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# Automated Parking Slot Identification Framework

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## ABSTRACT

This paper describes The detection of parking space with the help of image processing technique in MATLAB using GUI. The parking assist system is an essential application of the car's active collision avoidance system in low-speed and complex urban environments, which has been a hot research topic in recent years. Parking space detection is an important step of the parking assistance system, and its research object is parking spaces with symmetrical structures in parking lots. By analyzing and investigating parking space static information. An image processing algorithm is used to detect empty parking areas from aerial images of the parking space. 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. 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. The system also reports if individual parking spots are occupied or otherwise. Occupancy information is made available to newly arriving drivers by projecting it unto large displays positioned at vantage points near the vicinity. The smart parking slot detection reduces the stress and time wastage associated with car parking and makes management of such areas less costly.

**KEYWORDS:** GUI(Graphical User Interface), Matlab, Automatic parking , image processing

## INTRODUCTION

In today's society, cars have shifted from being a luxury to a necessity, particularly for working professionals. Many individuals opt to buy cars through instalment plans. Traffic congestion has become increasingly common in metropolitan areas due to the growing number of vehicles. As cars play an integral role in our daily routines, finding a parking spot has turned into a frequent struggle. Upon entering a parking lot, drivers typically look for signs indicating whether the lot is full, partially occupied, or has available spaces. Often, they don't know the total number of parking spots or where to find a suitable one. This lack of information can lead to inefficient use of available spaces, with some remaining empty even when the lot is crowded, causing traffic delays at the entrance. Offering drivers real-time data on parking availability has thus become essential. As a result, drivers may spend significant time searching for a vacant spot. Image processing offers a cost-effective solution to this problem by detecting vehicle presence and providing real-time updates on available spaces, implemented through MATLAB with a graphical user interface (GUI).

## LITERATURE SURVEY

In modern times, cars have transitioned from being a luxury item to a necessity, especially for working individuals. Many people choose to purchase vehicles through instalment plans. Traffic congestion has become a widespread issue in metropolitan areas, driven by the increasing number of cars on the road. Since vehicles are a vital part of our daily lives, finding a parking space has become a common challenge. When entering a parking lot, drivers often search for signs indicating whether the lot is full, partially occupied, or has available spaces. However, they are frequently unaware of the total number of spaces or the location of suitable ones. This lack of information can result in some parking spots remaining unused, even when the lot is nearly full, leading to traffic congestion near the entrance. Providing real-time parking availability


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information to drivers is, therefore, crucial. Consequently, drivers often spend a considerable amount of time searching for an open space. Image processing provides an affordable solution to this issue by detecting the presence of vehicles and delivering real-time updates on available parking spaces, using MATLAB and a graphical user interface (GUI).

