RUMMAGING FREE PARKING SPACES USING MASK R-CNN

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Abstract

What's one thing we all city folks witness in our day-to-day life? Yes, that's right it's Traffic, and one of the main reasons for that is the inconvenient way of parking vehicles, leading to more congestion on roads. The rise of car ownership has created an imbalance between the parking demand and supply. Parking spaces are expensive to build and the parking fee is hiking up day by day. It is hard to enforce and drivers spend an excessive amount of money and time in search of vacant lots. Here, we are proposing a project where our main goal is to detect occupied and empty parking spaces. This project develops a smart parking system through video data analysis using deep learning techniques that automatically determine the availability of vacant parking spaces. For automatic recognition of parking spaces, we are using the Mask R-CNN architecture, on data obtained from video footage. We are using a Preprocessed Region-based Convolutional Neural Network (Mask R-CNN) to mark the parking position on the input image of a full parking lot. And all this can be done with something as simple as a smartphone camera and can notify the user when a parking space is available, via a text message. At the end of the day, we intend to give the best solution for all the parking problems faced in our local area at the least.

Keywords: *Parking Space Detection, CNN, Mask R-CNN, COCO Dataset, Detection.*

I. INTRODUCTION

Finding a parking spot nowadays increases our anxiety level. Most of the time we get stressed out looking for a free space to park in. After putting in a lot of effort and precious time we get a spot. Thus this trouble is not worth it. As we are heading towards a mission of Smart cities we shall make our parking systems smart too. It is claimed that the world population in urban areas is expanding and the forecast is that 68% of the global population will live in cities by 2050. Streamlined parking is the only way to solve our future problems.

There are many parking spots which are not available most of the time, like shopping malls, tourist places, educational institutes, famous religious places, etc. Even if the spots are vacant we are not aware of them and hence either cancel our visit or roam here and there in search of free parking spots.

Thus, to ease up the situation and provide a helping hand, we can use a novel system where one can be notified about a free parking space through a simple text message. We proposed a parking-slot detection approach based on deep learning. Our occupancy detection process involves the segmentation of an image by using the Mask R-CNN algorithm. This would detect the cars in the parking lot and determine if the parking spot is free or not. The Mask R-CNN algorithm, which is qualified with the COCO dataset has more than 12,000 images of cars along with other objects would help us to determine the vehicles already parked in a spot.

II. EXISTING WORK

Harshita Bura et cetera all[1], offered a way of the usage of digital digicam networks. The complete gadget includes a community of floor cameras to seize license plates, a community of pinnacle view cameras to cowl the complete vicinity of the automobile parking space, gadgets like Nvidia Jetson and a Raspberry Pi. The gadget additionally protected a cloud server and a database to save the statistics approximately the occupancy of the parking slots. All this became related the usage of an internet web page which might show all of the important and applicable statistics

Giuseppe Amato et cetera all[2], proposed a way to run the detection gadget absolutely on clever cameras. A Raspberry Pi module ready with a widespread Raspberry Pi digital digicam. A deep convolutional neural community, referred to as AlexNet is used. The structure includes 60 million parameters and 500,000 neurons. Five convolutional layers, observed via means of max pooling layers, and absolutely related layers with a 1000-manner softwax.

Fabio Carrara et cetera all[3], proposed a way of the usage of exceptional CNNs. The skilled community was then used to determine approximately the occupancy reputation as acquired via way of means of the video digital digicam. The image of the automobile parking space became captured periodically and used to educate the neural community. The image became filtered via means of masks for parking spaces. The masks became constructed as soon as manually

Xuemei Xie et cetera all[4], proposed a way the usage of SSD(Single Shot Multibox Detector) for detecting items the usage of an unmarried deep neural community. It is capable of stumbling on items in snapshots without extracting the place proposal, warding off the downside of the historical past segmentation. There are hard and fast default bins with more than one element ratios at every location.

