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Smart Car Parking System Using Image Processing

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ABSTRACT-

In today's tech-driven world, automated systems play a crucial role, and one commonly seen application is automated parking. This project focuses on developing and implementing a system that automatically detects available parking spaces using image processing technology. By doing so, it aims to reduce the need for human intervention in parking management. The system is designed to minimize human involvement by providing guidance to drivers searching for parking spots. Given the challenges of urban traffic congestion and limited parking space, it's essential for parking facilities to incorporate efficient parking space detection systems. The proposed system utilizes image processing to count parked vehicles and identify available parking spots without relying on traditional sensors embedded in the ground. Instead, it employs cameras positioned strategically within the parking lot to capture images, allowing for accurate monitoring of parking space availability.

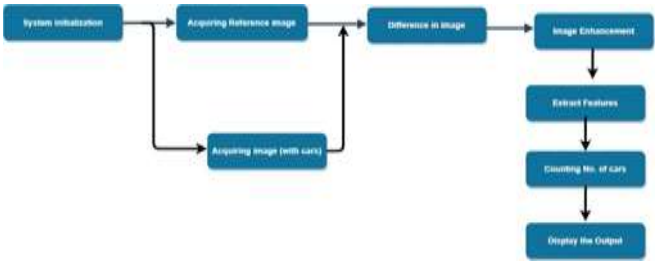
Keywords—Image processing, Camera, matab

1. Introduction

In today's world, owning a car has become a necessity, especially for those who work. Many people even opt for installment plans to purchase cars. In metropolitan areas, traffic jams caused by a large number of vehicles have become a common issue. Cars are an integral part of our daily lives, but finding parking spaces can be a challenge whenever we venture out in our cars. Upon entering a parking lot, drivers often struggle to determine if it's full, partially occupied, or empty. They also face uncertainty about the total number of parking slots available and where to find a spot for their car. Sometimes, despite high overall occupancy, certain parking spaces remain empty, leading to inefficient use of parking resources and congestion near parking lot entrances. Hence, providing drivers with real-time information about parking availability upon entry is crucial. Implementing a system that utilizes image processing to count available parking spaces addresses this issue affordably. The system uses CCTV cameras to capture images and processes them to determine parking availability. This project involves planning, analysis, design, development, and testing phases, with image processing techniques being employed throughout. By offering information about available parking spaces, this system benefits all drivers entering the parking lot. It leverages image processing technology, which allows for comprehensive coverage of the parking area with minimal camera usage, keeping the system compact and cost-effective. Surveillance cameras positioned at heights in the parking lot capture images, with MATLAB serving as the software platform for this project.

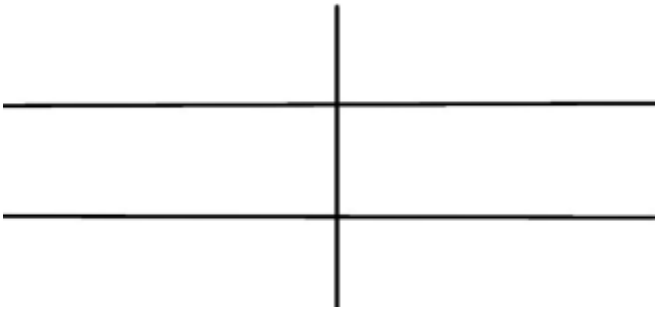
II. PROPOSED MODEL AND METHODLOGY

The core process of our framework is illustrated in Figure 1. We capture videos from a bird's-eye view perspective of the parking area using a stationary camera. These videos are broken down into individual frames. Subsequently, we extract a key frame from each segment to streamline computational complexity before applying further processing.



1. **System Initialization**

During the setup phase, we begin by capturing an image using a stable CCTV camera at the time of installation. This initial image serves as the reference background image and doesn't feature any parked cars. The primary objective here is to recognize the parking spaces depicted in the image. The camera utilized for capturing images remains fixed in a specific position and maintains a constant direction throughout.



2. Image Acquisition

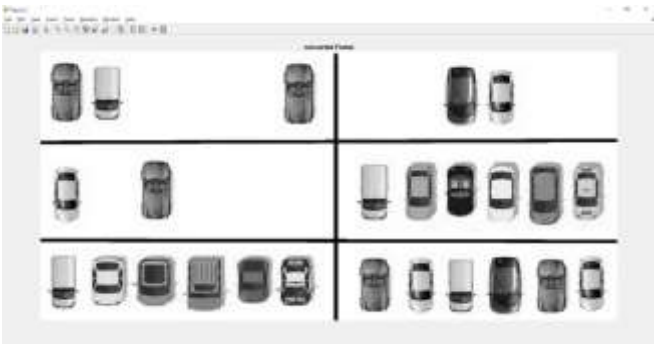
During this stage, we capture a picture of the parking area with cars using a high-definition camera. The image frame featuring six lanes is divided into individual lanes. Subsequently, the image data is transferred to MATLAB software for additional processing..

3. Thresholding of Image

Next, we convert the acquired RGB image into a grayscale image, followed by creating a binary image in the Image Segmentation module. To achieve this, we use the equation: Gray = 0.229R + 0.587G + 0.11B. This grayscale image represents the parking area with cars. From this grayscale image, we generate a binary image using a thresholding technique. The binary image provides crucial information about the position and shape of objects of interest. We adjust the threshold level to ensure that the objects of interest appear white while the rest of the image remains black..