## METHODOLOGY

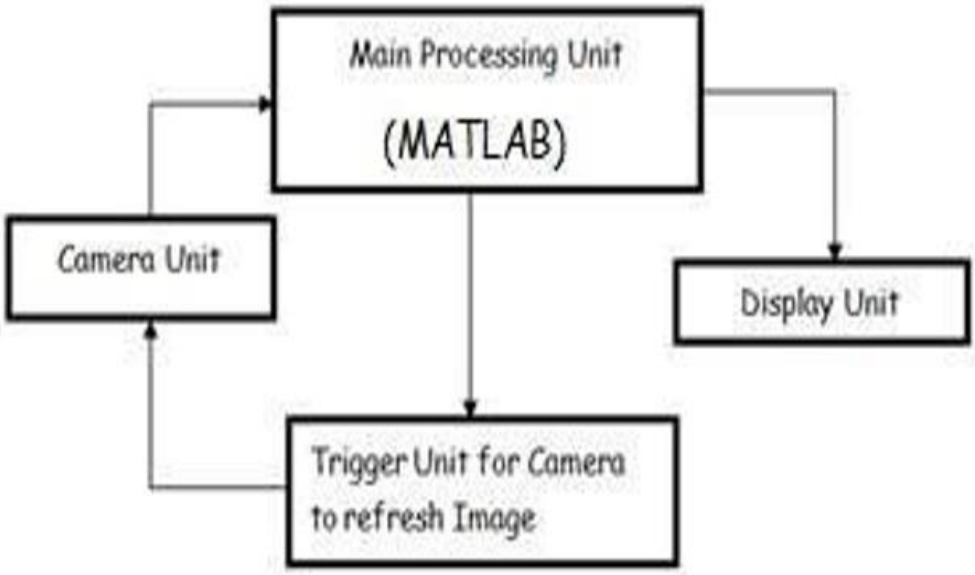


**Fig. 1: Block Diagram for Parking lot detection**

The proposed module utilizes an image processing technique implemented on the MATLAB software platform, as illustrated in Figure 1. A camera unit continuously captures images of the parking slots, which are then sent to MATLAB for analysis to display the number of available and occupied parking spaces. A trigger mechanism is used to refresh the camera feed, either when there are changes in the number of cars or at specified time intervals, ensuring up-to-date information is captured and processed.

### System Module

To carry out the operation, the proposed mechanism includes a five-step module. The following are the processing steps, as depicted in the block diagram in Fig. 2.

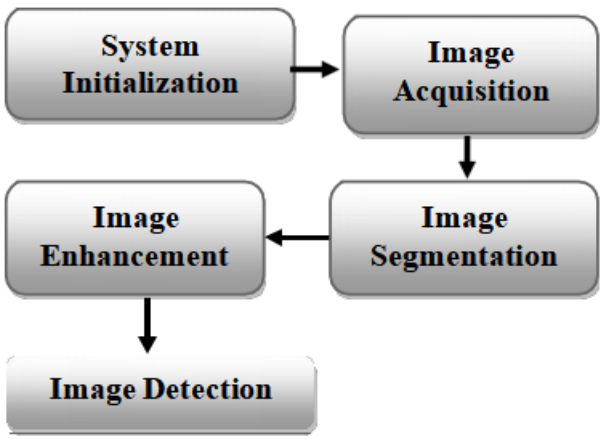


**Fig. 2 Block Diagram of System Module**

The first module is system initialization, which is a procedure that automatically identifies the location of each parking lot in the image. The second module is the image acquisition module, which captures and stores digital


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images captured by a video camera. This module receives input in the form of a parking lot scene.

The second module is the image acquisition module, which captures and stores digital images captured by a video camera. This module receives input in the form of a parking lot scene. This acquisition device is linked to a processing unit that runs the MATLAB software. The third module is image segmentation, which separates objects from the background and distinguishes pixels with similar values to improve contrast. Image enhancement is the fourth module. The noise is removed in this module by using morphology functions, which remove pixels that do not belong to the objects of interest. The boundary of objects in image is tracing which is concentrated on the exterior boundaries. The final module is image detection, which is used to determine the rounded brown image that is drawn in each parking lot.

The camera and system are initialized In the first section, and a procedure to automatically identify the location of every parking lot in the image is implemented. When the system boots up, a reference image with no cars parked is captured, and this image serves as a reference image for the processing of subsequent images. After a certain interval, the image with parked cars is refreshed or changed.

**System Initialization .i**

The module is only activated when the system is booted up for the first time. Each park undergoes a one-time manual drawing procedure in which a rounded brown image is created (with zero car present in the car park area) as shown in fig. 3. On each parking lot, a rounded brown image is manually drawn.

This procedure's goal is to automatically identify the location of each parking lot in the image. It should be noted that during the initialization process, the lines separating the parking lots must be visible, clear, and unobstructed. The camera is assumed to always be in a fixed position and facing a fixed direction.

The programme will begin the initialization process by detecting the shape of the image and searching for the rounded brown image.

The detected image is then analyzed to determine the availability of a parking lot. The manual
During the manual drawing process, the image can be labeled with the Park slot number, which will aid in identifying the empty parking area. The main goal of this process is to identify the empty parking area without requiring any manual intervention. The diagram should be visible, clear, easy to understand, and provide complete information about the parking slot during the initialization process.

