



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 3, March 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

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Implementing Urban Surveillance System in Smart Cities by Automated Object Detection Using Convolution Neural Network

Jeevitha S, Poojaa S, Sowndarya R, Dr.K Anbazhagan

UG Student, Department of Computer Science and Engineering, Velammal Institute of Technology, Chennai,
Tamil Nadu, India

UG Student, Department of Computer Science and Engineering, Velammal Institute of Technology, Chennai,
Tamil Nadu, India

UG Student, Department of Computer Science and Engineering, Velammal Institute of Technology, Chennai,
Tamil Nadu, India

Associate Professor, Department of Computer Science and Engineering, Velammal Institute of Technology, Chennai,
Tamil Nadu, India

ABSTRACT: Tackling the problem of car license plate detection and recognition in natural scene images proposing a unified deep neural network, which can localize license plates and recognize the letters simultaneously in a single forward pass. The whole network can be trained end-to-end. In contrast to existing approaches which take license plate detection and recognition as two separate tasks and set them step by step, our method jointly solves these two tasks by a single network. It not only avoids intermediate error accumulation but also accelerates the processing speed. For performance evaluation, four data sets including images captured from various scenes under different conditions are tested. Extensive experiments show the effectiveness and the efficiency of our proposed approach.

KEYWORDS: Urban surveillance system, License plate.

I. INTRODUCTION

Deep Learning is at the cutting edge of what machines can do, and developers and business leaders absolutely need to understand what it is and how it works. This unique type of algorithm has far surpassed any previous benchmarks for classification of images, text, and voice. Deep learning is a specific subset of Machine Learning, which is a specific subset of Artificial Intelligence. For individual definitions:

- Artificial Intelligence is the broad mandate of creating machines that can think intelligently
- Machine Learning *is one way of doing that*, by using algorithms to glean insights from data (see our gentle introduction here)

- Deep Learning *is one way of doing that*, using a specific algorithm called a Neural Network

Vehicles are widely used in all areas of production as well as in our daily lives. Therefore, the vehicle License Plate (LP) number is an efficient way to identify vehicles, which is unique for each vehicle. With the rapidly increasing number of vehicles, traffic violations appear more frequently in public traffic, such as fraud tolls in highways or parking, speeding, theft of cars, etc. Therefore, it is necessary to identify the LPs of vehicles for safety. The extracted information from an LP can be used for several purposes, like access and flow control, monitoring border crossings and highway toll stations, searching for suspicious vehicles or even fighting crime, etc. This makes the automatic LP detection and recognition crucial and inevitable in the system of LP extraction. There are two separate processes: LP detection and LP recognition. Different algorithms, system and techniques have been worked out and applied to both of them. Moreover, the previously image processing developed concepts of or other concepts are applied in order to get more accuracy. However, there is still room for improvement. Although some studies have been performed on LP detection and recognition, this research work is different from the previous ones due to a number of reasons. Nevertheless, in major researches, a neural network or a deep learning system is used only in the detection or recognition process. The novelty of this work is that our system uses a few pre-processing steps to classify LPs / non

LPs utilizing a first Convolution Neural Network (CNN) model for LP detection, and to classify and recognize the characters and digits from an LP using a second CNN.

II. LITERATURE SURVEY

In 2015, Baoguang Shi, Xiang Bai and Cong Yao “An End-to-End Trainable Neural Network for image-based Sequence Recognition and its Application to Scene Text Recognition”. Image-based sequence recognition has been a longstanding research topic in computer vision. In this paper, we investigate the problem of scene text recognition, which is among the most important and challenging tasks in image-based sequence recognition. A novel neural network architecture, which integrates feature extraction, sequence modeling and transcription into a unified framework, is proposed. Compared with previous systems for scene text recognition, the proposed architecture possesses four distinctive properties: (1) It is end-to-end trainable, in contrast to most of the existing algorithms whose components are separately trained and tuned. (2) It naturally handles sequences in arbitrary lengths, involving no character segmentation or horizontal scale normalization. (3) It is not confined to any predefined lexicon and achieves remarkable performances in both lexicon-free and lexicon-based scene text recognition tasks. (4) It generates an effective yet much smaller model, which is more practical for real-world application scenarios. The experiments on standard benchmarks, including the IIIT-5K, Street View Text and ICDAR datasets, demonstrate the superiority of the proposed algorithm over the prior arts. Moreover, the proposed algorithm performs well in the task of image-based music score recognition, which evidently verifies the generality of it.

In 2016, Chao Gou, Kunfeng Wang, Yanjie Yao, and Zhengxi Li “Vehicle License Plate Recognition Based on External Regions and Restricted Boltzmann Machines”. This project presents a vehicle license plate recognition method based on character-specific extremal regions (ERs) and hybrid discriminative restricted Boltzmann machines (HDRBMs). First, coarse license plate detection (LPD) is performed by top-hat transformation, vertical edge detection, morphological operations, and various validations. Then, character-specific ERs are extracted as character regions in license plate candidates. Followed by suitable selection of ERs, the segmentation of characters and coarse-to-fine LPD are achieved simultaneously. Finally, an offline trained pattern classifier of HDRBM is applied to recognize the characters. The proposed method is robust to illumination changes and weather conditions during 24 h or one day. Experimental results on thorough data sets are reported to demonstrate the effectiveness of the proposed approach in complex traffic environments.

