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Innovative Way to Check the Status of Vacancy in Outdoor Parking Lots

Neeru Mago, Satish Kumar

Abstract: ***With the unprecedented increase in number of private vehicles, the availability of parking space has become a daunting task for vehicle owners. Be it a shopping mall or a government building, it is hard for drivers to find an appropriate space almost everywhere in the present times. This makes it necessary to find out novel ways to resolve the issues regarding car-parking. Though there are many systems in place for detection of space availability, but one has to shed huge amounts for their implementation. Also there are constraints in using rides-based technologies as they do not consider climatic changes and conditions. The study consists of designing a hybrid model to detect outdoor parking vacant lots and the lots getting vacant in the real-time scenario. The dataset for training, validating and testing the system is extracted from online source which consists of various images of parking lots collected from varied heights and angles. The proposed work in this paper is the advancement of our previous work [1] in which we are going to apply more advanced machine learning techniques to classify vacant and occupied parking lots in the outdoor parking areas.***

Keywords: ***Innovative Parking Management, Image processing, Noise removal, Feature extraction, Machine learning.***

I. INTRODUCTION

As the world population comes close to 8 billion mark this year, one of the major issues being con- fronted in densely populated areas (urban in particular) is parking trouble. This can largely be attributed to a rapid surge in the volume of private vehicles, change in lifestyle where owning a vehicle has shifted to become a necessity from being a luxury, better developed roadways and highways and impetus to automation and mechanization. This has consequently led to a dire need for finding out mechanisms for innovative, optimum and better utilization of existing parking lots as shown in Fig 1.

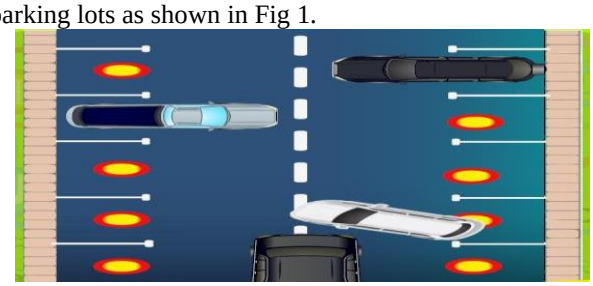

Fig.1. Innovative Parking Management System

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Long queues, haphazard parked vehicles and great rush are a common sight in parking spaces these days. This is owing to the fact that there is hardly any mechanism being followed for parking. Quite often, parking is managed by a single individual responsible for entry, exit and parking of hundreds of vehicles at a given time. This makes it infeasible to ensure hassle-free parking. One person can't track each and every vehicle entering or exiting parking lot manually without any technological intervention to his aid. Considering the ever- surmounting parking challenges, it is important that new and novel technologies be employed to overcome this problem. The present study aims at designing a low-cost/ economical parking management mechanism utilizing image processing technique as a replacement/ alternative to sensor based technologies that require exorbitant amounts. The objective is to design an effective, efficient and secure system which can make parking not to be a taxing and time-consuming endeavor.

II. LITERATURE REVIEW

Neeru Mago, Dr Satish Kumar [1] presents an intelligent model for detecting outdoor parking using machine learning algorithms like Artificial Neural network in order to find the vacant or occupied parking slots in the outdoor parking areas. C. Tang et.al [2] proposes a fog computing-based smart parking architecture in which Fog nodes are deployed at parking lots. They interact with each other in real time and provide real-time parking slot information. C. Badii et.al [3] presents a set of techniques for predicting the number of available parking slots in city garages with gates. The experimental results shows that a Bayesian regularized neural network provides a robust solution. Sherzod Nurullayev et.al [4] presents an efficient solution—CarNet, for visual detection of a parking status using Dilated Convolutional Neural Networks. Paulo et.al [5] provides a comprehensive dataset of parking lots containing 695,899 images. These images are captured from two parking lots with three different camera views under different climatic conditions (sunny, rainy and overcast periods). In this paper, authors have also showed by experiments that texture-based descriptors are a good solution to classify between empty and occupied parking spaces. Kharusi et.al [6], proposes an intelligent system to detect parking space based on image processing technique. Qing Tian et.al [7] introduces the intelligent parking management system based on LPR (License plate recognition) and provides almost 95 % accuracy in real time implementation. R. Yusnita et.al [8] designs an intelligent system for detecting parking space based on the Image processing technique. A rounded brown image at each parking lot is identified as a reference on image detection.

