भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

Project Report for DA526

Automatic Parking System

`https://github.com/ayush-62/Automatic_Parking_System`

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1 Problem Statement

Vehicle Parking Space availability system using Image processing and machine learning:

We are creating a vehicle parking space availability system using image processing and machine learning models where the system will detect whether the spot of the parking area is free or is it already occupied by some other vehicles.

Our Goal is to knowing the total number of available parking spots based on which various decisions can be made such as Is parking space available at each layer(floor) in multilayer Parking system? And also to get the knowledge of parking space in Normal parking at places like malls, restaurant, residential area, Industrial area etc.

Occupancy information can be made available to newly arriving drivers by projecting on the screens or sending it on the parking application on the driver's mobile phone or any similar devices.

2 Dataset

Our Dataset consists of around 6000+ images which is further divided into almost 3000+ empty and 3000+ non-empty set of images.

Empty set of images contains the images of parking spots which can considered as Empty.
Non-Empty set of images contains the images of parking spots which can be considered as Non-empty or there is some vehicle parked(Occupied) at that space.

Here are some example from the dataset:-

Figure 2: Empty images

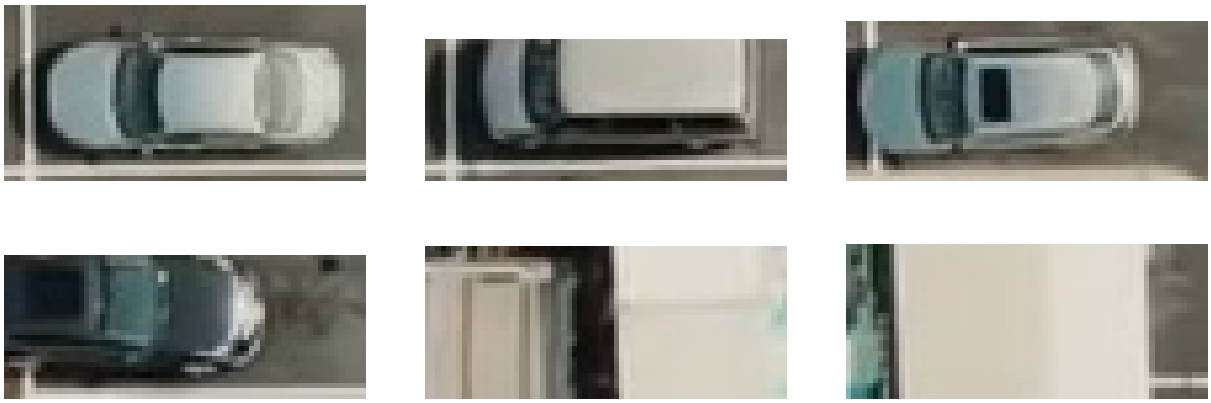


Figure 4: Non-Empty images

3 Methodology

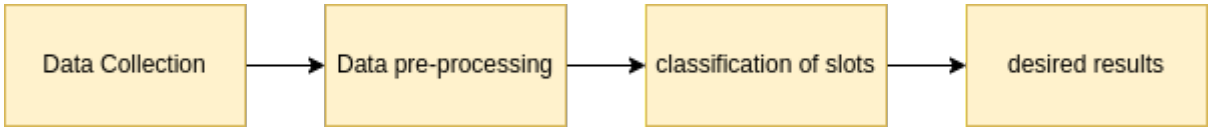
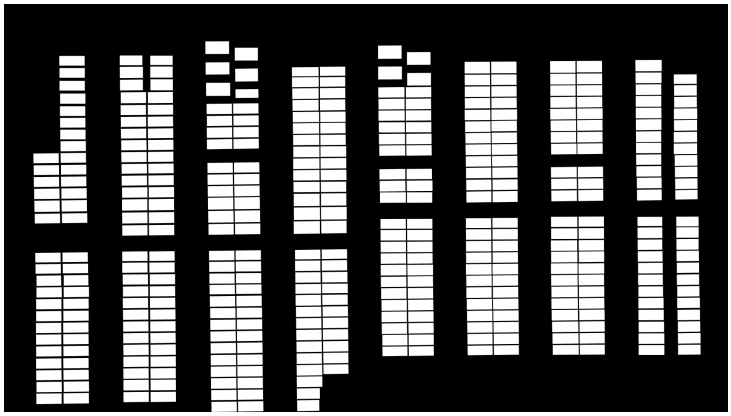


Figure 5: Methodology

Data Collection:-
Install high-resolution cameras at strategic locations in the parking lot to capture video of the parking spots. Top view of the parking space is our desired dataset.

