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Enhanced Parking System

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ABSTRACT

The majority of parking lots are maintained manually by the human workforce, and there is a least automated system in place to manage the parking area appropriately. Drivers must circle the parking lot in search of a parking slot. This type of issue is most common in metro cities near retail malls, hospitals, and so forth.

In this paper we develop a OpenCV model where when a car enters any of the parking lots the car driver can find the state of the parking lot, namely whether it is fully occupied, partially occupied, or unoccupied at the entry itself. And also in this paper we are going to extract car information and perform some data visualization and analyze that output.

Keywords : Data analysis, Data Visualization, Open CV, MatplotLib.

I. INTRODUCTION

Looking for a free parking spot takes time and wastes energy. The parking slots are empty most of the time, although the total occupancy is low due to poor parking lot management. This leads to inefficient utilization of the parking area as well as causes traffic delays and congestion around the parking lots. It has become critical to handle the issue of effectively managing the parking lot and displaying each parking division's information to cars before entering the parking lot. The main contribution of this study is to optimize the identification of available parking slots to possibly reduce the congestion in the parking arena.

We try to take the layout of the parking area, mark desired parking slots. Such that, whenever there is an empty space it will mark that slot in green color otherwise in red color using OpenCV. This is how we can make it easy for the vehicle drivers to find the parking slot easily in a vast parking lot. OpenCV is a python module by which we do image processing, we use it in our prototype.

We also extract the car data such as car number plate number, vehicle type, registration year, car lot entry time and exit time etc., by which we try to analyze the data by using some python modules. Python has various modules which help us to visualize data easily. Some of them are MatplotLib, Seaborn, etc. Seaborn is a python module used for statistical data visualization based on MatplotLib.

The remainder of this paper is organized as follows. Section II presents the proposed methodology. While implementation in section III. Finally, conclusions are drawn in Section IV.

II. METHODOLOGY

In this section, we present the adopted methodology to process, analyse the data and get valuable insights from the data such as number of vehicles each hour, how much time a vehicle is kept at the lot and find the average parking lot usage time, etc.

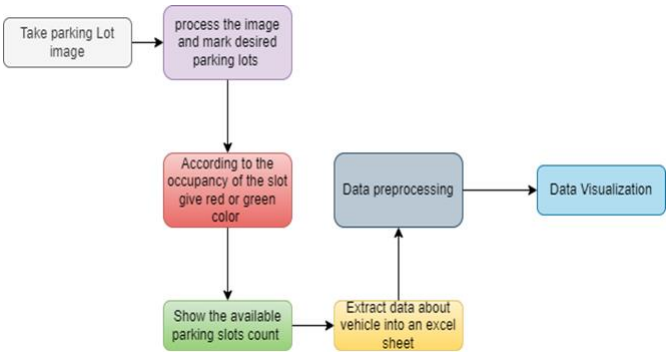

Fig. 1: Workflow of the proposed methodology.

A. Image Processing

We use OpenCV for processing the image.For the desired parking lot video we take the layout of the lot, Mark all the slots with a rectangle manually. We use various methods in the cv2 module such as cvtColor, gaussianBlur, dilate, etc. for grayscaling, image blur and image dilation respectively.

Gray Scale

It is a process of converting multi-color images into shades of gray. The color ranges from complete black to complete white. We use the cvtColor() method to convert the image into grayscale.

ImageBlur

Here we use GaussianBlur. It is a mathematical function applied on an image in order to blur the image. Instead of the box filter, the picture is convolved using a Gaussian filter. The Gaussian filter is a low-pass filter that eliminates high-frequency components. You may execute this operation on an image by calling the imgproc class's Gaussianblur() function.

Dilation

Dilation is the process of adding pixels to the edges of objects in a picture. dilate() function is used.

B. Data Preprocessing

Data Preprocessing is a data mining technique which is used to transform the raw data in a useful and efficient format,

Techniques used for Data pre-processing are

Data Cleaning

Data cleaning is the process of detecting, rectifying, or removing inaccurate and corrupted information from the dataset or database. In addition, it recognizes inaccurate or unfinished parts of data, filling the missing ones, and removing the noisy data.

Data Integration

Data integration involves combining data residing in different sources and providing users with a unified view of these all data. Data integration may involve inconsistent data and therefor needs data cleaning.

Data Reduction

Data reduction involves reducing the number of attributes, attribute values, number of tuples.

