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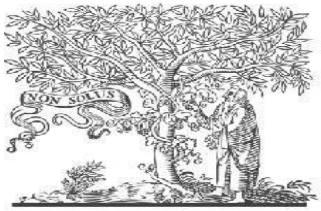

ELSEVIER SSRN

IJIEMR Transactions, online available on 05th Apr 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 04

10.48047/IJIEMR/V12/ISSUE 04/20

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Volume 12, ISSUE 04, Pages: 149-158

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EXPERT SYSTEM DESIGN FOR VACANT PARKING SPACE DETECTION IN NON-DELIMITED

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ABSTRACT

Nowadays increase in vehicles leads to lack of parking space in the cities and for that a parking guidance management system which provide car owners with actual information about the accessibility and destination of parking areas are introduced. In previous method suggests a approach for rapid recognition of vacant lots in defined parking spaces with pre-determined boundaries are specified. Later it is implemented to the more strategical section of non-defined parking lots. But, when tested on public datasets with images of true parking spaces, the previous method exhibits robustness against produced variants in vehicle pose as well as magnitude for each parking lot. So, in our proposed model we introduce a systematic algorithm such as Convolution Neural Network (CNN), Support Vector Machine (SVM) classifiers. The CNN algorithm gives us an efficient space detection in non-delimited spaces by using background subtraction model. This model gives efficient performance in detection of parking spaces. This method is implemented on public PKLot dataset in deep learning. Due to its success in fields like computer vision, natural language processing, and in reinforcement learning, deep learning is one of the most widely recognised branches in artificial intelligence.

KEYWORDS: Convolution Neural Networks (CNN), Background Subtraction Model, PKLot data set.

1. INTRODUCTION

Due to a lack of parking places at a number of locations, including companies and retail centers, there is additional traffic congestion today. Due to the enormous effect that inconsistent illumination has on the automatic parking system's objective, it might be challenging to estimate parking spaces from a distance when presented with a variety of

visual indications. In essence, the ground is important, but earlier methods do not honestly address this situation. Users can save time by quickly locating parking spaces. If the search for a parking space proves vain, a dissatisfied driver might park in an illegal location, which could result in accidents. If no solutions are discovered, the issue will only get worse in the upcoming years as more automobiles are added to our roadways daily. In previous methods a machine learning strategy for the automatic detection of unoccupied lots in bounded spaces is proposed. In training, detecting parking lots in non-delimited parking spaces with no markings on the ground is critical, but previous works do not address this scenario. But the difficulty is to obtain the most accurate prediction in the non-delimited parking spaces.

The previous model is performed using various assessment metrics such as accuracy (ACC), precision (PRE), and recall to properly evaluate the classifier. And, as previously stated, the majority of the methods are focused on delimited spaces with boundaries. The main goal of our project to improve the classification of the background rejected hypothesis, accurate image extraction to improve the detection processes in non-delimited parking space.

2. RELATED WORK

[1] Huanmei Qin, Qianqian Pang proposed a model of Analysis on cruising process for on - street parking using a spectral clustering method. In the proposed model works by using clustering methods they used to detect the parking vacancy for the travelling passengers due to lack of parking space they implement on - street by using HMM method. This model addresses about the on-street parking management for the travelling persons. The accuracy of this model is 97%.

[2] Hongmei Zhu, Shengzhong Fe [7] proposed a model Parking Detection Method Based on Finite-State Machine and Collaborative Decision-Making. They implement Finite state machine, collaborative decision parking, wireless sensor networks techniques and they have proposed a high accurate parking occupancy detection method by using magnetic sensor. The work focuses on dealing with the interferences from adjacent vehicles, including moving and parking vehicles. It provides 98.13% accuracy.