This integrated image processing technique has shown better results as compared to the sensor based. Faheem et.al [9] outlined the various parking methods such as Expert Systems, wireless sensor based, fuzzy based, GPS based. Different problems arising out of the current existing parking methods have been discussed and the solution to these parking related problems is given by using Vehicular communication details and Vision based details. Aalsalem et.al [10] designs a smart vehicle parking monitoring system called CAMPUSSENSE for JAZAN UNIVERSITY. The proposed system is designed by automating the existing manual parking system. Vanessa et.al [11] designs a robust car parking system. This system is based on WSN (wireless network sensor) which deploys sensor to the car park field. Parida et.al [12] proposes an efficient approach for improving object segmentation by extracting gray color information for background subtraction. Catherine Wah [13] considers the problem of occlusion and presents a technique to identify vacant spaces in parking lots by using a stereo camera system. Vacancy status under vehicular occlusion is determined by creating a 3D reconstruction of the scene. Liu et.al [14] provides a comprehensive details of application of intelligent video systems, analytics, video system architectures, analytic methods and tasks.

Many authors have proposed various Parking Management system (PMS) which have the following limitations/**Challenges** (i) wireless sensor networks is expensive to deploy, (ii) higher accuracy can be achieved using advanced image processing and machine learning techniques.

Further, it is very difficult to handle noise in the images captured under various weather conditions like rainy, cloudy and sunny as shown in Fig 2. [5].

Fig.2. Images of Parking Lot under various weather conditions (a) Sunny, (b) Rainy and (c) cloudy

Thus an innovative framework for outdoor Parking lot detection using hybrid model is proposed.

III. METHODOLOGY

The main goal of the proposed system is to design an innovative and hybrid model for optimizing Parking Management System based on machine learning techniques. It will help the people to find vacant slots in the outdoor parking area without wasting time and fuel. It also helps the people in guiding them where to park by showing available vacant stols in the parking area. The proposed system consists of the following steps as shown in Fig 3:

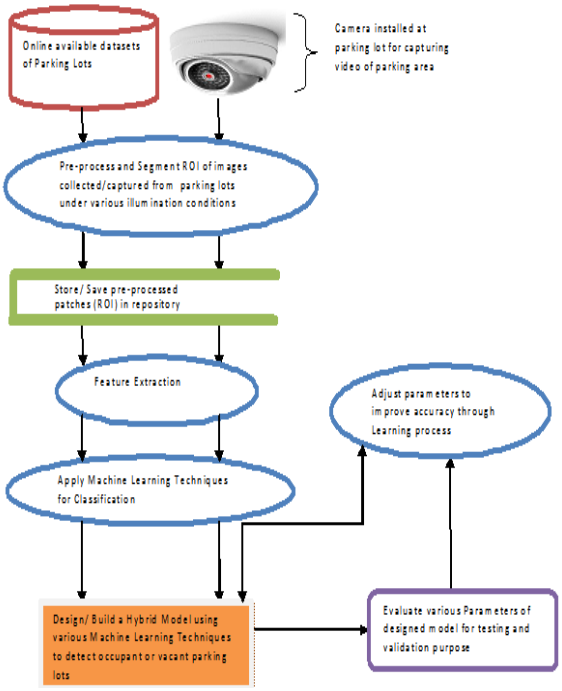

Fig.3. Proposed Design of Innovative Framework for Detecting Outdoor Parking lot using Hybrid model

Step 1: Collect or Capture Video of parking lots to make Dataset of images

The first step consists of collecting multiple images of parking lots either from online available, existing source or by installing high resolution cameras at various places from different angles and under various weather conditions like sunny, rainy and cloudy. In the latter case, collect frames from Video sequences of parking lots.