III. DEEP LEARNING FOR PARKING OCCUPANCY DETECTION

1) DEEP LEARNING: Deep learning consists of numerous layers of nonlinear nodes, combining a computer file with a group of weights in order that assigning importance to inputs for the corresponding project the set of rules is making an attempt to be instructed in supervised and/or unsupervised behaviour. The sum of the manufactured form that enters and weights is surpassed through the activation characteristic of nodes. The output of each layer is fed concurrently as input to the following layer starting from the enter layer. Learning is frequently finished in a couple of tiers of representations that correspond to several tiers of abstraction[6]

2) MASK R-CNN : Mask RCNN is a deep neural community aimed to resolve example segmentation issues in device mastering or laptop vision. There are ranges of Mask RCNN. First, it generates proposals approximately the areas wherein there is probably an item primarily based totally at the enter photo. Second, it predicts the elegance of the item, refines the bounding container and generates a masks in pixel stage of the item primarily based totally on the primary degree proposal. Mask R-CNN no longer requires a massive quantity of records for schooling the neural community. Mask R-CNN is a great desire that mixes the accuracy of CNNs with smart layout and performance hints that significantly accelerate the detection process. This will run exceedingly fast (on a GPU). The Mask R-CNN structure is designed in one of these ways, wherein it detects gadgets throughout the complete photo in a computationally green manner. In different words, it runs pretty quickly. In addition, Mask R-CNN offers us masses of data for approximately every detected item. Most item detection algorithms simply go back to the bounding container of every item. But Mask R-CNN will now no longer simplest deliver us the region of every item, however it'll additionally deliver us an item outline (or masks)

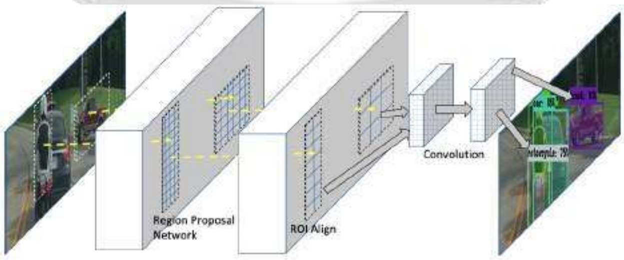

Figure 1: Architecture of Mask R-CNN.

3) COCO DATASET: Dataset for the training is obtained from a popular dataset called COCO(Common Objects in Context). The COCO dataset contains images annotated with object masks. The dataset contains more than 12,000 images of cars which are already outlined. COCO is a large-scale object detection, segmentation, and captioning dataset. COCO has several features: Object segmentation, Recognition in context, Superpixel stuff segmentation, 330K images (>200K labeled), 1.5 million object instances, 80 object categories, 91 stuff categories, 5 captions per image, 250,000 people with keypoints. COCO categories: person bicycle car motorcycle airplane bus train truck boat traffic light fire hydrant stop sign parking meter bench bird cat dog horse sheep cow elephant bear zebra giraffe backpack umbrella handbag tie suitcase frisbee skis snowboard sports ball kite baseball bat baseball glove skateboard surfboard tennis racket bottle wine glass cup fork knife spoon bowl banana apple sandwich orange broccoli carrot hot dog pizza donut cake chair couch potted plant bed dining table toilet tv laptop mouse remote keyboard cell phone microwave oven toaster sink refrigerator book clock vase scissors teddy bear hair drier toothbrush.

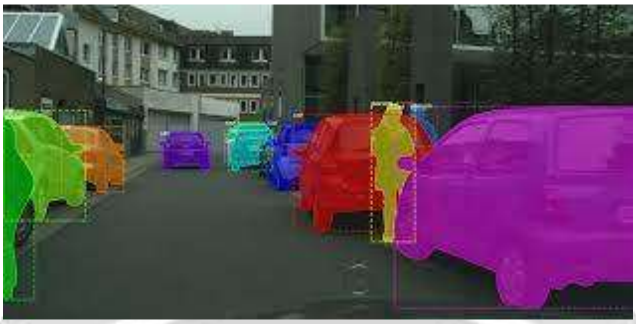

Figure 2: Object detection using COCO Dataset

IV. MODULES

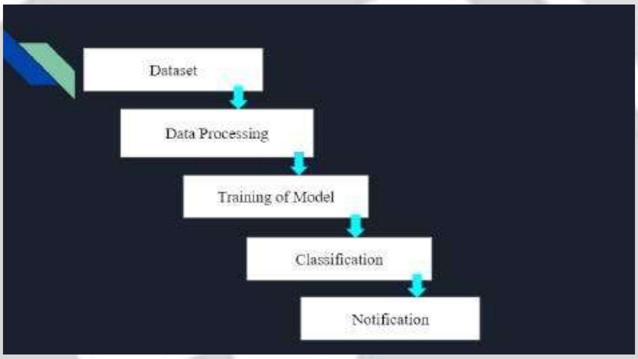

Figure 3: Project Modules

DATASET: Dataset for the training is obtained from a popular dataset called COCO(Common Objects in Context). The COCO dataset contains images annotated with object masks. The dataset contains more than 12,000 images of cars which are already outlined.