[3] Minchul Lee, Seokwon Kim [6] proposed Probabilistic Occupancy Filter for Parking Slot Marker Detection in an Autonomous Parking System Using AV. They used AVM-based parking marker recognition, Bayesian filter techniques and the proposed model is suitable for where a scene is repeated with different conditions, such as parking. In this a around view monitoring (AVM) can compensate for the disadvantages of distance-sensor-based detection because it can recognize parking spaces based on parking slot markers instead of empty spaces. This framework can be applied to detect parking slot markers or all types of road surface markers, such as lane and road signs. The proposed system gives 97.57% accuracy.

[4] Jie Song, Weiwei Zhang [3] introduce a Laser-based SLAM automatic parallel parking path planning and tracking for passenger vehicle. In this model they used B-spline parallel parking path planning algorithm which is used to detect a control strategy (MPC) algorithm-based route having followed influence technique is suggested. This approach selects short-range lidar to enlarge its perceptron on parking environment and senses available parking space with the help of simultaneous localisation. It provides 95% accuracy.

[5] Ahmad Afiif Naufal1, Chastine Fatichah [16] has developed a model known as Pre-processed Mask RCNN for Parking Space Detection in Smart Parking Systems. This research introduces a Pre-processed to indicate the parking space on the input image of a full parking lot, a region-based convolution neural network (Mask R-CNN) is used. mAlexNet is used to analyze the video-based data. With an Interaction Over Union (IOU) accuracy of 85.80%, the pre-processed Mask R-CNN provides improve parking position marking. The accuracy of the parking spot determined by video information using mAlexNet is 73.73%.

Table 1: Existing system analysis

S. No	Title	Algorithm Used	Merits	Demerits/Future work	Accuracy
1	Analysis on cruising process for on - street parking using	HMM method	The hidden Markov model (HMM), essentially proposes that each observation is dependent on a	There are frequently many unstructured parameters in HMMs. The first-order markov property of first order	97%

	a spectral clustering method		hidden Markov chain's indicate the popular modeling approach for dealing with sequential data. This method addresses about the on-street parking management for the travelling persons.	HMMs limits them. Dependencies between concealed states cannot be expressed by them.	
2	Parking Detection Method Based on Finite-State Machine and Collaborative Decision-Making	Finite-State Machine	A finite state machine is a type of computation model which is able to replicate sequential logic as well as some computer programs. It can be implemented in software as well as hardware.	In futher, intend to extend the collaborative decision-making mechanism to moving vehicle detection, speed estimation, and vehicle classification in the application of intelligent traffic system.	98.13%
3	Probabilistic Occupancy Filter for Parking Slot Marker Detection in an Autonomous Parking System Using AV.	Bayesian filter technique	This technique uses a Monte Carlo-based Bayesian filtering algorithm. The idea behind it is to identify a collection of random particles spreading around the state vector to represent the system's current condition.	By using more efficient algorithm the accuracy of the system will be increased.	97.57%
4	Laser-based SLAM automatic parallel parking path planning and tracking for passenger vehicle	Model predictive control (MPC) algorithm	Predictive modeling (MPC), a complex type of process control, is utilized to control a system while conforming to a set of limitations.	sensor fusion such as cameras should be taken to recognise parking slot in cases where adjacent obstacles do not exist, to improve the performance of parking space detection.	95%
5	Pre-processed Mask RCNN for Parking Space Detection in Smart Parking Systems	RCNN algorithm	This research introduces a Pre-processed to indicate the parking space on the input image of a full parking lot, in this a region-based convolution neural network (Mask R-CNN) is used. mAlexNet is used to analyze the video-based data.	This technique may be improved upon by not having to identify the availability of a parking space.	85.80%

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3. PROPOSED METHODOLOGY

In the design consists a system for vacant space detection in non-delimited parking spaces. In this methodology the PKLot slot dataset is implemented as input. The PKLot dataset contains different parking space images. The dataset is taken from dataset repository. The input dataset is in the format '.png', '.jpg'. The collected input images are subjected to pre-processing. In the pre-processing step, we implement Resize the images, and gray scale conversion.

