

VEHICLE SLOT DETECTION AND SMART PARKING SYSTEM USING MACHINE LEARNING

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Abstract- Parking space detection is a major challenge in our cities and drivers waste time when moving from one place to another in search of a free parking space. The current parking space detection systems available are based on sensors which are costly to install and maintain. The sensor systems cannot also be used outdoor environments such as in cities as the sensors can be stolen or vandalized. This study compared the performance of M-RCNN and YOLO algorithm which are a deep learning algorithm used to classify images. YOLO was seen to be the best to use in this study because it was able to run under low comping resources and give accurate predictions. It was thus used to develop a prototype that was used for detecting the status of parking slots as either empty or occupied. The solution was verified by feeding it with a parking area video stream that had vehicles coming and leaving the parking area and monitoring how well its able to identify the vehicle objects from other objects and how well it is able to predict the status of a parking area as either vacant or occupied

Keywords- Parking Slot, Deep Learning, Automated Parking, CNN, Mask R-CNN, YOLO, Image Processing

I. INTRODUCTION

In the present scenario around us we see excess vehicles and the ineffectiveness to manage them in the correct order. As the population increases day by day the rate of utilization also increases and coping up with the numbers becomes a task. An omnipresent problem around the world is finding a parking space to park your vehicle. This task looks simple on side roads and interior lanes but the actual problem arises when parking in malls, multi store parking structures, IT hubs and parking facilities where several hundred cars are parked and it becomes arduous to find a spot. The general approach to finding a parking space is to go around and drive aimlessly until a free space is found. Finding a

parking space could be the easiest task or could be the most tedious one when it involves wide acres of distributed space across one level or multiple levels. The time and fuel are consumed unnecessarily because the destination is unknown. The easiest way of approach is to provide a destination specific driving within the parking structure. Identification of parking spots in cities is a challenge especially during peak hours when people are reporting to work. An average of 7-8 minutes is spent by people cruising for a parking spot in the city which contributes to 30% of the traffic in the cities. Most Motorists who park their vehicles in Nairobi Central Business District are forced to wake up early so that they can find uncopied parking spots. To alleviate this problem, suggestions on how to solve city parking spots have been given but majority have not been effective. An example, in Nairobi City, it had been suggested that parking fee should be doubled so as to make people leave their cars at home but the proposal was rejected by the courts (Mediamax Network Limited, 2019).

II. AIM & OBJECTIVE

To Provide the parking space for the people in the less possible time.

- To investigate the application of computer vision technologies in parking space detection.
- To investigate features of machine learning algorithms such as Region Based Convolution Neural Network, Faster R-CNN and YOLO algorithms on accurate detection of cars and parking spaces.
- Implement a prototype based on the above model for automated and real time parking spot detection.

III. EXISTING SYSTEM & ITS LIMITATIONS

Many large cities face the dire problem of providing available parking spaces to their citizens at the peak hours of a day. As a result, citizens spend a massive amount of time searching for the perfect parking space or waiting in line to get one. This, in turn, creates traffic congestions. Considering the problems, many researchers have suggested different SPS approaches and technologies to mitigate this problem. A Car Parking Framework (CPF) based on IoT has been proposed in.

LIMITATIONS

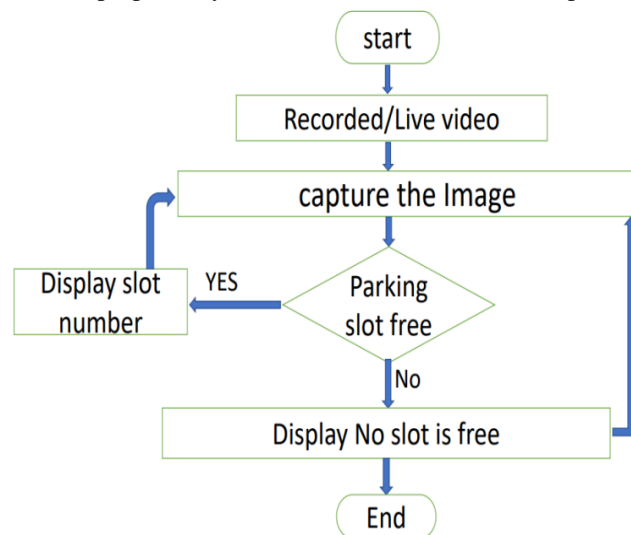
- The framework combines an automatic car parking management system with the integration of networked sensors and actuators along with Radio Frequency Identification (RFID)
- The CPF provides vehicle guidance, payment facilities, parking lot retrieval, and security

- The system uses a hybrid communication method instead of regular nodal communication. Due to that, the system has a low energy consumption rate with low implementation costs.

IV. PROPOSED SYSTEM & IT'S ADVANTAGES

In this paper, we propose We proposed to include deep learning algorithms such as Convolutional neural network (CNN), It is a type of Artificial Neural Network in image recognition and processing that is specifically designed to process pixel data.