DATA PROCESSING: The datasets will be divided into different groups and frames that are required for the next step, that is, Training of the model using different networks. We use TensorFlow and Keras , both of which are Python libraries. Keras is a neural network library while TensorFlow is an open-source library for a number of various tasks in machine learning.

TRAINING OF MODEL: Deep Learning consists of numerous layers of nonlinear nodes, combining a computer file with a group of weights in order that assigning importance to inputs for the corresponding project the set of rules is making an attempt to be instructed in supervised and/or unsupervised behaviour. The sum of the manufactured form that enters and weights is surpassed through the activation characteristic of nodes. The output of each layer is fed concurrently as input to the following layer starting from the entered layer. Learning is frequently finished in a couple of tiers of representations that correspond to several tiers of abstraction.

CLASSIFICATION: Mask R-CNN is a deep neural community aimed to resolve example segmentation issues in device mastering or computer vision. First, it generates proposals approximately the areas wherein there is probably an item primarily based totally at the entered photo Second, it predicts the elegance of the item, refines the bounding container and generates a masks in pixel stage of the item primarily based totally on the primary degree proposal. Mask R-CNN is a great desire that mixes the accuracy of CNNs with smart layout and performance hints that significantly accelerate the detection process.

NOTIFICATION: After the above mentioned steps, we will use the results in notifying our users by sending them a message using the
Twilio API.

V. IMPLEMENTATION

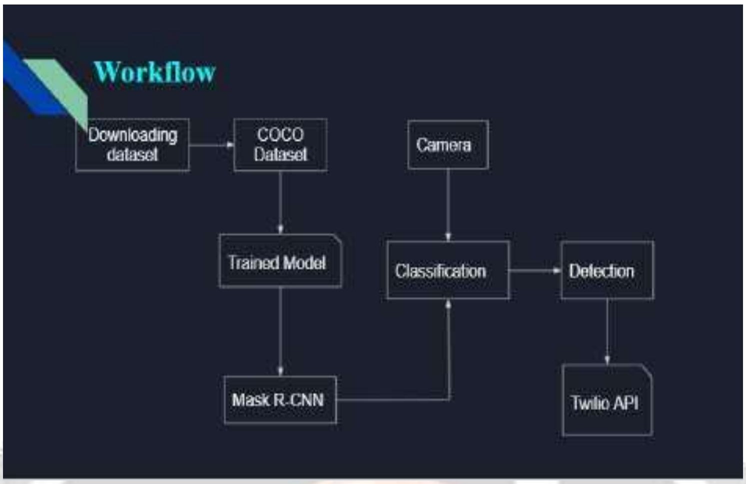

Figure 4: Implementation Workflow

In this method, we are proposing to use a system which does not have much requirement in the hardware section. Our method should work effortlessly with softwares only without relying much on the hardware components. Our secondary aim is to inform the user of a free parking space. The dataset is downloaded from COCO datasets. The data is pre trained, if not pre trained then they are fed into the training model. The trained data is then used for the classification using the Mask R-CNN architecture. The video from the camera is fed into the classification so that it is easily detectable by the detection system. After everything is a success a notification is sent to the user using the Twilio API.