Data preprocessing :-
Data preprocessing step includes creation of mask for the parking spot captured as well as creating empty and non-empty space cropped images for the purpose of training the model.

Here is an example of mask we used and corresponding parking image:-



(a) Mask

(b) Parking lot

Classification of slots:-
In this step we are classifying our image into empty and non-empty slots using support vector machine classifier which is giving good results in our case than other image classifiers

4) Results:-
The system should determine total occupancy status.
With the help of mask for the parking system we are classifying the parking spots into empty and non-empty parking spots by indicating the green rectangle boxes for empty parking spots and red rectangle boxes for non-empty parking spots(occupied).

Image classification approach:-
For Image classification we have used SVM classifier and perform the following steps

- Prepare data
- Train/ Test Split
- Train classifier
- Test performance

Prepare data-
Prepare the data for the classification of data into two classes of empty and non- empty parking spots.

Train / Test split-
We divide our dataset into training and testing set where training dataset is larger as compared to testing dataset, in our case we have taken 80 percent training data and 20 percent testing data of the total dataset size.

Train the Classifier:-
We have used support vector machine classifier for our classification by including the scikit library.

SVM is a supervised learning algorithm that works by finding the optimal hyperplane that separates the data points into different classes.

The main goal of SVM is to find a hyperplane that maximizes the margin between the different classes of data. In other words, the SVM algorithm tries to find the hyperplane that best separates the data points into different classes and maximizes the distance between the closest data points of different classes, called support vectors.

Test performance:-
Once the SVM classifier classifies the data into classes of empty and non-empty parking spots Our testing data is used to test the accuracy which is pretty good in our case with the help of SVM classifier

4 Experiments and Results

our project was able to classify the spots as empty or not-empty with more than 98 percent accuracy but we were checking the status of each and every spot each time which was not needed and this was leading to more unnecessary computation resulting delay in video due to which we can't use it real time. So we decided to slightly modify the code. Now we will not check the status of each and every spot every time but when the difference between the image of particular spot of current frame and last frame is more than threshold.we decided the threshold by analysing histogram showing how many images are changing with how much amount of intensity.