After performing pre-processing step comes to image segmentation step. In this step, we can segment the parking slot area into occupied and non-occupied, in this calculating the counter region, drawing bounding box for both occupied and non-occupied parking area are done. Then, we indicate the occupied area as green and non-occupied area as red. Later, in this process background substarction is performed. Later data splitting process is performed, in this the pre-processed data's are split into train set and test set for the decision. After completion of all the steps we come to classification process in this step we implement the deep and machine learning algorithms such as, Convolution Neural Network (CNN), Support Vector Machine (SVM). Finally, we can detect the parking slot area as occupied and non-occupied slots separately.

Fig.1. Methodology of parking space detection

3.1. Convolution Neural Network (CNN):

A typical Deep Learning neural network architecture in computer vision is the convolutional neural network (CNN). This

algorithm can comprehend and analyze visual data or images in the field of artificial intelligence known as computer vision. We utilize convolution neural networks to classify images. Artificial neural networks (ANN) have progressed into convolutional neural networks (CNN), which are mostly used to extract features from datasets with grid-like matrixes. Examples of visual datasets where data patterns play a significant role are photographs and movies.

The input layer, convolutional layer, pooling layer, and fully connected layers are the layers that make up a convolutional neural network. In order to extract features from the input image, the convolutional layer applies filters. In order to reduce computation, the pooling layer down samples the image before the fully connected layer makes the final prediction. With the help of gradient descent and backpropagation, the network learns the best filters.

3.2. Support Vector Machine (SVM):

A supervised machine learning approach called Support Vector Machine (SVM) is used for both classification and regression. Finding a hyperplane in an N-dimensional space which clearly classifies the data points is the goal of the SVM method. The best subspace in the SVM algorithm is the vector field that depicts the biggest difference or profitability between the two classes.

The goal of the SVM algorithm is to find the best quote or distance measure that can distribute n-dimensional space into categories, allowing us to classify new data points quickly in the future. This effective decision boundary is known as a hyperplane. SVM chooses the severe feature vector and points that will help create the hyperplane. The SVM method is built on basis functions, which are employed to portray these severe cases. Image classification, text categorization, etc. may all be done using the SVM method.

4. DATASET DESCRIPTION

This work's key contribution is the availability of a trustworthy dataset for the scientific community. Researchers and practitioners working to develop outdoor parking lot vacancy detection systems have a significant option in the form of the PKLot. It fixes the issue with the lack of a shared dataset, enabling benchmarking and evaluation in the future. 12,416 parking lot photos that

were taken from surveillance camera frames make up the PKLot dataset. The parking spaces are marked as being occupied or vacant, and there are pictures taken on sunny, overcast, and rainy days. By enclosing a bounding box around the rotated rectangle annotations from the original dataset, we were able to convert the original annotations to a number of common object detection formats.

5. PERFORMANCE ESTIMATION

The dataset utilized in the classifier, attributes derived from the evaluations, as well as classification model quality attributes such as accuracy and error rate calculated values by the CNN and SVM are all mentioned. The method and some other emerged classification models have been deeply compared.

5.1. Accuracy

Accuracy is a performance indicator that explains how method fits in overall throughout all classifications. It is useful once to all classifiers were vitally valuable. It is calculated by dividing the entire number of predictions by the amount of correct predictions..

Accuracy= (TP + TN)/(TP+TN+FP+FN)

Where TP stands for True Positive, values that are predicted to be positive.

TN stands for True Negative, values that are negative and are expected to be negative.

FP stands for False Positive, negative values that are intended to be positive.

FN stands for False Negative, positive values that are forecast to turn negative.

5.2. ERROR RATE

A ratio of unpredictable events divided by the total number of predictions is the error rate. It is important to note that testable prediction for classification tasks comprise all true positive and true negative findings.

