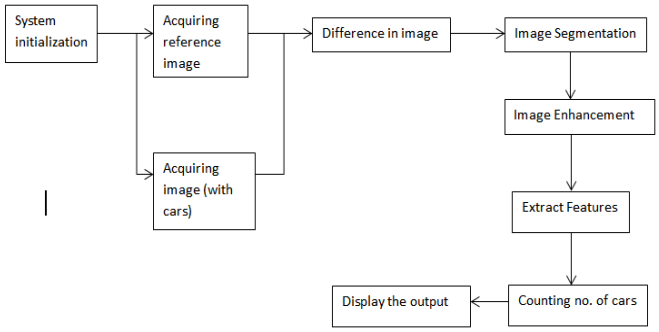

Fig-1: Block diagram

The five modules involved in parking space detection are as follows:

2.1 System Initialization

In the initial stage, a certain number of images are captured and their average is calculated to make an averaged background reference image. This reference image does not contain any cars. The main purpose is to identify the parking slots in the image. The camera which is used to take the images is fixed at a certain position and it faces a fixed direction all the time.

Fig-2: Empty parking lot

2.2 Image Acquisition

In this step, the picture of parking space containing cars is taken with the help of a high-definition camera. The image data is then supplied to the MATLAB software for further processing. [1] [2]

Fig-3: Parking lot with cars

2.3 Image Segmentation

Image segmentation is the process of partitioning the digital image into various segments in order to change the representation of the image into something meaningful which is easier to analyze. [1] [4] The RGB image acquired is then converted to gray-scale image and then binary image is created in the Image segmentation module. The equation used for the conversion to gray-scale image is-

$$Gray = 0.229R + 0.587G + 0.11B \quad (1.1)$$

Fig-4 shows the gray scale image of the parking space with cars. From the resulting gray-scale image, binary image is obtained using thresholding technique. The binary image contains all the information about the position and shape of interest. The threshold level is set in such a way that the objects of interest are made into white and the rest of the image black.

Fig-4: Gray Scale transformed image

Fig-5: Binary image

2.4 Image Enhancement

The binary image contains a lot of noise which is removed using morphological operations such as dilation, erosion etc. The objective of enhancement is to process an image so that result is more suitable than the original image for the specific application. There are many techniques that may be used to play with the features in an image but may not be used in every case. Some of the functions which are used for image enhancement are:

i. Logarithmic transformations

ii. Power law transformations

iii. Linear transformations

iv. Piecewise linear transformations

The proposed system uses power law transformations. It's basic form is

$$S = cr^{y} \quad (1.2)$$

Here, S is the output gray level, r is the input gray level and c and y are constants. [1] [5]

Fig-6: Power transformation applied on image

Fig-7: Image free of noise

2.5 Image Detection

Now, in order to detect the cars, the eccentricity of the image is calculated. The process to calculate the eccentricity runs in a loop and the output is displayed in the MATLAB software.

3. ALGORITHM OF THE PROPOSED SYSTEM

The main steps of the proposed algorithm for parking space detection are:

i. System will get live stream video of the parking lot from camera.

ii. Images are captured when a car enters or leaves the parking lot.

iii. RGB Images are converted to gray scale images.

iv. Do calibration i.e. first select the coordinates of the parking lot. This will crop the extra space other than parking lot from the image. Secondly, select the coordinates of the single parking slot. This will divide the parking lot into equal size slots.

v. Each block is converted from gray scale to binary and then inverse binary to get the car in white color and parking area into black color.

vi. Threshold value is calculated in every block to detect whether that block contains car or not.

vii. If the value is less than threshold value than that block is free and available for parking car and if value is greater than, block is occupied.

4. EXPERIMENTAL RESULTS

An intelligent parking lot detection system based on image processing have been tested and proposed in this paper. This results are included the sequences of the car park detection from empty lot (10 parking available) until the full parking lot. The system shows the number of availability of parking lot resulted by using camera preview panel, and GUI output display.

5. CONCLUSION AND FUTURE WORK

The parking space detection system based on image processing in MATLAB was designed and tested. It is possible to manage large area by just using several cameras. It is consistent in detecting incoming cars because it uses actual car images. It is cheap and easy-installed because of the simple equipment. Drivers can get useful real-time parking lot information from this system by the guidance information display. Future researchers can focus on allocation specific location to customers already registered from online parking management system.

ACKNOWLEDGEMENT

The project work has been supported by The National Institute of Engineering, Mysore and the authors would like to thank Mr. Suhas S, Assistant Professor, Department of Computer Science and Engineering, NIE, Mysuru for helping in this project.

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