Team Name

Steins Gate

JIO ARTIFICIAL INTELLIGENCE HACKATHON

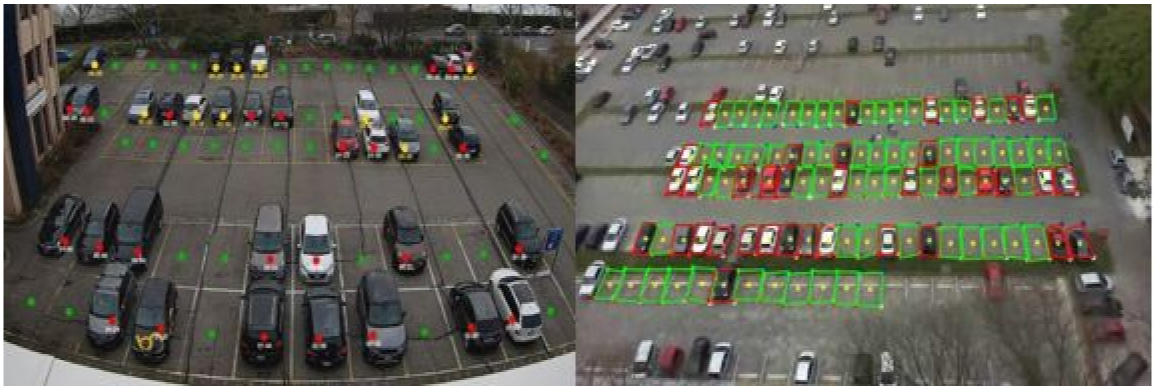
Finding a parking space is quite often frustrating, time consuming and scarcity of the same is a disturbing fact in fast growing metro cities. Even if you are lucky enough to find a parking slot, you might still find yourself in a bit of pickle to get your car out. More than being a mere headache for drivers parking space problem is now considered as an issue of major environmental concern at a global level. Daily search for a parking lot by drivers burn millions of barrels of world's fuel.

Automated parking spot detection is not a new concept, it has been around for some time, mostly based on costly sensors. With recent advent in the field of V2V and self driving cars, efficient parking solutions are a necessary outcome.

With the sudden and huge improvement in the fields of deep learning and computer vision, it's natural to attempt to tackle the problem with these tools. As part of Jio TechGig Code Gladiators, we, a team of three self motivated engineering students, are coming up with a solution to the problem.

Problem Statement

Given an aerial view of a parking lot, extract parking lots and get info about occupancy of the lot.



Our Approach

The problem statement can be interpreted in two different ways:

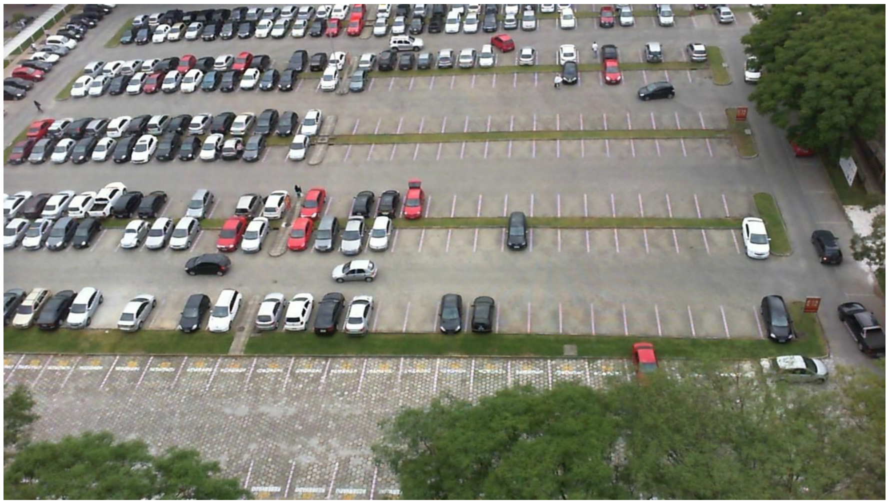
1. Input : Parking lot location precoded (coordinate for the boxes)
   Output : occupancy info for each box