Error rate= 1-Accuracy

6. RESULTS AND DISSCUSION

The PKLot dataset was utilized without lot boundary information to evaluate the suggested approach for non- delimited spaces.

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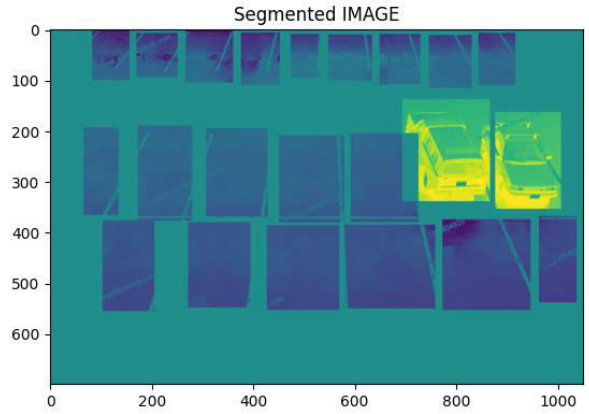

Fig.2(a). Parking Space Segmented Image

From the above fig2(a), shown the parking space detection in non-delimited. By using our methodology, we can detect the parking space in various climatic condition.

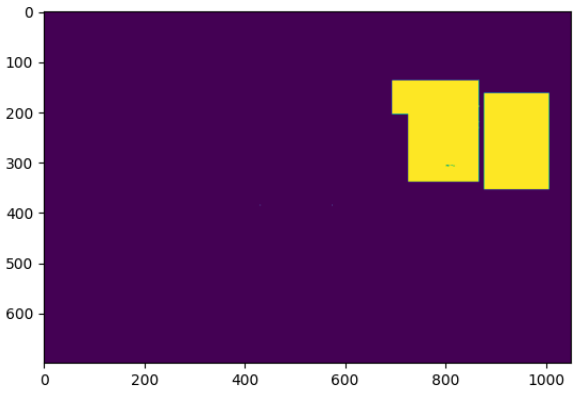

Fig.2(b). Parking Space Detection in Dark climate

The proposed system provides more accuracy compared to the previous model. The main goal of our project to improve the classification of the background rejected hypothesis, accurate image extraction to improve the detection processes in non-delimited parking space.

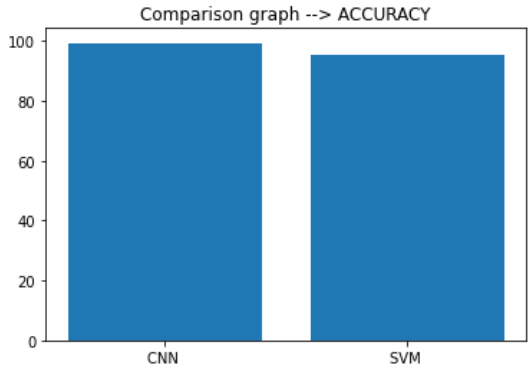

Fig 2(c). Comparison graph of CNN and SVM

The above figure shown the accuracy of the two classifiers namely CNN and SVM. So, according to the above graph we can assure that CNN classifier works efficiently compared to SVM.

8. CONCLUSION

This work addresses the difficulty of finding parking, one of the main issues faced by the drivers in urban areas. The proposed model provides the information about the occupied and unoccupied parking space in the non-delimited parking space in which no boundaries are presented. In this model we use two classifiers i.e., Convolution Neural Network (CNN), Support Vector Machine (SVM) algorithms for the detection of

parking space. In our proposed model the images are taken from the PKLot dataset. The CNN algorithm is the deep learning approach which have capability to classify the large number of datasets and also it comprehends and analyze visual data or image. The proposed model provides the accuracy of 99.30% for the CNN algorithm. Meanwhile, SVM algorithm gives 95.19% accuracy. Compared to CNN classifier, large number of images do not suit the SVM algorithm. When the dataset includes additional noise, such as when the target classes overlap, SVM does not perform very well while compared to CNN algorithm.

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