# Smart Parking system using Image processing

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**Abstract -** This project aims to design a smart parking system that is sensor free and functions as an indicator of the vacant spaces to the oncoming users of the parking lot.

**Keywords**— sesnsor free, indicator, parking system

## I. INTRODUCTION

An automatic parking system is used to make the whole process of parking cars more efficient and less complex for both drivers and administrators of the parking unit. This automation can be hardware based or entirely software based. An entirely software based system has not been employed so far. This project aims to replace the existing automated parking systems that rely heavily on various sensors for day to day operations with a system that relies more on software systems. The proposed system does not use any sensors, hence the mechanical and electronic liability of the system is reduced to a great extent. The proposed system just uses image processing algorithms to automate the parking with footage obtained from the parking lot's surveillance cameras. These algorithms detect the empty parking spaces and convey the information to the drivers entering the parking premises.

## II. EXISTING SYSTEMS

### A. Existing methods of detection

There are numerous methods of detecting cars in a car park such as Magnetic sensors, Microwave Radar, Ultrasonic sensors and image processing. This project discusses image processing. This is used because cameras can capture many cars at once making them efficient and inexpensive and this also adds to added security in parking lots that may prevent theft and damage of the vehicles . One or more cameras are used for video image processing depending on the area to be covered. Software is needed to process the images taken by the cameras. This processing is usually done by examining the difference between consecutive video frames. The area that a camera can scan can be easily changed by simply altering the position of the camera. There are two ways of using this system either by applying the edge detection with boundaries condition method for image detection module or applying point detection with canny operator method. In this project, the parking lot detection is done by identifying the green rounded image drawn at each parking lot. Matlab is used as a software platform. The process flowchart is shown in Figure 1.

### B. Process Flow chart

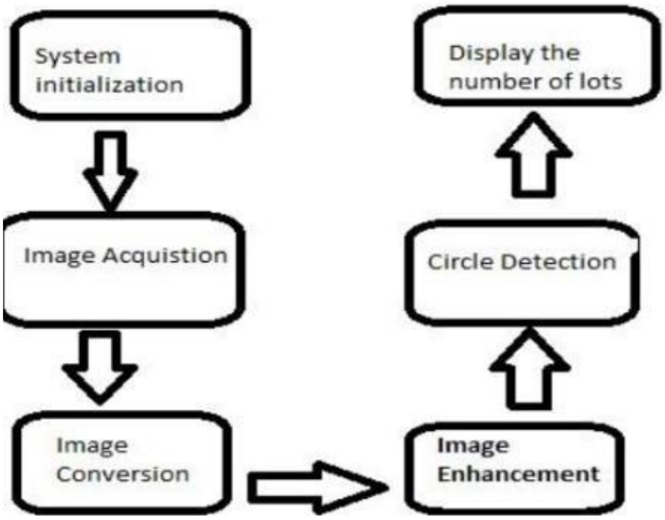


Figure 1: The process flowchart

## III. THE PROCESS

The process of identifying and processing whether the parking lot is empty or not entails the following :

### A. Image Identification

First an image of the empty car park will be taken and stored for future references. The RGB value can be used to find where green circles are that represent empty car spaces if the system has enough processing power to process color images in a quick and efficient manner. If this is not the case, the image is converted into gray scale image. With these the system will know where to look for cars in the future.

The color image is converted into a HSV image that describes the hue and saturation variations of the image. This enables the processor to be better able to distinguish the green circle based on the user's input RGB value. The HSV image is simplified to a black and white binary image so that it is easier to deal with by making the pixels white where the threshold is more than 40%. In order to do this the HSV image needs to be converted to a gray scale format so that each pixel can be easily can compared with the threshold. This means if the pixel is less than the threshold the color of it will be black. Otherwise it will be white.

### B. Image Acquistion

A camera placed at a fixed position above the cars will be used to acquire the image used to calculate the vacancy of the car parks. This camera should be in a position where can clearly see all the car parks and not be obstructed by any objects. A sample image that was used for processing is shown in Figure 2 and Figure 3.