- By using this algorithm we will get more accuracy when compared to other algorithms.
- In our proposed system we will follow different steps.



V. STUDY OF THE SYSTEM

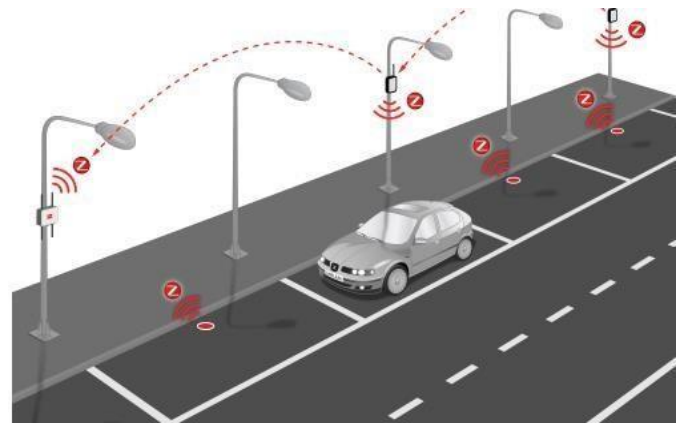
Counter based Systems

The counter-based systems work by having sensors at the entry and exit places of parking areas. These systems count the availability of parking spaces by getting the difference between the cars counted at the entrance and the cars counted at the exit place of the parking place. The difference gotten is then subtracted from the total parking space which gives the count of available parking spaces in the parking area. In case the count of available

spaces is zero, then the entrance does not open until there are available parking slots. This method however cannot be applied on street parking spot detection.

Sensor Based Systems

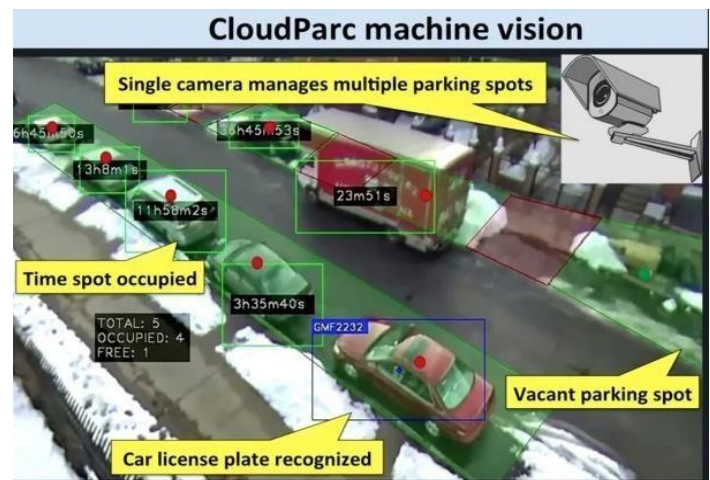
Sensor based systems (Wireless sensor and wireless magnetic sensor-based systems) use infrared light, ultrasonic or wireless magnetic sensors that are deployed on every parking space (Ichihashi, 2016). This technology has worked well in shopping malls and private parking spaces; however, the



technology is expensive due the high cost of the sensors installations required. The technology is not also applicable in street parking as the sensors can be vandalized or stolen.

Vision Based Systems

Vision based systems rely on the use of cameras to detect images and deep learning to train the models to be able to detect parking spaces which are empty and which have been occupied. According to (Girshick & Donahue, 2015), research has been done



on object detection and model training to enable accurate detection of objects. There is also more data on objects which allows better training of models for better prediction (Girshick & Donahue, 2015).