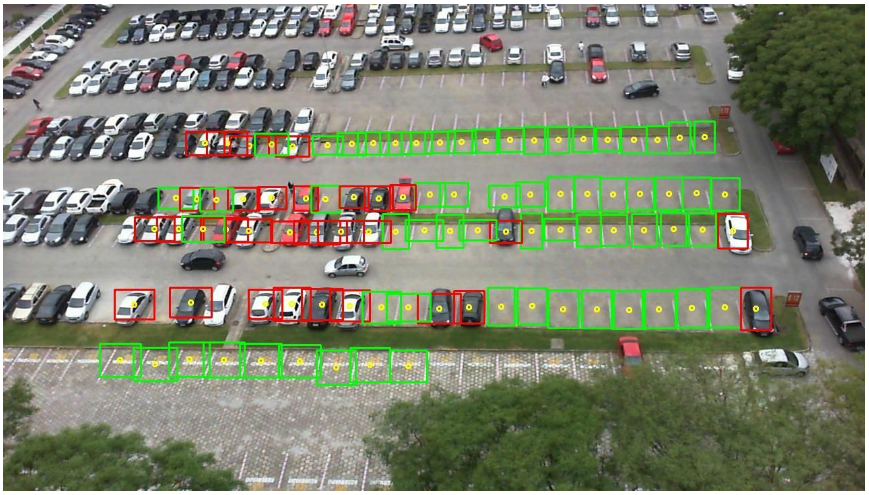
2. Input : Aerial view of a parking lot
   Output : Detection and localisation of parking lots and occupancy info of the detected lots.

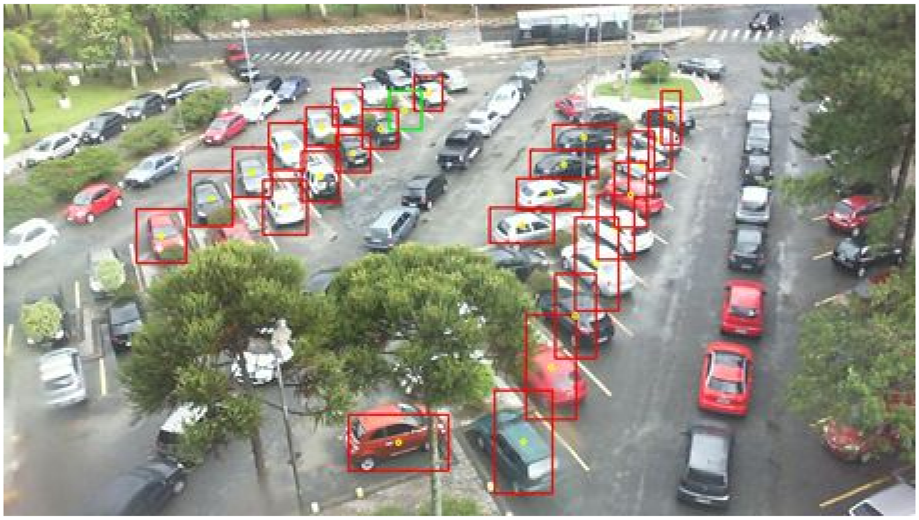
The first choice is easier than the second as if we already have locations of the boxes then it's essentially a binary classification problem to detect if spot is filled by a vehicle or not. And since datasets like ParkLot[1](Segmented), CNRPark[2] already provide enough images for the task it's only a matter of training an established object detection network on top of it.

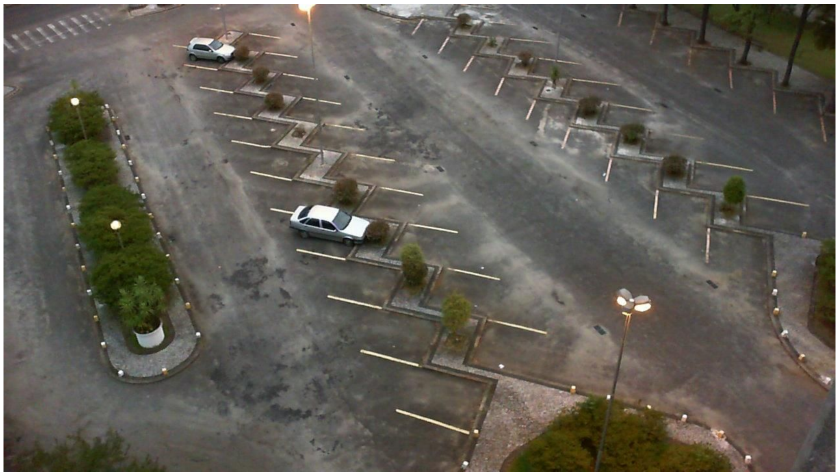
For this hackathon we decided to go with the second approach as we couldn't find many literatures which does both localization and detection and we wanted our approach to be as general as possible.