Step 2: Image preprocessing

Next, various Image preprocessing techniques will be applied for removing noise, shadow, occlusion etc in the images. It will improve the quality of images of dataset. Then apply segmentation techniques to detect Region Of Interest (ROI) and save patches of occupied and vacant parking lots in the data store/ repository.

Step 3: Feature Extraction

After image preprocessing, multiple feature extraction techniques based on color and texture will be applied to extract important or essential features of images.

Step 4: Classification models

Once the Region of Interest has been segmented and features have been extracted, the next step is to apply various machine learning techniques for classification and train the system for detecting occupied or vacant slots in the parking area.

Step 5: Design a Hybrid Machine learning model

The last step in building a hybrid model is to design an ensemble Model/ System/ Framework based on the combination of various machine learning techniques.

Step 6: Testing and Validation

Once a hybrid model for machine learning is designed, it will be tested on various parameters. During testing and validating phase, performance parameters of various machine learning techniques will be evaluated and compared. Based on the comparisons, parameters will be adjusted till we achieve the desired accuracy through learning process.

IV. RESULTS

In the proposed system, some machine learning techniques like Neural network (NN) and Support Vector Machine (SVM) are implemented on online available, existing dataset PKLOT. The dataset consists of 695,899 images. All images of dataset were captured in the parking areas of Brazil. All the images were arranged into three subsets named as PUCPR,UFPR04 and UFPR05 consisting the images of the parking area captured from 10thfloor of the administration building of PUCPR building,4th floor and 5thfloor of the UFPR building respectively. The available images show a wide range of uneven illumination because they were captured in different climatic environments such as cloudy, rainy and sunny.

The framework is implemented in MATLAB R2016b. First of all, empty and occupied patches from the dataset for all climate conditions are separated using segmentation techniques as shown in Fig 5 (a) and 5 (b). After that, various preprocessing techniques like histogram equalization, edge detection are applied to remove noise in the images captured under different climatic conditions like cloudy, rainy and sunny. Next, we have extracted features on the basis of color and texture such as mean, max variance for both RGB and HSV color space. And finally, we have applied Scaled conjugate gradient back propagation Neural Network over the dataset and various parameters like, confusion matrix, accuracy and ROC plots are checked as shown in Fig 5 (c) through 5 (g). In the end, we have applied Support Vector Machine on the same dataset as shown in Fig 5 (h) and results of both the techniques are compared using confusion matrix. In this case, Neural network (Scaled conjugate gradient back propagation Neural Network) is providing better results (98.3% accuracy) as compared to SVM (93.9% accuracy).