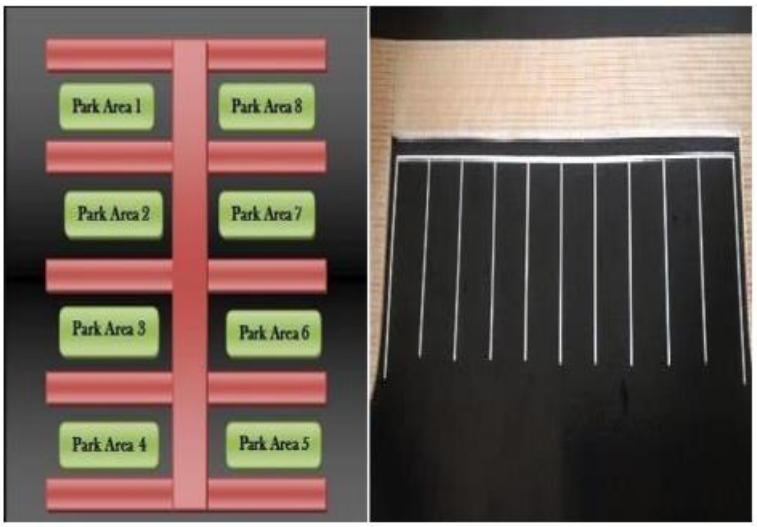


**Fig. 3 System Initialization**

**ii. Image Acquisition**


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Once the System Initialization module has been completed, access to the next processing module in the Image Processing Techniques, known as the image acquisition module, can be granted. Images from the parking area can be captured using the Camera in the Image Acquisition module. The acquired images for processing can be captured using high-definition cameras located in the parking lot.

The Camera can capture images from the top and side views of the parking slot in order to sense the incoming input image and consider the image. As illustrated in Figure 4.

**Fig. 4 Image Captured from Camera**

The image will be processed in the image acquisition module after the first step. The steps involved in this case are image capture and storage of digital images from video cameras. For this purpose, a high definition camera is connected to the processing unit and provides data for the MATLAB software, which is running in real time situations. The camera should be aligned with extreme caution. The camera should be placed at a good height in order to get a clear and top view of the parking area. The image captured by the camera in Fig. 5 depicts the cars parked in the area.

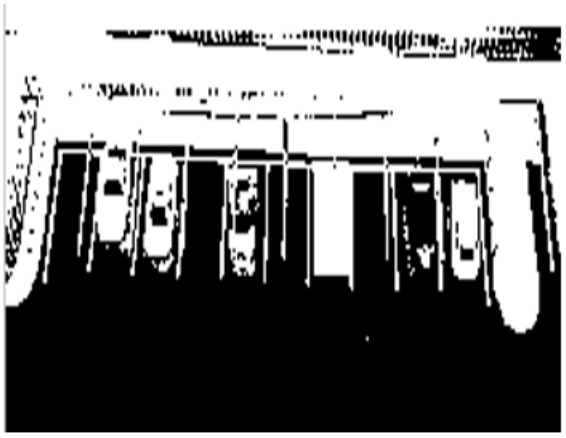

**Fig 5: Difference in the Images**

**iii. Image Segmentation**

Image Segmentation is a type of module that can be found in the Image Processing Steps. Image segmentation is a major component of image processing techniques that can be used to identify and analyse images at a glance. The image segmentation process can be depicted in a block diagram, as shown in Figure. 6,


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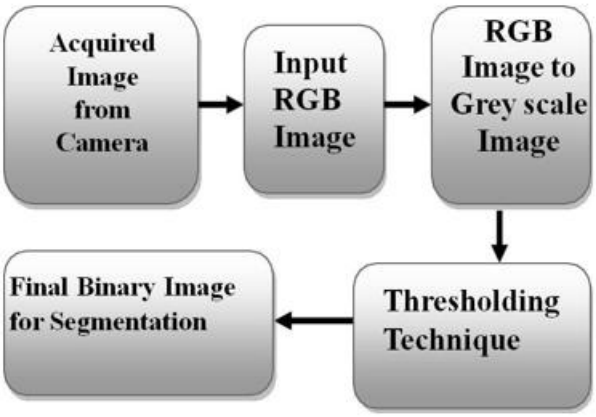


**Fig. 6 Flow chart of Image Segmentation Process**

Each and every part of the image will be provided by the Image Segmentation process. The visual characteristics are obtained by taking into account the number of pixels in the captured image. As a result, the image obtained after the segmentation process will be of higher quality. The obtained set of Pixels can provide the entire image. Thus, the outline, Edge, Boundary, Object, and so on can be used to identify the empty parking area in a parking slot. Clustering, the process involved in Image Segmentation, will divide the image into a number of clusters.