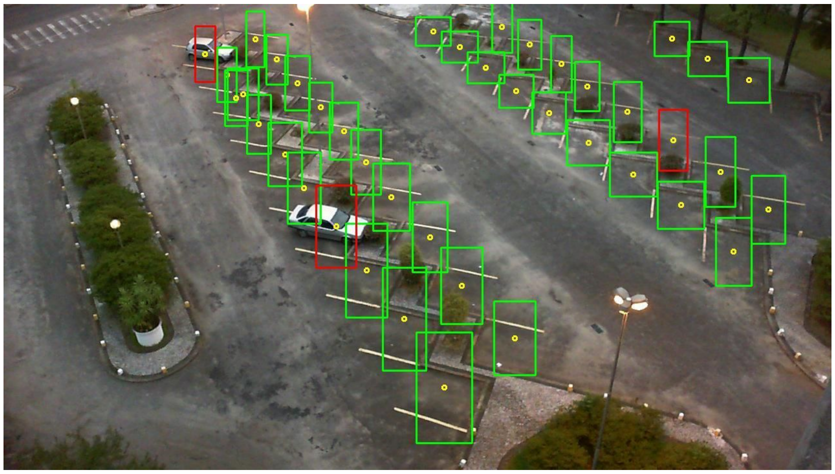
Examples of model outputs:











Technical Aspects

Since the problem at involves both detection and localization our first line of thought was to try to train models like SSD, R-CNN and we finally went with YOLOv3[0] as its fast and the problem statement requires real time processing.

A YOLOv3[0] model was trained on publicly available dataset ParkLot[1]. The dataset contains both segmented and whole parking lot and we have used only the snapshots of the whole parking lot. Since the model is predicting both lots and occupancy info, we didn't use the segmented files. The dataset also contains xml files for each image, containing bounding box parameters (centre, height, width). But not all the bounding boxes have occupancy info and dataset was filtered and preprocessed accordingly.

YOLOv3[0] was trained using Darknet[3] framework. Instruction and details are attached in the markdown file *' ParkiLot_YOLOv3.md '*.

Challenges and possible improvements

- The model does well in predicting whether detected boxes are occupied or not, but fails in detecting all of the lots, this might be due to the fact that not all of the parking lots are not labelled in the training set.
- A completely labelled dataset might solve the above issue
- On deployment we think that it's best to hardcode the locations of parking lots and run the binary classification problem, not only does it guarantee an improved accuracy, it'd also be better at inference time; as the said model would have to do less compared to the current model.
- Occlusion : the model fails to detect a spot when its occluded by trees or other objects in the frame.

Why our team is the best

The given problem of parking lot detection and management, is undoubtedly handled best by us, Steins Gate. We are a team of three engineering undergraduate students from India's premier Technical institution, IIT Madras, with different specializations. We can take the problem statement further by optimising all stages of the project, starting from data collection as our expertise extends from Artificial Intelligence to IoT, Mechatronics and Engineering Design. Lack of proper training dataset is in fact a major issue faced in this particular problem statement as we mentioned above.

Further, with our previous experience in V2V projects and android app development, we plan a project through which all registered vehicles can be united in an app (car number being used as unique I_D) , showing details of parking lots, allowing pre-booking of parking lots for a nominal fee, also notifying drivers of erroneous parking. Increased security is a serendipity of this solution.

With all this,Steins Gate is a team of vision, aiming at a hassle free and smart city life.

Associated Attachments and Files

- darknet
    - Directory containing files for inference using darknet framework
- detection.py
    - Interface file for the model
    - Eg:-
        - *python detection.py --image=path/to/single_image*
        - *python detection.py --images_dir=/path/to/directory/containing/images --save_dir=/path/to/save/predictions*
    - Note : The parameters under the comment '*tunable params'* in the file must be set accordingly
- test_images
    - Directory containing few test images
- data_utils.ipynb
    - Jupyter notebook to extract data from ParkLot[1] in proper format
- readme_yolov3.md
    - Markdown file containing instructions to setup darknet

References

[1] PKLot dataset

[2] CNRPark dataset

[3] Darknet

[4] YOLO