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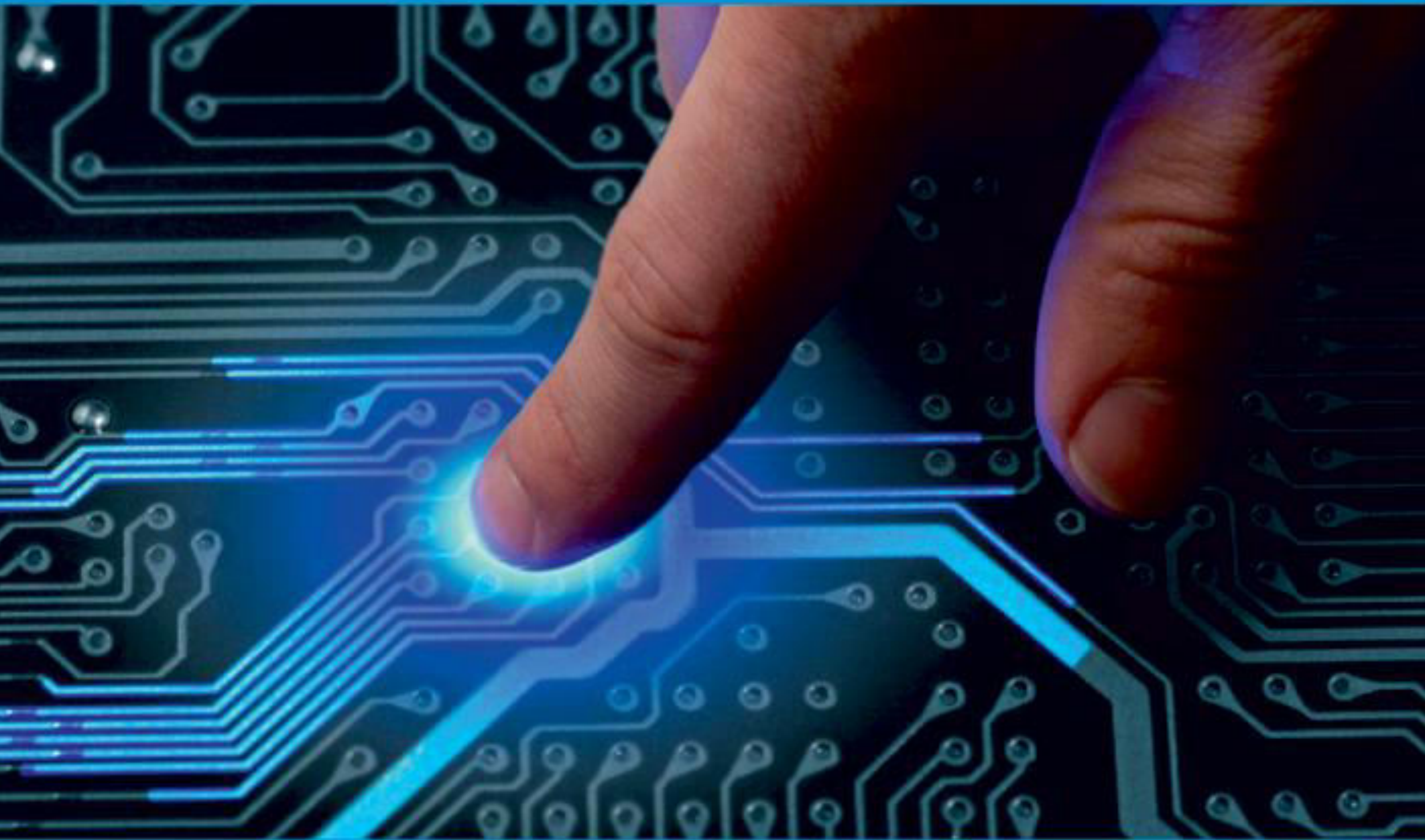

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# Automatic License Plate Recognition Using YOLOv4 and Tesseract OCR

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**ABSTRACT:** In modern times the quantity of on road vehicles is expanding very quickly. Most of the time, it is important to verify the identity of these vehicles for authorization of the transit regulation, overseeing parking garages. it is hard to check this colossal number of moving vehicles physically. Subsequently, building up a precise automatic license plate recognition model (ALPR) including character recognition is important to ease the issues mentioned above. We have developed a model based on multiple types of license plates from different countries. The dataset of images was trained using Yolov4. Character recognition was done using the Tesseract OCR after multiple image pre-processing techniques and morphological transformations. The proposed program has obtained an accuracy of 92% in license plate detection and 81% in character recognition.

**KEYWORDS:** Automatic Number plate recognition, Object Detection, Character Recognition, YOLOv4, Tesseract-OCR.

## I. INTRODUCTION

The objective of ALPR is to separate the vehicle number from pictures of moving vehicles. ALPR incorporates two significant steps; detecting the license plate region using bounding boxes and recognition of the characters using image pre-processing techniques and tesseract- OCR.