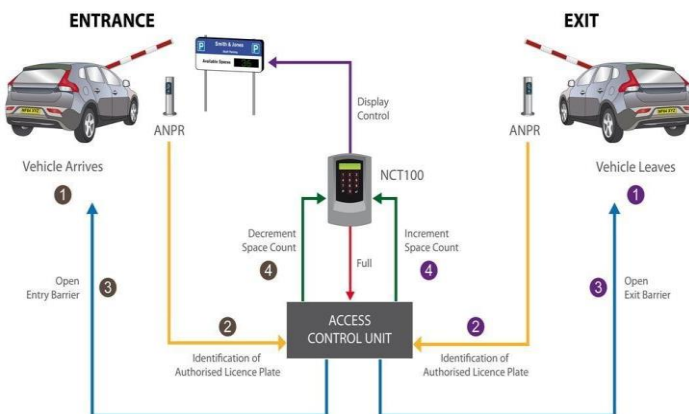


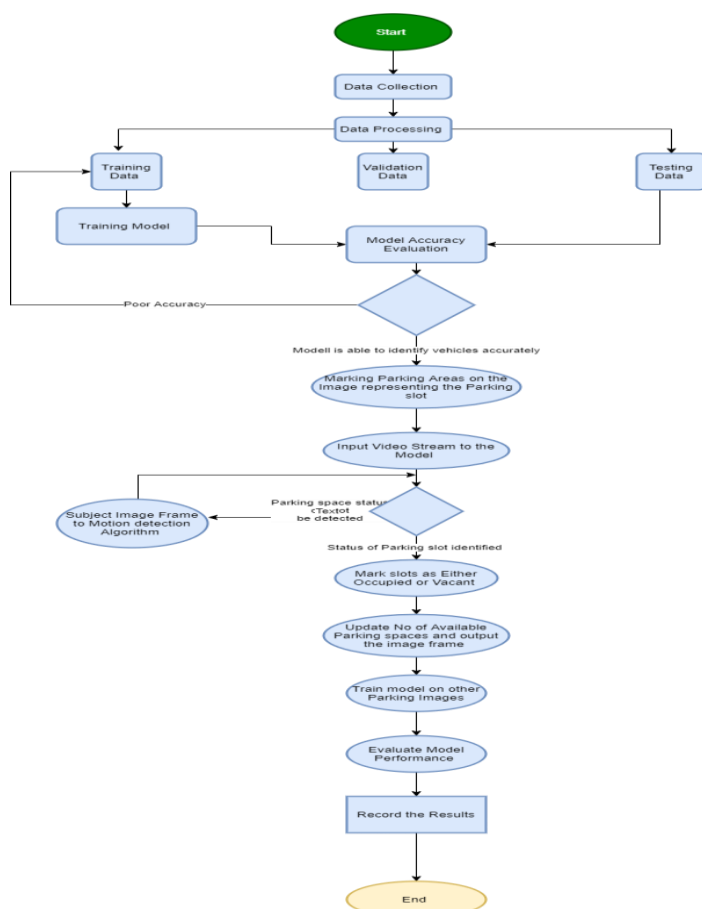
Image Processing

This refers to the process of object manipulation so as to extract areas with objects in the image. Different techniques are used in image processing and they include

Image Difference: This is the process of comparing two images so as to determine the differences in the images. This is however affected by changes in lighting conditions and environment climate change. This technique will be important in the parking slot system as it will help to train the model on parking spaces which have been occupied and those which have not been occupied.

VI. SYSTEM ARCHITECTURE

The complete working procedure of the project.



VII. SYSTEM DESIGN

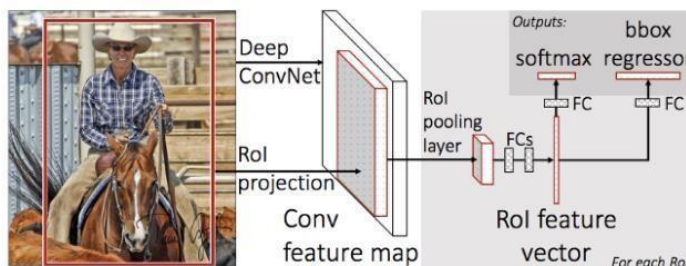
System design shows the overall design of system. In this section we discuss in detail the design aspects of the system.

METHODOLOGY INVOLVED IN THIS PROJECT

Convolution Neural Networks: This is a class of deep learning networks which take image as an input and assign various weights on the image so as to be able to differentiate it from another image (Nielsen, 2015). With proper training, convolution neural networks are capable of doing the learning themselves. The network is divided into neuron layers where each layer passes information to the next layer in a process known as feed-forward process. Network training is done through giving the network a large input of the same image so that it can be able to correctly categorize the image. If the network gives a wrong prediction, supervised learning is applied to train the network

Region Based CNN (R-CNN)

This is an improved CNN algorithm that is concerned with selecting the areas that one is interested with on an image (Malik, 2016) and trying to do classification on those areas and not the whole image



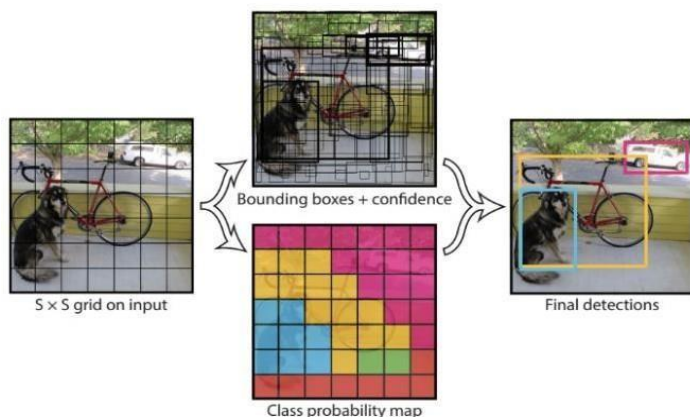
Mask RCNN

(Rahul K. Kher, 2017) describes Mask RCNN as a deep neural network algorithm that achieves object detection through segmenting objects in an image or video. The algorithm detects the bounding boxes, masks and image classes of objects in an image frame. Generation of proposals on area where images might be in an image frame is the first step on how the algorithms works. Class prediction of objects identified in an image follows as the second process, where it refines the bounding boxes and masks are generated in pixel level of the detected object.