III. PROPOSED SYSTEM

In existing system, the system which uses computer vision to address these problem were using a single central computing server to process the collected images using cameras scattered across the smart city. A single unified deep neural network (DNN) is proposed, which can detect license plates from an image and recognize the labels all at once. The whole framework involves no heuristic processes, such as the use of plate colors or character space, and avoids intermediate procedures like character grouping or separation. In this chapter we will talk about the Region based methods for object detection. In particular, R-CNN (Regional CNN), the original application of CNNs to this problem, along with its descendants Fast R-CNN, and Faster R-CNN. In classification, there's generally an image with a single object as the focus and the task is to say what that image is. But when we look at the world around us, we carry out far more complex tasks. We see complicated sights with multiple overlapping objects, and different backgrounds and we not only classify these different objects but also identify their boundaries, differences, and relations to one another. The goal of a Region based CNN is to take an image input to detect and localize the object in the image. All three above mentioned architectures were used for object detection and localization for a driving scenario to detect cars, pedestrians and traffic signs etc. and performed a time study to conclude which of the three architectures can be used as a detector for a real-world driving scenario for detection of objects present on road. We will also discuss their architecture and describe how they perform the task of object detection and localization given the input image.

R-CNN

R-CNN was first introduced by Ross Girshick, Jeff Donahue, Trevor Darrell and Jitendra Malik in 2014. Region based Convolutional Network (R-CNN) combines two ideas: (1) one can apply high-capacity Convolutional Networks (CNN'S) to bottom-up region proposals in order to localize and segment objects and (2) When labelling data is scarce, supervised pre-training for an auxiliary task, followed by domain-specific fine-tuning, boosts performance significantly. They combined region proposals with CNNs and called the resulting model an R-CNN or Region-based Convolutional Network.

R-CNN Architecture.

In R-CNN we input an image and then using the basic feature detection techniques such as edge detection etc. we get Region Proposals Also referred as Regions of interest. This process is also known as selective search.

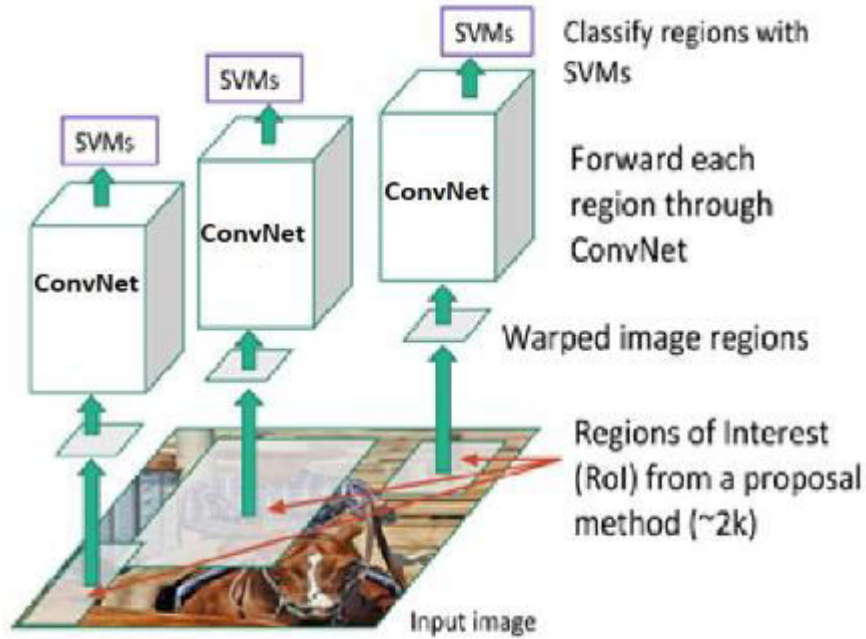


Fig no:1

In the next step after these region proposals are extracted these wrapped image regions go through a trained CNN in our implementation AlexNet and then on the final layer the classification is done Using a Support Vector Machine(SVM) classifier which classifies whether this is an object and if so what.

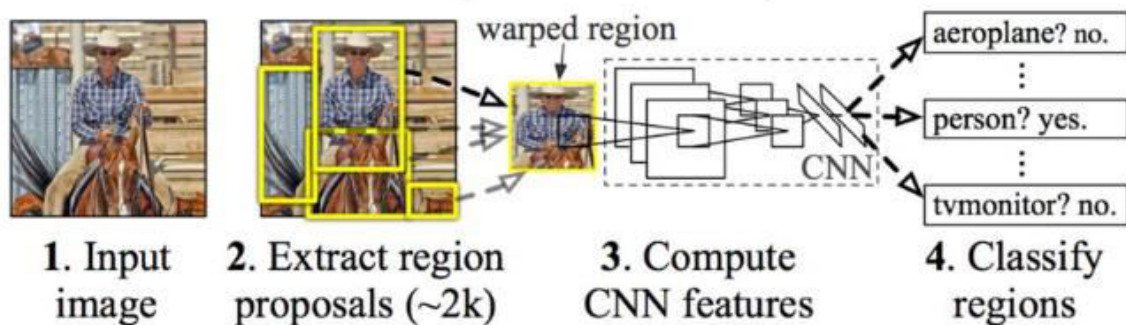


Fig no:2

R-CNN works really well but is really quite slow for implementation in real time object detection.

- 1.It requires a forward pass of the CNN (AlexNet) for every single region proposal for every single image that’s around 2000 forward passes per image.
2. It must train three different models separately -the CNN to generate image features, the classifier that predicts the class and the regression model to tighten the bounding boxes. This makes the pipeline extremely hard to train.



VII. CONCLUSION

The scope of this project is to present a cost-effective viable solution, so we will be implementing the system and technologies needed to process the image locally and convolution neural network (CNN) techniques used in detecting the number plate region.

To our best knowledge, CCPD is the largest publicly available LP dataset to date with over 250k unique car images, and the only one provides vertices location annotations.

Through comparative experiments, we demonstrate our model outperforms current object detection and recognition approaches in both accuracy and speed. The detection and recognition of a vehicle License Plate (LP) is a key technique in most of the applications related to vehicle movement.

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