The Clustering procedure can be chosen based on the source of the assortment, either manually or through the Random Selection procedure.

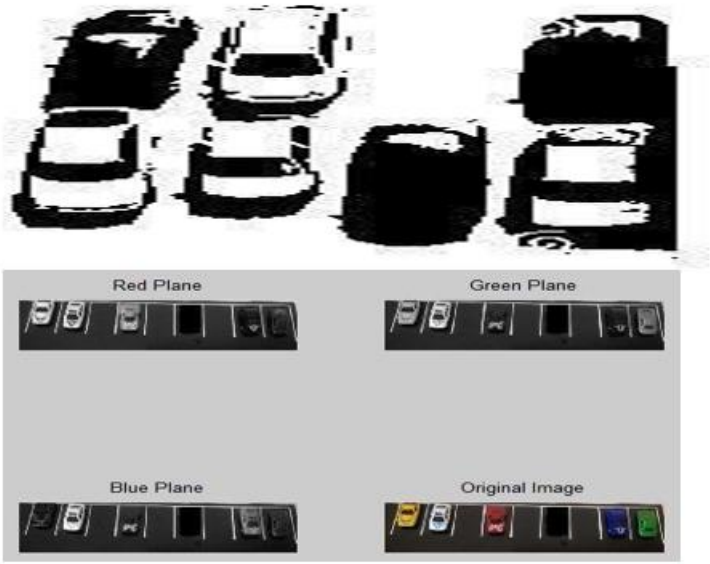


**Fig. 7 Binary Image for Segmentation**

The equation is used to convert an RGB image to a grayscale image.

Image Grey = 0.229R + 0.587G + 0.114B —[1]

The grey level image can be obtained using the equation [1], and the binary image can be obtained using the thresholding technique. All of the information about the position and shape of interest is contained in the binary image. The threshold level is set so that the objects of interest are white and the rest of the image is black.


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This method not only reduces complexity but also simplifies the image processing processes. There are several types of threshold methods, including basic, two band tile, optimal, and adaptive.In this paper, we used a basic thresholding technique. The thresholding is defined as follows:

g (x,y) = 1 if x > T
0 if x T—[2]

The threshold value, denoted by T in equation [2,] is chosen. Since the RGB is obtained, it is converted to binary before being separated into the respective channels and appropriate threshold levels are chosen. The threshold technique works as follows: any value less than or equal to T is classified as black (0), while any value greater than T is classified as white (1), Fig.8. depicts the converted binary image in R, G, and B channels, as well as the sum of all channels.

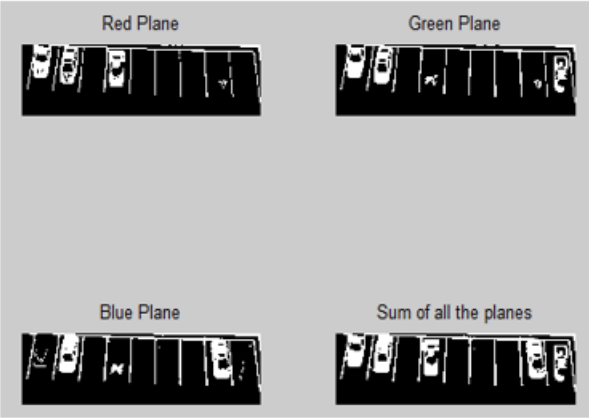


**Fig. 8: Converted binary Image in RGB channels and the summation of all the channels**

**iv. Image Enhancement**

The binary image obtained from the Image Segmentation module is taken into account by the Image Enhancement module. The image has been enhanced in this process to remove the unwanted noise obtained during the Binary Image Conversion. They can be used to trace the Detected Image's outline. The digital camera will capture images from various locations, some of which will be noisy. The obtained noise can be removed using a technique. Morphology is an abbreviation for "morphology."