C. EDA & Feature Engineering

Exploratory Data analysis is the technique for analyzing datasets to summarize the main characteristics. There are many tools that are useful for EDA. Typical graphical techniques used are: box plot, histogram, multi-vari chart, run chart, odds ratio etc. Interactive versions of these plots are Dimensionality reduction. Univariate analysis, Bi-variate analysis, multivariate comes under the exploratory data analysis.

Univariate analysis

Univariate analysis is the analysis of the single variable in this paper. We do analysis using Univariate analysis. Feature Engineering is the process of using domain knowledge to extract features from raw data. A feature is a property shared by independent units on which analysis or prediction is to be done.

III. IMPLEMENTATION

After processing the image and marking the parking slots, we feed this to the parking lot camera. According

to the occupancy the video output will be generated showing empty spaces and providing the count of empty spaces in the parking arena.

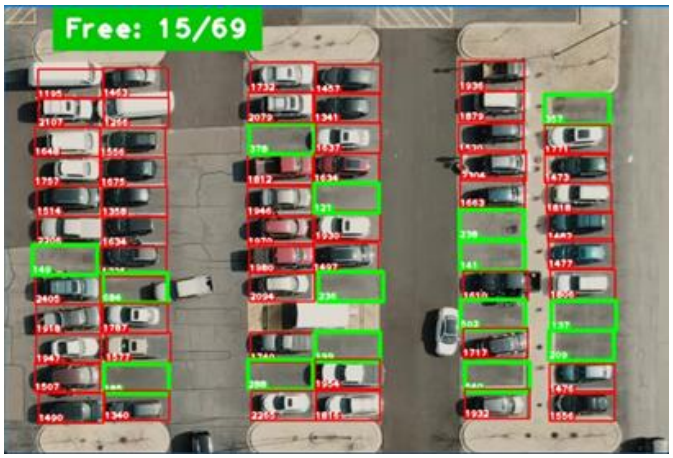

Fig 2. This is the sample output of the parking lot.

All the selected slots which are empty are marked in green color and occupied are marked red color. There is also a counter showing how many unoccupied spaces are present in the parking space.

To consider a parking space as occupied or unoccupied we consider the number of pixels in the grayscale image after dilation. If the number of occupied pixels in the selected rectangle slot are less than 900 we consider it as empty.

In this paper we also take car data entered into the parking lot in a day. The features of the data include car plate number, registration date, type of plate(such as private, taxi), vehicle body type, vehicle color, entry time into the parking lot and exit time.

Univariate Analysis

Univariate analysis of type of car plate

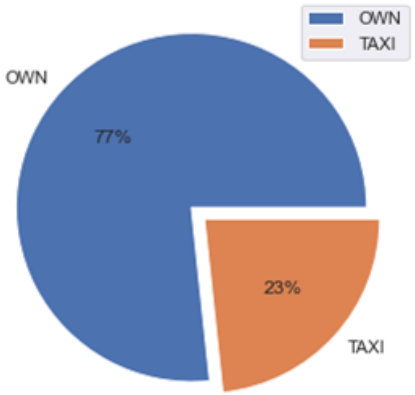

Fig 3. Based upon the type of car plate count, we plot pie chart.

With the help of Fig 3. we can analyze that almost 3/4 th of vehicles are private and the rest are taxi vehicles of the vehicles that entered parking arena that day.

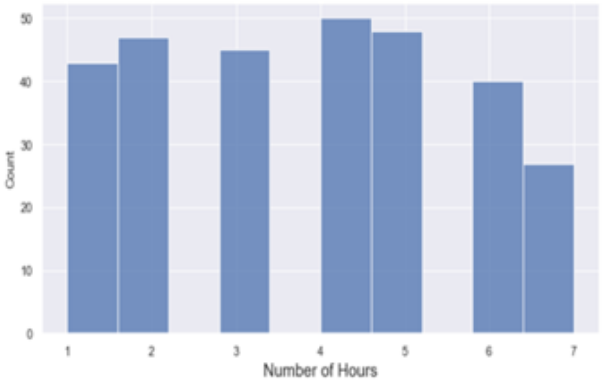

Fig 4. Based upon how much time cars stayed in the parking lot we plot histplot.

All the vehicles entered that day stayed varied amounts of time, we can say most of the vehicles stayed upto 4 hours by seeing the data visualized in Fig 4.

