PARKING SPOT DETECTION

Team 15

Abijith Velaga

Sai Rohini Yarlagadda

Rohith Jallipalli

Akash Karuturi

Introduction

The majority of parking lots are now maintained manually, with no automated monitoring systems in place to keep track of vacant parking places. This can force vehicles to circle the parking lot in quest of an open spot, especially in congested areas such as hospitals, malls, schools, and other big meeting places. Inefficiently managed parking lots can also lead to spots being occupied in such a way that they are nearly useless, causing traffic congestion around parking lots. To overcome these difficulties, we suggest a novel strategy for increasing parking lot efficiency. We can count how much space is available in each parking zone using a camera and image processing techniques and show that data to vehicles. This method provides for real-time updates since the status of the entire lot changes anytime a car enters or exits a specific parking zone. We can minimize the duration that drivers spend looking for a parking place and enhance overall parking space occupancy by providing them with up-to-date information on available parking spots.

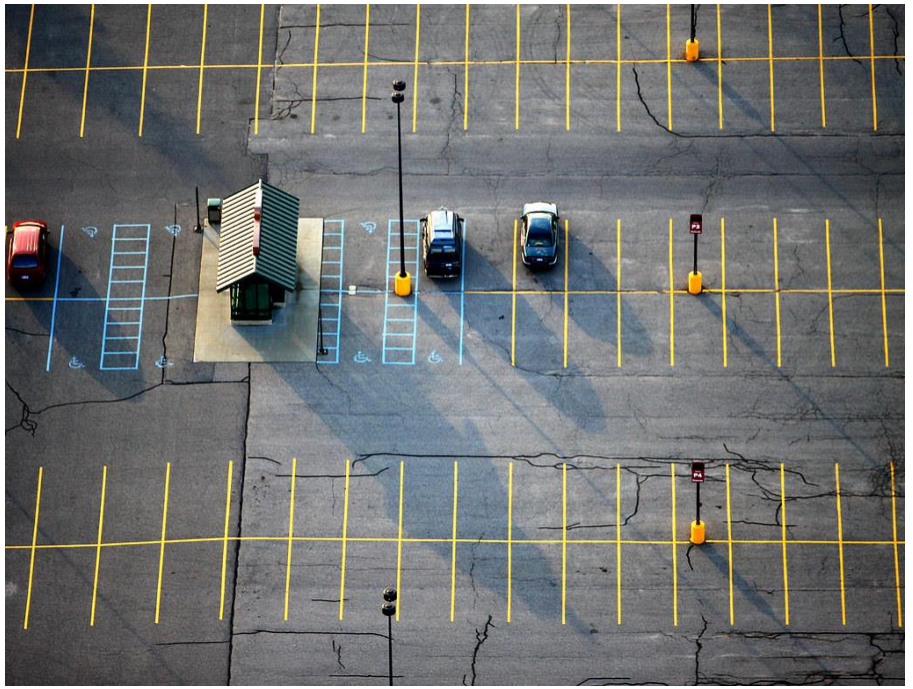
Problem

The act of manually parking vehicles in cities contributes to higher car emissions as drivers have to continuously circle city blocks in search of a parking spot. Additionally, it leads to increased traffic congestion due to a lack of sufficient parking infrastructure and adds to the daily stress associated with parking problems.