Morphology is a special technique that is used to ignore the Imperfection discovered during Image Segmentation. The Morphological mechanism went through the following processes: dilation, erosion, opening and closing, and among those four processes, the opening and closing Morphological process is the most commonly used for noise removal.

The Opening process removes the tiny objects that were present in the Segmented Image, and the Closing process removes the unwanted and tiny holes that were present during the Segmentation process.

The Morphological mechanism's primary function is to provide the image's exact edge and shape without distortion. In the proposed mechanism, the exact boundary of the image must be traced inorder to detect an empty parking space.

In this stage, the remainder of the process known as Dilation and Erosion is used to increase or decrease the pixel range of the Output Image after enhancement. Dilation is used to increase the Pixel range to an image's outline boundary. If the input pixel value of a binary image is equal to '0,' the output pixel is also equal to '0,' according to the proposed process. As a result, the image obtained in Figure 6 will show the Enhanced for processing Edge and Outline Boundaries of an Image. In order to obtain the exact shape of an image, the parameters of Area and Perimeter must be considered during this process. The exact shape of an image is


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required to provide information to drivers in order for them to park their vehicles in an empty parking area.

Shape = (4piarea) / (perimeter2)

**Above is the expression that can be used to calculate the shape of an image.**
The detection of the number of cars present in the image is implemented when the boundaries are traced. Here, we find the image's eccentricity and then make it run in the loop. The presence of a car is detected and marked using square boxes in this section, and image output is produced, as well as output on the MATLAB software.

**Figure 9. Image after Noise Reduction and Tracing the boundaries**

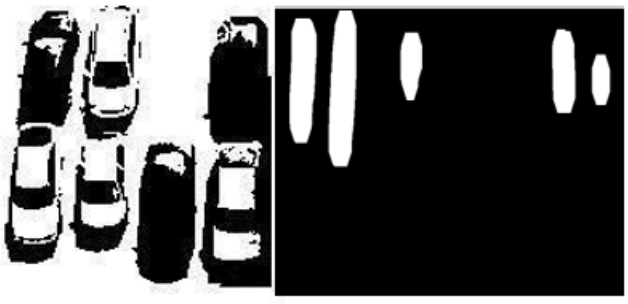

**Fig. 9: detecting availability of Parking Slot**

Figure 9 depicts the number of cars detected by drawing a square parking slot. The IFTTT (If This Then That) application is triggered from the console and sends an SMS to users as well as

The converted binary image will have some noise and will trace the object's boundary. To remove the noise that the image has acquired from a variety of sources, morphological operations such as dilation, erosion, and so on will be used. In the paper, we used the binary image's open and close operations. This operation is primarily used in the majority of image processing operations.

**v. Image Detection**
The Image Detection Module is only activated if the Image Enhancement Module obtains the Exact notifies people on social media via internet services.

## CONCLUSION

The concept of an image-processing-based parking slot detection system was developed and tested. It is a quick way to compare the reference image to the captured image, which simplifies the system. This paper's conceptualization is based on software rather than hardware, which makes the system inexpensive to maintain and implement. This system also include providing secure parking and making the system work in a variety of environmental conditions. The system can be used not only in cities, but also on highways, shopping malls, and other public spaces. The ability to send internet messages can be advantageous to the system. The parking slots can be easily identified, and the shape of that specific slot can be determined, resulting in the occurrence of parking the vehicle in a safe area in a short period of time without any delay, after which they can fill the


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vacancy. In the entire test set of parking slots, the method's recall ratio is 98.72 percent and its accuracy is 99.14 percent. Parking slot detection on real vehicles has yielded positive results and can accurately identify parking slots. Second, in all of the studies, this is the first time that the deep learning method has been used to directly identify a parking slot, which compensates for the lack of research in the field of directly detecting parking slot.

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