Fig.4. Empty Patches

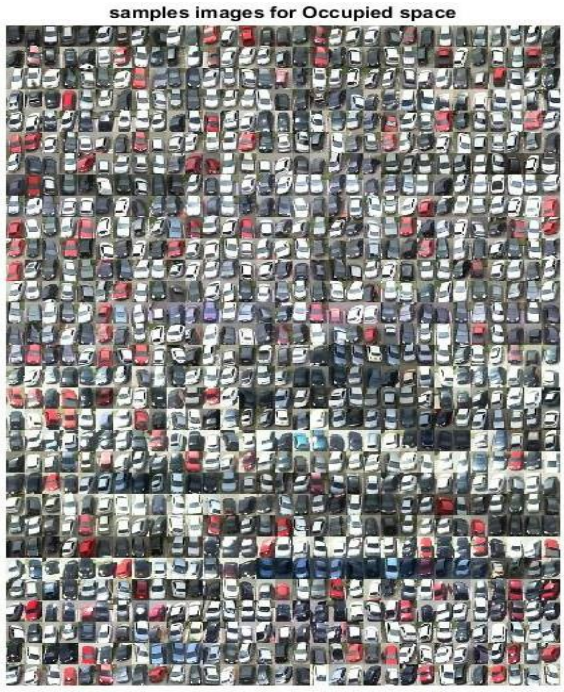

Fig.5. Occupied Patches

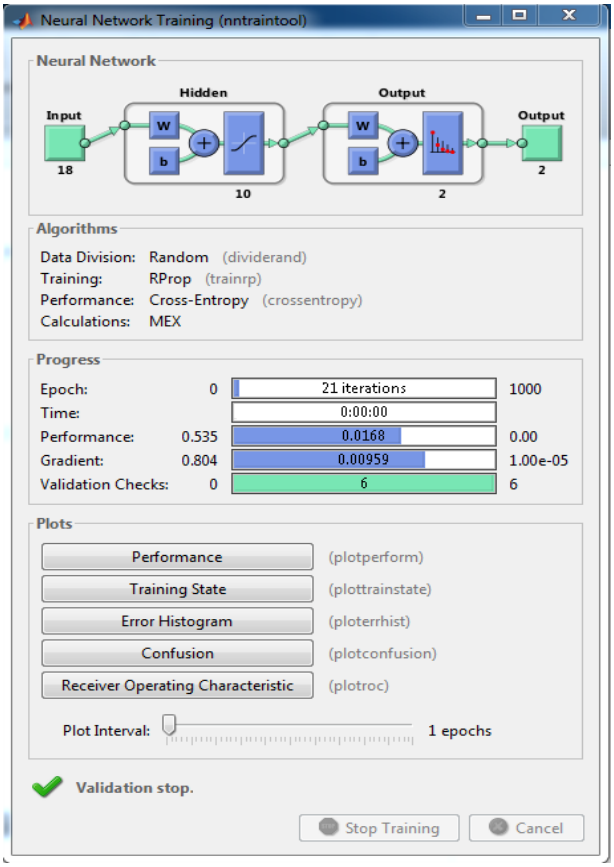

Fig.6. Scaled conjugate gradient back propagation Neural Network

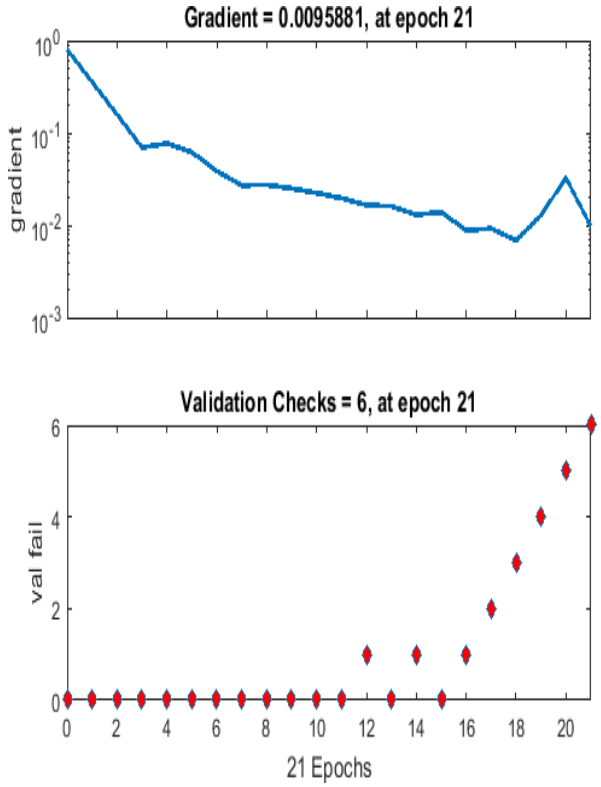

Fig.7. Gradient and Validation checks

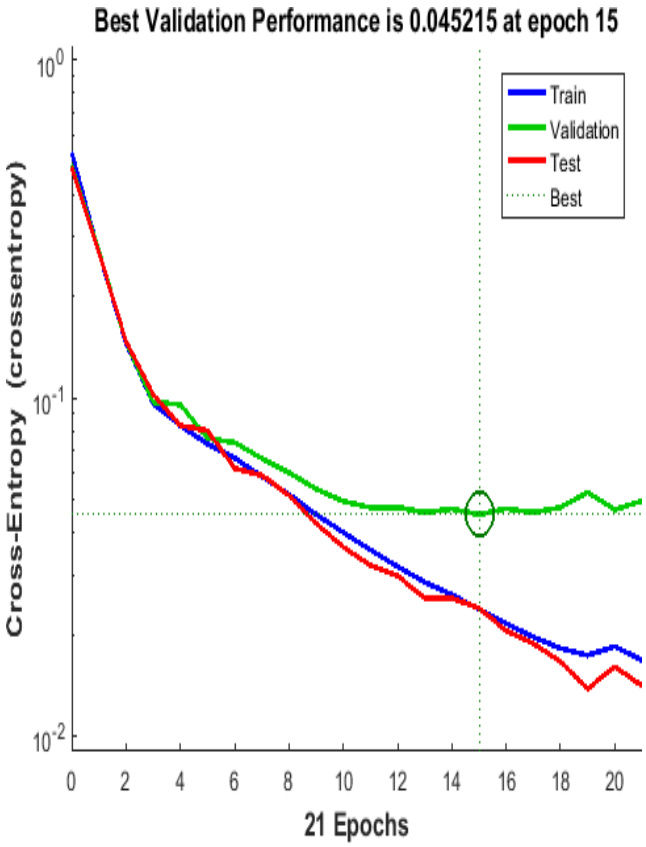

Fig.8. Cross-Entrophy

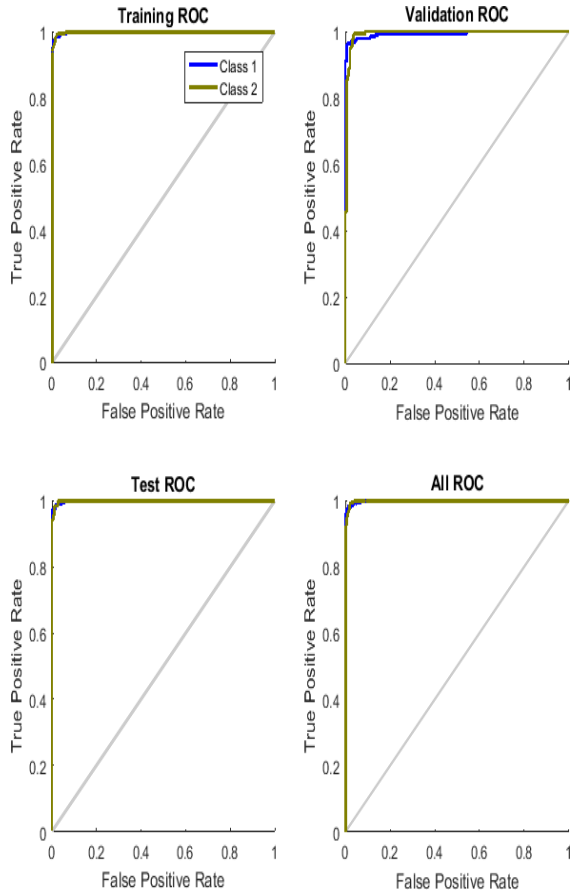

Fig.9. ROC curves

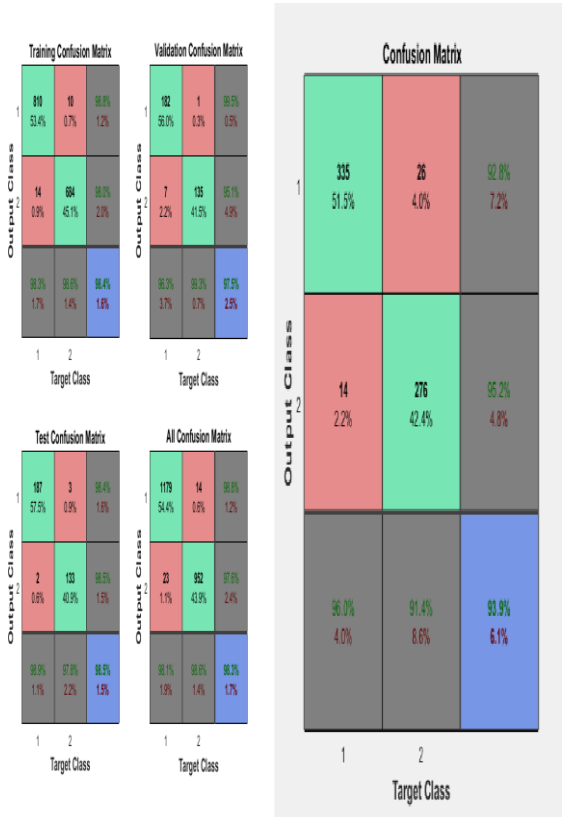

Fig.10. Confusion Matrix

V. FUTURE WORK

In this paper, we have applied various preprocessing techniques, feature extraction techniques and few machine learning techniques to detect parking lot vacancy. In future, we can explore various deep learning techniques and work upon it. Since deep learning is an emerging field for automating systems, we can compare the results of machine learning and deep learning in future.

VI. CONCLUSION

The proposed system is designed with the aim to provide us with an efficient and automated Parking Management System using various machine learning techniques. The main objective of this study is to save driver's time and resources to find the vacant parking lots in the outdoor parking area. In this paper, we proposed a framework for detecting whether a parking lot is vacant or occupied in outdoor parking area using various machine learning techniques. To evaluate our method, we trained and tested it on well known publicly available dataset PKLot. Our experiments showed that, the proposed approach is more accurate, stable and focused in comparison with previous approaches.