Approach

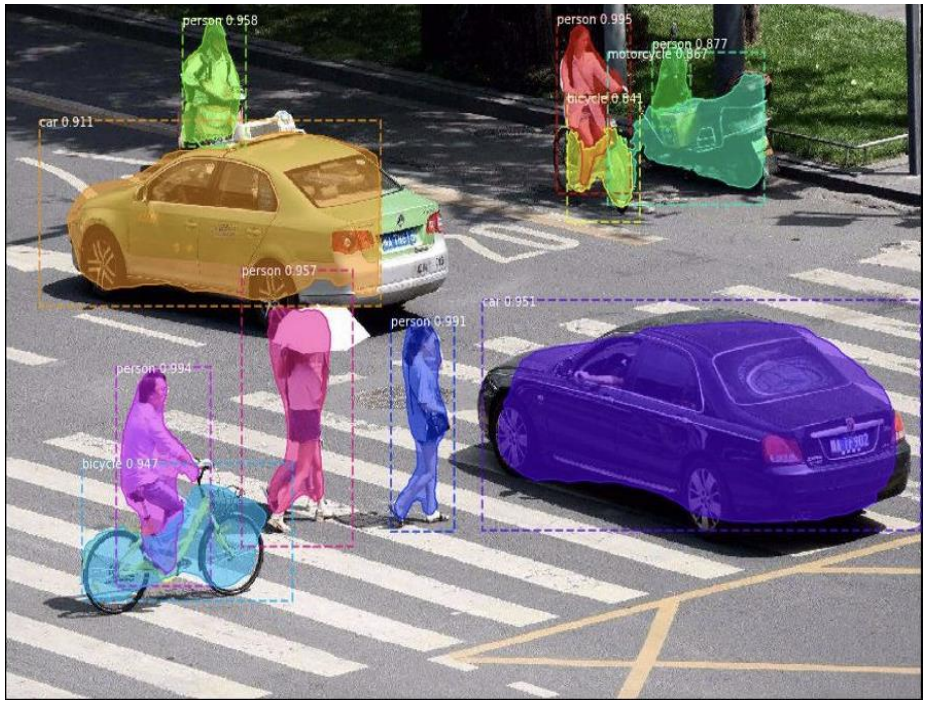
Detection of parking spots-

To begin, a parking space detection system must identify available parking spaces. There are a number approaches for doing this, such as detecting parking places by finding the parking lines in a spot using edge detectors provided by OpenCV. It is a popular open-source computer vision library that provides tools for image and video processing. As a result, we will use a frame from a video of a parking place to indicate the parking areas.