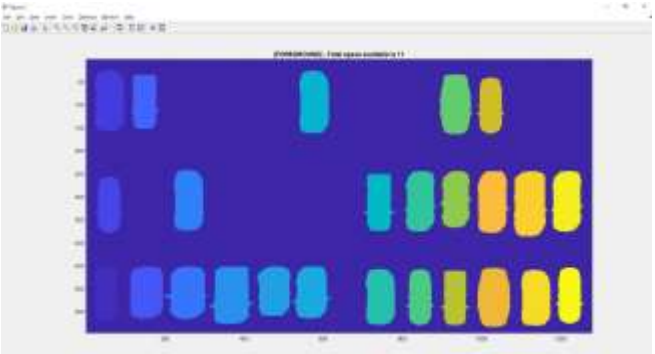
4. Image Enhancement

To improve the quality of the binary image, we address the noise present using morphological operations and filters like the Weiner filter. Additionally, we utilize functions like imfill and bwareaopen to eliminate any holes present in the image.



5. Image Detection

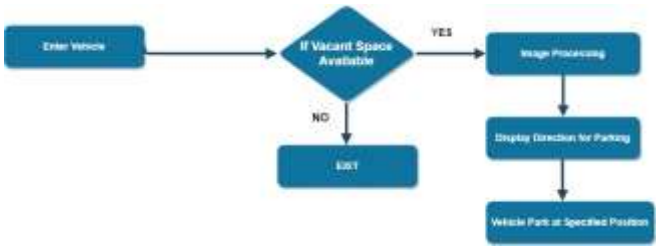
To identify the cars, we conduct blob analysis using predefined functions available in MATLAB, enabling us to count the number of cars present.



III. ALGORITHM OF THE PROPOSED SYSTEM

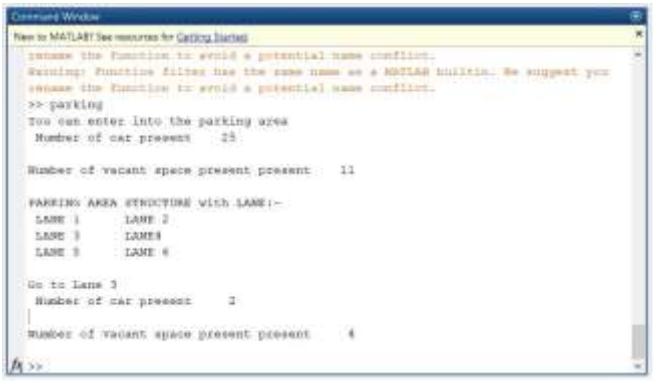
The key steps of our proposed algorithm for parking space detection include:

1. 1.Retrieving live video feed of the parking lot from the camera.
2. Capturing images as cars enter the parking lot.
3. 2.Converting RGB images to binary images.
4. 3.Cropping each frame lane by lane, processing them sequentially and individually within a loop.
5. 4.Determining vacant slots and their respective lanes by calculating the number of cars.
6. 5.Providing accurate navigation guidance to vehicles based on the available parking spaces.



IV. Results

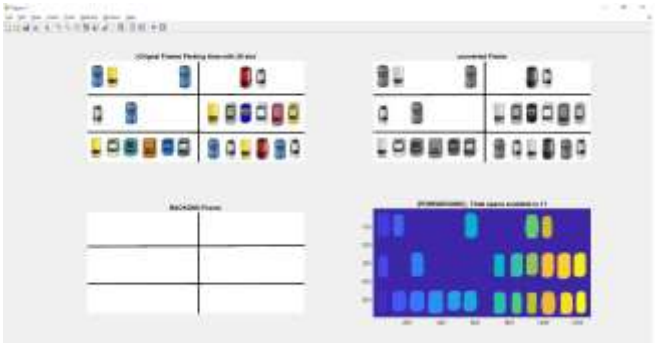
Command window of MATLAB after the execution of code.

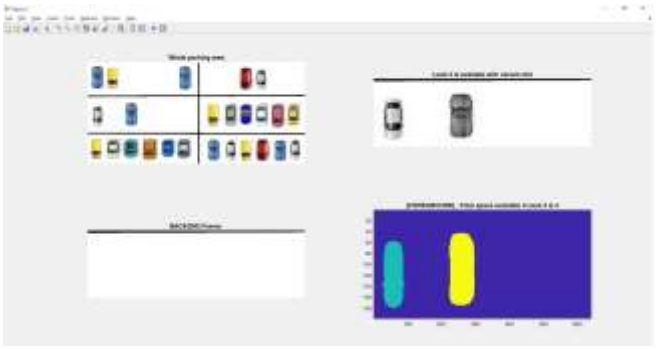


Two output figures are there after the execution of code.

Figure 1 – Observation of the Whole parking area .

Figure 2 – Observation of the each lane in parking area and the vacant lane is shown.





V. Conclusion

While there are various automated car parking systems available utilizing technologies like GSM and wireless transmitters, this project was undertaken with the aim of delving deeper into image processing. Image processing stands as one of the most pertinent technologies of our era, with widespread applications. We designed and tested a parking space detection system leveraging image processing within MATLAB. By employing several CCTV cameras, it becomes feasible to manage large parking areas efficiently. The system exhibits consistent performance in detecting incoming cars, relying on actual car images. Moreover, it is cost-effective and straightforward to install due to its uncomplicated equipment. Drivers benefit from real-time parking information displayed through guidance systems. In future research endeavors, there's potential to allocate specific parking locations to customers already registered through online parking management systems.

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