REFERENCES

1. Neeru Mago, Dt. Satish Kumar, "A machine learning technique for detecting outdoor parking", International Journal of Engineering & Technology, Scopus Indexed, 7 (2.30) pp. 39-43, 2018.
2. C. Tang, X. Wei, C. Zhu, W. Chen, and J. J. P. C. Rodrigues, "Towards smart parking based on fog computing", *IEEE Access*, vol. 6, pp. 70172–70185, 2018.
3. C. Badii, P. Nesi, and I. Paoli, "Predicting Available Parking Slots on Critical and Regular Services by Exploiting a Range of Open Data", *IEEE Access*, vol. 6, pp. 44059–44071, Aug. 2018.
4. Sherzod Nurullayev and Sang-Woong Lee, " Generalized Parking Occupancy Analysis Based on Dilated Convolutional Neural Network", Sensors 2019, 19, 277. 2019.
5. Paulo et.al, "PKLot – A robust dataset for parking lot classification", Expert Systems with Applications 42, pg. 4937–4949, 2015. www.elsevier.com/locate/eswa.
6. Al-Kharusi et.al, "Intelligent Parking Management System Based on Image Processing", World Journal of Engineering and Technology, 2, pp. 55-67, 2014.
7. Qing Tian et.al., "Design of Intelligent Parking Management System Based on License Plate Recognition:, Journal of Multimedia, Vol. 9, No.6, pg 774-780, June 2014.