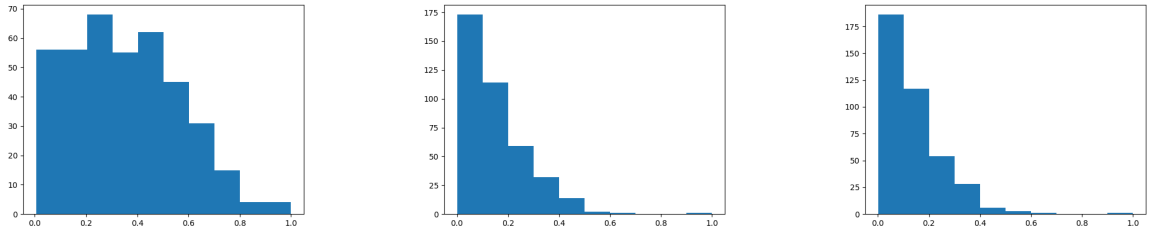
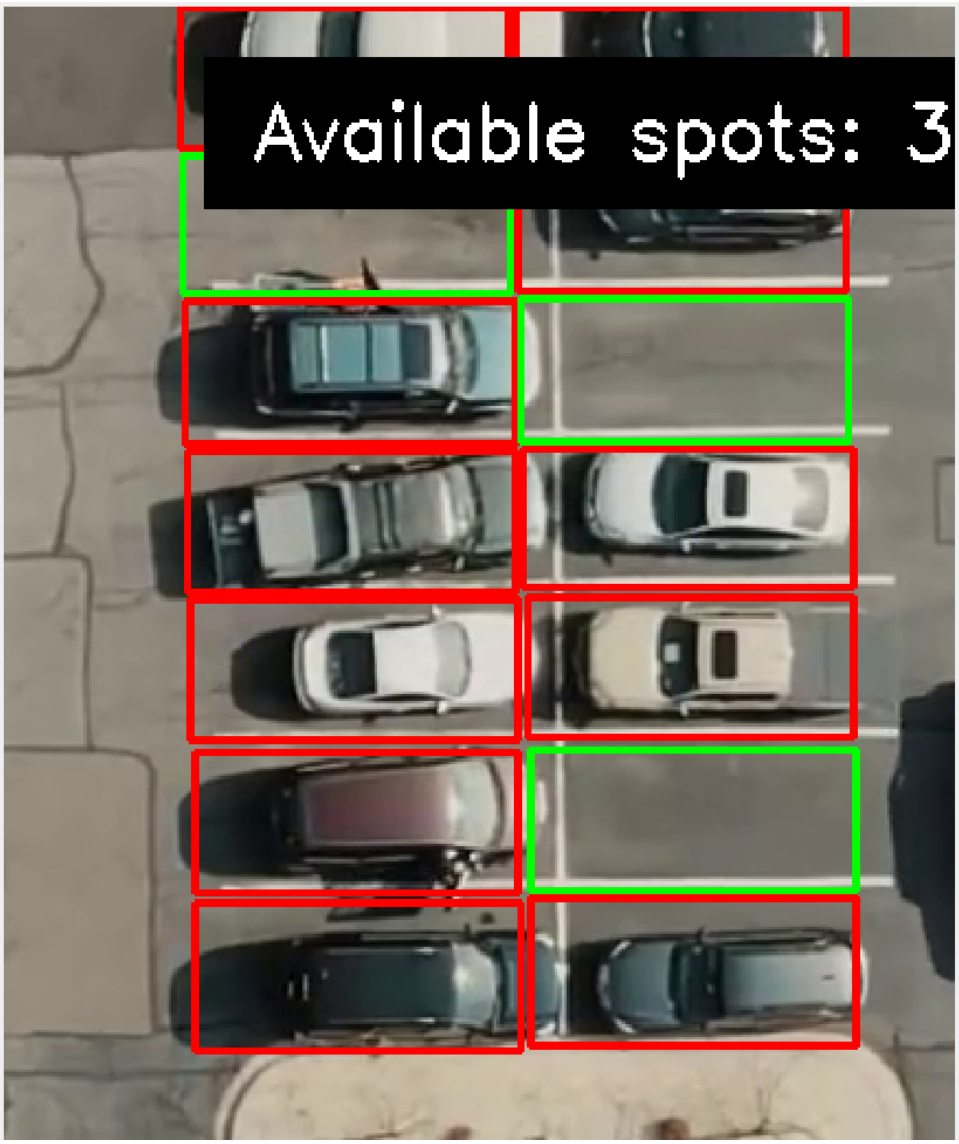


Figure 7: Histograms of change intensity

Final result



5 Related Work

1)"A Smart Parking System using Image Processing and Wireless Sensor Network" by T. Bhuvaneswari and P. Anitha. This paper presents a parking management system using image processing and wireless sensor networks. The system uses cameras to detect vehicle occupancy and wirelessly transmits the information to a central server for real-time parking management.

2)"Real-Time Parking Lot Occupancy Detection using Deep Learning" by A. Baheti, M. Alakwaa, and M. Alrashed. This paper proposes a real-time parking lot occupancy detection system using deep learning techniques. The system uses a deep neural network to detect and classify vehicles in parking lots, achieving high accuracy in real-time.

3)"Parking Space Detection System Based on Image Processing and Edge Detection" by L. Zhang, Y. Guo, and Y. Sun. This paper proposes a parking space detection system based on image processing and edge detection. The system uses a Canny edge detection algorithm to detect parking space boundaries and classify them as vacant or occupied.