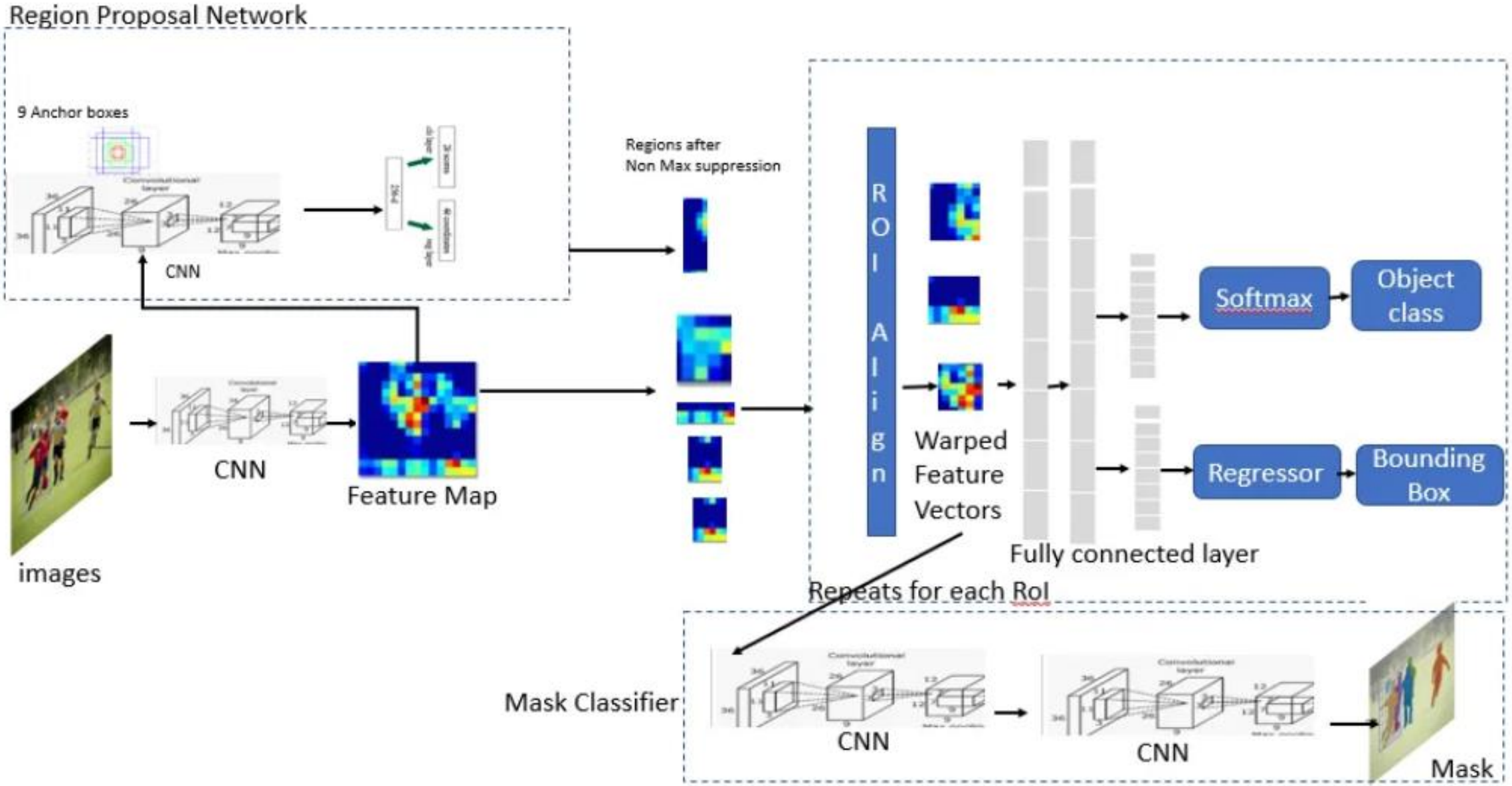


Detection of cars-

The Mask-RCNN will be used to detect automobiles in a video. It is essentially a convolutional neural network trained to recognize numerous objects and their borders on millions of photos and videos from multiple datasets, including the dataset. The Mask-RCNN object detection model is constructed on top of the Faster-RCNN object detection model.



Mask RCNN


Region Proposal Network
9 Anchor boxes
CNN
Regions after
Non Max suppression
images
CNN
Feature Map
ROI Align
Warped
Feature
Vectors
Softmax
Object
class
Regressor
Bounding
Box
Fully connected layer
Repeats for each RoI
Mask Classifier
CNN
CNN
Mask

How does MaskR-CNN work?

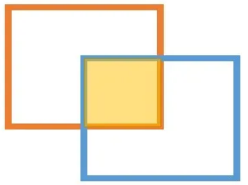
- Image is run through the CNN to generate the feature maps.
- Region Proposal Network(RPN) uses a CNN to generate the multiple Region of Interest(RoI) using a lightweight binary classifier. It does this using 9 anchors boxes over the image. The classifier returns object/no-object scores. NonMax suppression is applied to Anchors with high objectness score
- The RoI Align network outputs multiple bounding boxes rather than a single definite one and warp them into a fixed dimension.
- Warped features are then fed into fully connected layers to make classification using softmax and boundary box prediction is further refined using the regression model
- Warped features are also fed into Mask classifier, which consists of two CNNs to output a binary mask for each RoI. Mask Classifier allows the network to generate masks for every class without competition among classes

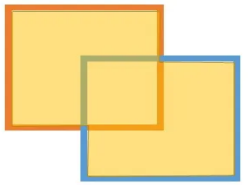
Calculating Intersection Over Union (IoU)-

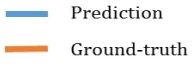
IOU stands for Intersection over Union. It is a metric used to evaluate the performance of object detection algorithms, including the detection of parking spots.

As its name suggests it the ratio of the **area of overlap** and **area of intersection.** Computing Intersection over Union can, therefore, be determined via