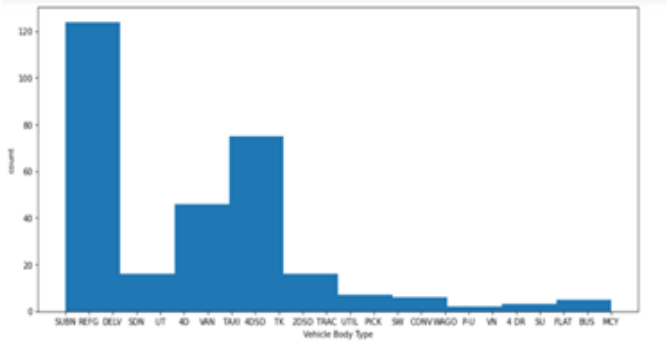

Fig5. Based upon the car type we plot countplot.

According to Fig 5. There are different types of cars such as sedan, SUV, van, bus, hatchback etc. out of which we can say the number of sedan cars are dominating.

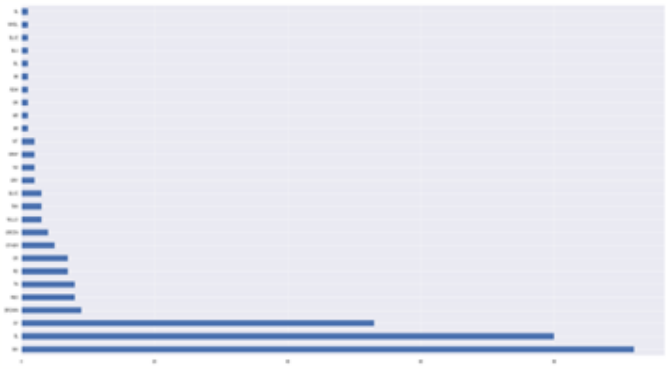

Fig 6. Based upon the car color we plot countplot.

Most of the cars entered that day into the parking lot are white in color.

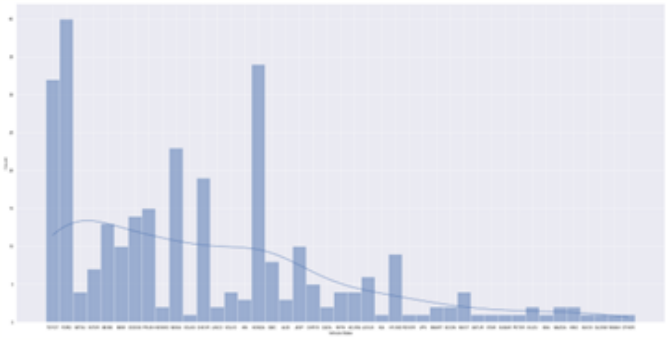

Fig 7. Based on the car model we plot a countplot.

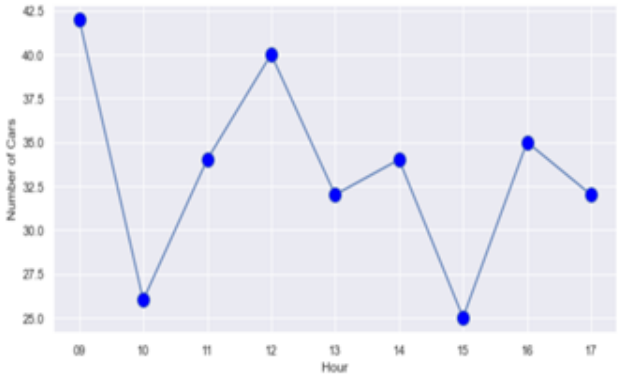

Fig 8. Based on the traffic in each hour of the day we plot a line plot.

IV. CONCLUSIONS

Using OpenCV, we found a solution to easily identify the empty spaces in the parking arena. This will be helpful for the vehicle driver to get to an empty parking slot without any hassle. We have also analysed the data of vehicles entered in a day in the parking lot and gained some valuable insights from that data which can be used in planning future decisions.

In this study it is quite evident that most of the cars stayed on an average of 4 hours in the parking lot and also we can find that the traffic is more in the morning hours compared to the rest of the day. This solution presents an important asset for parking lot vehicle management and this data analysis will be helpful for the parking arena owners to gain more profits and also helpful to attract more customers to park in their parking area.

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