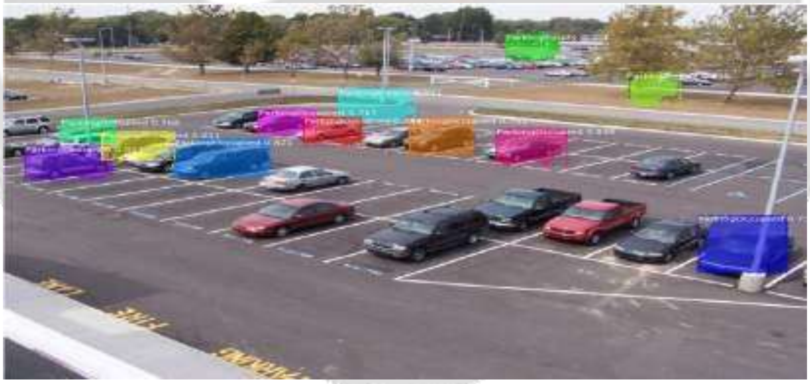

Figure 5: Parking Space detection using Mask R-CNN

FLOW DIAGRAM:

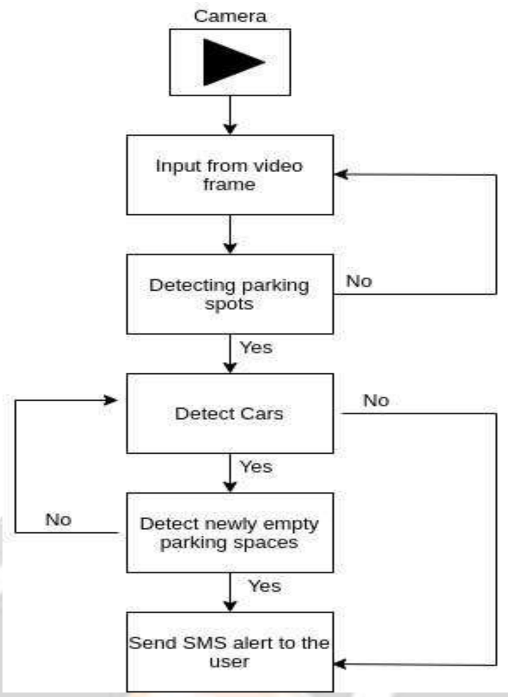

Figure 6: Flow diagram for the detection system.

In the first stage, the video footage from the camera is fed into the neural network. The network then detects the valid parking spaces by analysing various conditions. Upon detecting a valid parking the algorithm detects if a parking space is free or not. If it is free then the user is notified by a message on their phone and if not then the algorithm keeps on checking for a free space.

VI. RESULT

Our project does not need to use any testing or training datasets, therefore it is difficult for us to calculate an accurate efficiency for our project. Since we have used a pre-trained model it comes with an efficiency of 73.73%. Our project will keep on improving in efficiency with more uses.

Projects	Efficiency
Rummaging free parking spaces using Mask R-CNN and COCO Dataset (Our Project)	73.73%
Parking occupancy detection using Deep learning	96.65%
Illegal parking detection using deep learning	99%(On their own videos)
Parking occupancy detection using smart camera networks and deep learning: 1) Single camera setup 2) Multiple camera setup	89.8% 90.7%

Table 1: Comparison of Results

Figure 7: A parking lot with few empty spaces

Figure 8: Detecting empty parking space

Figure 9: Empty parking space detected

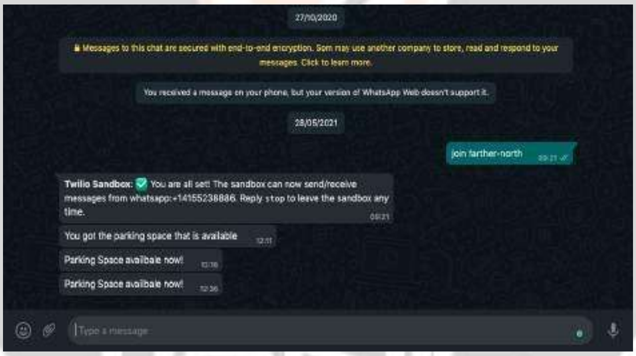

Figure 10: Notification received by Twilio

VII. CONCLUSION

By analysing the existing methods, it has been observed that these methods require a hardware device like a Raspberry Pi and a smart camera. The data sets required for training in some of these methods are also manually entered. These methods don't have any implementation for alerting the user of a free space. Our approach is to have a method which does not require much in the hardware department. A method that is fast and efficient to detect the objects even with high resolution video feed. Mask R-CNN can be used to achieve our goal. Though for better accuracy Mask R-CNN needs to be trained more and if possible needs to be improved or combined with some similar architecture.

VIII. REFERENCES

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