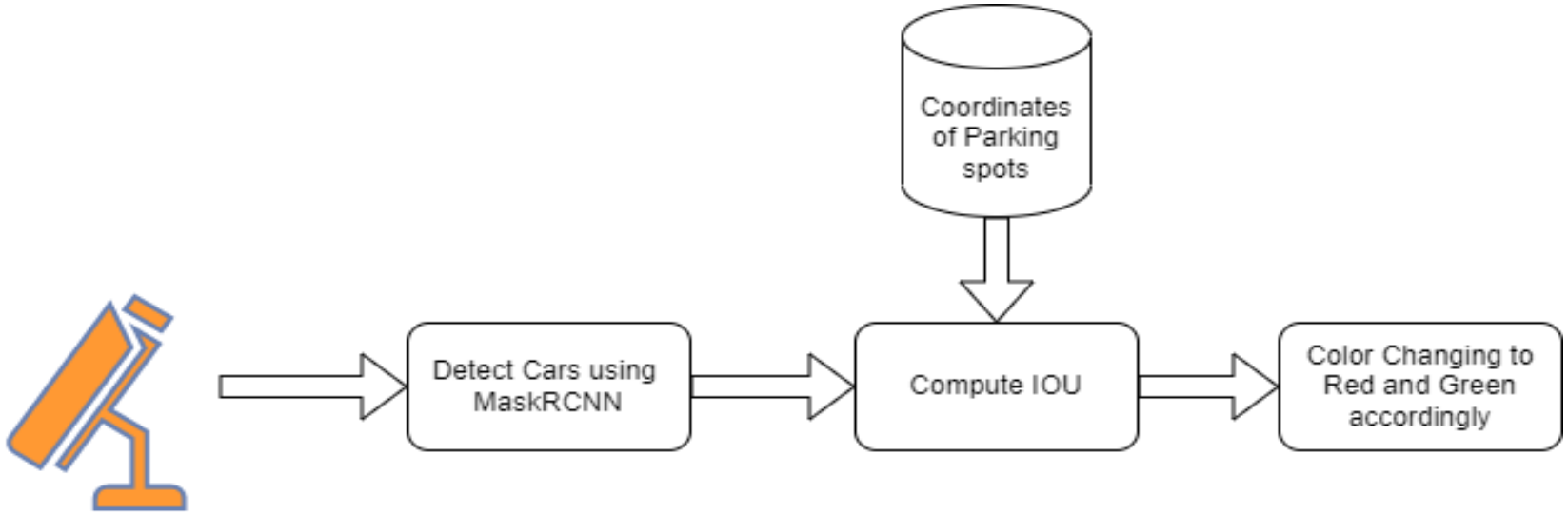
$$Intersection\ over\ Union\ (IoU) = \frac{Area\ of\ Overlap}{Area\ of\ Union}$$







Architecture



Overview of the System

Dataset

The UFPark dataset is a parking lot occupancy detection dataset that contains 14,200 images of parking lots with varying levels of occupancy, captured from different angles and viewpoints. The dataset is labeled with information about the number of available and occupied parking spaces, as well as the location of each parking space. This dataset is commonly used in research related to parking management and vehicle detection.

The dataset was created by researchers at the University of Florida to serve as a benchmark for parking lot occupancy detection algorithms. It is often used in the evaluation of machine learning models and computer vision techniques for parking lot monitoring and management. The UFPark dataset is available for free download on the official UFPark website, along with additional information about the dataset and its properties.

The primary objects in the UFPark dataset are vehicles parked in various spaces within the parking lot. The dataset also includes other objects that may be present in a parking lot, such as trees, poles, and other stationary objects. These objects serve as potential obstacles to vehicle detection and can be used to evaluate the accuracy of object detection algorithms. The UFPark dataset is a valuable resource for researchers and developers working on parking management and vehicle detection systems, allowing for the development and evaluation of algorithms that can accurately detect parking occupancy and locate individual vehicles within the parking lot.

Demo

Conclusion

- In this project, we have explored how to use a Mask-RCNN to make a simple parking space detection system. The only reason we have used Mask-RCNN for this project because of higher accuracy. On a single GPU, it can process around 4–5 frames per second. For a better frame rate, you can go for the YOLO object detection model. YOLO is significantly faster than M-RCNN but, it is less accurate compared to M-RCNN.

Future Work

- Integration with mobile apps: The system can be integrated with a mobile application that allows users to find available parking spaces, reserve them in advance, and pay for them through the app. This can increase convenience for drivers and reduce the need for manual billing.
- License plate recognition: The system can be enhanced to use license plate recognition technology to track the entry and exit of vehicles, and to automatically bill users based on their parking duration.
- Integration with traffic management systems: The system can be integrated with traffic management systems to provide real-time traffic updates and optimize traffic flow in and around the parking lot.
- Multilevel parking system: As mentioned in the initial proposal, the system can be further developed to support multilevel parking structures, where vehicles are automatically parked and retrieved using robotic systems. This can further reduce traffic congestion and increase parking capacity.


THANK YOU