8. Yusnita et.al., "Intelligent Parking Space Detection System Based on Image Processing", International Journal of Innovation, Management and Technology, Vol. 3, No. 3, pg 232-235, June 2012.
9. Faheem, S.A. Mahmud, G.M. Khan, M. Rahman1 and H. Zafar , "A Survey of Intelligent Car Parking System", Journal of Applied Research and Technology, Volume 11, Issue 5, Pg. 714–726, October 2013.
10. Aalsalem et.al., "CampusSense - A Smart Vehicle Parking Monitoring and Management System using ANPR Cameras and Android Phones", ICACT Transactions on Advanced Communications Technology (TACT) Vol. 5, Issue 2, pg 809-815, March 2016.
11. Tang et.al., "An Intelligent Car Park Management System based on Wireless Sensor Networks", 1st International Symposium on Pervasive Computing and Applications, pg 65-70, 2006.
12. Parida et.al, "Detection of objects in a video of traffic", International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 05 | www.irjet.net p-ISSN: 2395-0072, e-ISSN: 2395 -0056, pg 676-678, May-2016.
13. Catherine Wah, "Parking Space Vacancy Monitoring", University of California, San Diego 9500 Gilman Drive, La Jolla, CA 92093 cwah@cs.ucsd.edu
14. Liu et.al, "Intelligent Video Systems and Analytics: A Survey", IEEE Transactions on Industrial, Vol.9, No.3, pg 1222-1233, August 2013.

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