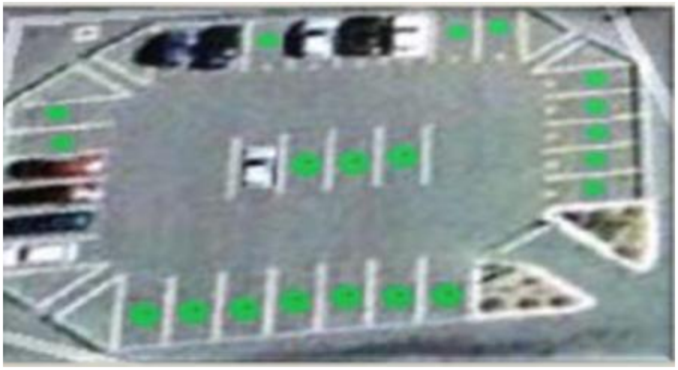

Figure 2: Sample Input image (Partially filled)

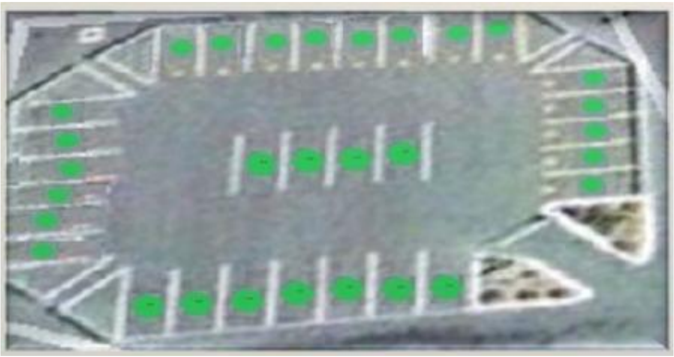

Figure 3: Sample Input image (Empty Parking lot)

### C. Image conversion

Image conversion is done to simplify the processing while also to be able to identify the different objects present in the image. One way is to take a sample of the RGB image and see where clusters form in a 3-dimensional graph. Since this process cannot be done for every image frame in the system, the need to find another technique for this purpose arises. A simpler and a more convenient method was found to be to find the green dots by using the HSV (Hue and Saturation Variation). HSV separates luma, or the image intensity, from chroma or the color information. This is very useful in many applications. Using only the Hue component makes the algorithm less sensitive (if not invariant) to lighting variations. The prefix "non" is not a word; it should be joined to the word it modifies, usually without a hyphen.

### D. Image Enhancement

After obtaining the segments for the objects used the noise in the image needs to be removed. This can be done through dilation and erosion. Dilation increases the boundary of the objects in the image. This causes a problem in the image. The problem is that objects merge together so it is hard to distinguish object from one another. However, this is good to fill up holes in objects. Erosion decreases the boundary of the objects so that they can be easily distinguished from one another. After erosion objects are more distinguishable from each other and small dots are removed. This prepares the image to identify whether parks are empty or filled. In order to find the optimum erosion and dilation variations, we use the Otsu's method of optimal thresholding to find if the image requires more of erosion or dilation. Otsu's thresholding method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either falls in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum.

### E. Circle Detection

This process is important to the system since the number of circles is equal to the number of parking lots that are vacant. Hough transform is exclusively used for circle detection in various image processing systems. The Circle Hough Transform (CHT) is a feature extraction technique for detecting circles. It is a specialization of Hough Transform. The purpose of the technique is to find circles in imperfect image inputs. The circle candidates are produced by "voting" in the Hough parameter space and then select the local maxima in a so-called accumulator matrix. The equation for the CHT is given by :

$$(x-a)^2 + (y-b)^2 = r^2 \quad \_\_\_\_\_\_ \quad (1)$$

Set a threshold When the circles are found out, detect the diameters of each circle. Then calculate the number of diameters in the image. The number of diameters is equal to the number of circles. The number of circles implies the number of vacant spots.

## IV. RESULT

The processes mentioned above were executed using MATLAB tool. The Video and Image processing toolbox was used for the processing of test images. The result of the processing is as shown below in Figure 4.

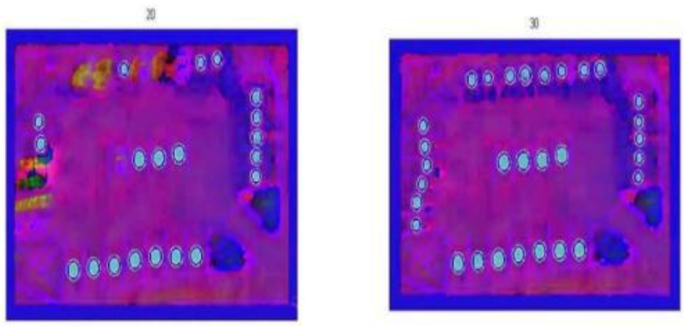

Figure 4: The Simulated results

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