YOLO

YOLO technique (You Only Look Once) is an object detection algorithm that is based on the use of a single

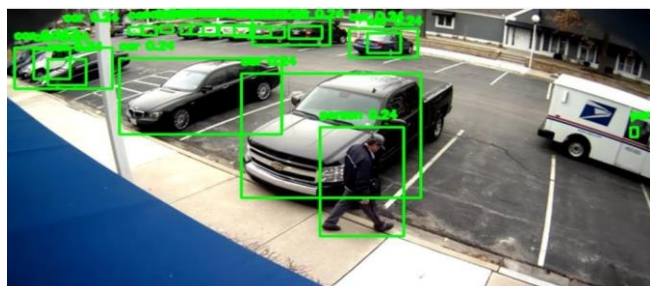
convolutional network to determine the bounding boxes and the classes of the boxes in an image (Malik, 2016).



Research Design

(Uma Sekaran, 2016) describes research design as a blueprint for collection and analysis of data that is created to answer questions that guide the research. It articulates the data that is required, the methods that will be used to gather the data and how the research questions will be answered by the data collected. The general approach used was to train YOLO and M-RCNN algorithms to detect vehicle objects and marking of parking spaces in a parking area the status of each parking area was determined and the objects in the parking area were classified as either vehicles or other objects and thus the status of the parking area established as either vacant or empty.

THE RESULTS



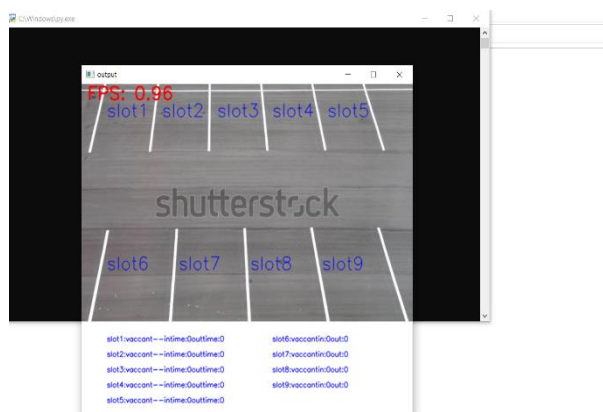
LITERATURE SURVEY

Identification of Human & various objects through Image Processing based system: The objective of this paper is to image processing-based system. This paper identification of humans through the image proceeding development technique by an image-based database system. The techniques involve using of identification of human object monitoring. We monitoring the human activities for deflection through the surveillance system and recognition through the image process system. We proposed machine learning algorithms such as SVM (SUPPORT Vector Machine) and Naive bayes to classification various activities recognition. From this we are using image processing.

Camera based smart parking: In this paper, the author proposed a system using raspberry pi and camera module to detect the free parking slots in a area and he propose a computer vision-based smart parking lot occupancy detection system employing low-complexity deep neural network architecture. A smart camera system which consists of a Raspberry Pi 3 attached to a camera utilizes a reduced-complexity deep neural network model to detect vacancy positions. Rather than this our model achieves 88% accuracy, almost 15% higher than those obtained from state-of-the-art approach.

Automated Vehicle Parking System: In this survey the author proposed a system for vehicle detection and pedestals counting. Vehicle detection and counting plays a major role in Intelligent Transportation Systems, which continuously provides the traffic information. The Haar Cascade was first proposed by Viola Jones. Haar Cascade classifier is an efficient method for object detection. Background Separation method uses K-NN algorithm to identify the pedestrians. From this we are using haar cascade-based vehicle detection system.

FINAL OUTPUT





VIII. CONCLUSION

The research focused on evaluating the current algorithms used in car parking detection, design of a model and testing its accuracy in predicting parking spaces. Pascal VOC, an open source dataset of standardized objects was used to train a YOLO and M-RCNN algorithm to detect vehicle objects in a parking area. Parking slots in the parking area were marked using a small program which was developed in this research to aid in marking the coordinates of each of the parking slots in the parking area. This coordinate were fed in a classifier which was used to classify the parking area as either empty or parked. Video stream image was fed in the model where object detection was the first

thing to take place, then classification of the parking slot status followed. In order to enhance the accuracy of the parking slot detection model, parking spaces whose status could not be known were subjected to a motion detection algorithm which was used to detect motion of objects coming to the parking slots and try to retest the parking slotstatus after two seconds. This approach aided in improving the performance of the model as parking space status could easily be updated once vehicles leave or come to a parking area.

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