The paper intends to build up another and effective ALPR approach for multiple license plates. The proposed approach is based on deep learning to solve plate detection and recognition problems. The YOLO4 is to distinguish and perceive little items (characters of tag), the quantity of layers is little thought about with YOLOv4, which thus diminishes the running time. YOLO is short for You Only Look Once. It is a real-time object recognition system that can recognize multiple objects in a single frame. YOLO recognizes objects more precisely and faster than other recognition systems. It can predict up to 9000 classes and even unseen classes. The real- time recognition system will recognize multiple objects from an image and also make a boundary box around the object. It can be easily trained and deployed in a production system. The recognition of characters is done using the Tesseract OCR software after image pre-processing techniques are done on the detected license plate, using Python language.

## II. RELATED WORK

Computer vision and character recognition, algorithms for license plate recognition play an important role in video analysis of the number plate image. Therefore, they form the core modules in any ALPR system. Nijhuis et al. [3] combined neural networks and fuzzy logic in recognition of car number plate for the case of the Dutch number plates. Sindh standard number plate recognition is done by Quadri and Asif [7] where the number plate region is cornered with the help of yellow color identification, later using smearing algorithm the plate is segmented, then the Optical Character Recognition (OCR) is used to identify the characters. However, the type of OCR algorithm used is not mentioned and the accuracy rate is also not given. Tejas et al. [8] proposed Indian number plate detection and recognition using techniques like Sobel edge detection, bounding box segmentation, and neural networks for recognition.

## III. PROPOSED METHODOLOGY

The method used can be divided in 3 main phases:

a. Firstly we have gathered a dataset of images containing cars and their respective license plate. We have trained the dataset using YoloV4. It divides an image into regions and then it predicts the boundary boxes and probabilities for

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each region. In this case, we will train the dataset in order to recognize the license plates and form bounding boxes around them.

b. Secondly, we have used image processing techniques, namely; grayscaling and binarization method being pre-processing techniques applied to the detected license plate region. This is done using OpenCV.

c. Finally, the characters are segmented and recognition is done using the Tesseract-OCR.

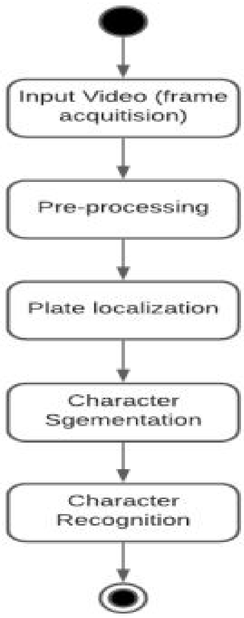


**Figure 1**. Proposed methodology Flow Diagram

## 1. Training Dataset Using Yolov4 and Detecting License Plate

Yolov4 is an object detection model. Object detection models are usually trained to look at an image and search for a subset of object classes. These object classes are enclosed in a bounding box and their class is identified. Yolov4 is a one-stage object detection model.

In contrast, a two stage detector uses a preliminary stage where regions of importance are detected and then is classified to see if the object has been detected in these areas. The main upside of a one stage detector is the speed it is able to make predictions quickly for real time use[8].

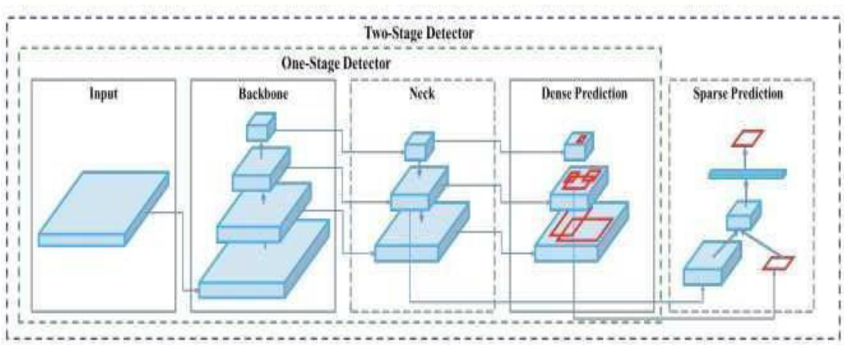


**Figure 2.** Structure of One-stage detector (YoloV4)[8]

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**Backbone**

**CSPDarknet53:** The Cross Stage Partial architecture is derived from the DenseNet architecture which uses the previous input and concatenates it with the current input before moving into the dense layer.

**Neck (detector)**

The main role of the neck is to collect feature maps from different stages.The structure of the latter will consist of a Spatial Pyramid Pooling Layer which will allow to generate fixed size features whatever the size of our feature maps

**Head (detector)**

The role of the head in the case of a one stage detector is to perform dense prediction. The dense prediction is the final prediction which is composed of a vector containing the coordinates of the predicted bounding box (center, height, width), the confidence score of the prediction and the label which in our case, the bounding box will be around the license plate.


**Figure 3**. License plate detected in bounding box

As we see in Fig 3. the license plate has been detected with an accuracy of 92%.

**2. Image Processing and Segmentation**

The next phase after training the dataset of images and detecting the license plate is to apply pre-processing techniques i.e. gray scaling, binarization. First step of the process is taking the bounding box coordinates from YOLOv4 detection phase and simply taking the sub image region within the bounds of the box.


**Figure 4**. Cropping the license plate and resizing it

**Grayscaling**

The importance of grayscaling is dimension reduction for example, in RGB images there are three color channels and has three dimensions while grayscaled images are single dimensional. Grayscaling also reduces the complexity of processing of the image On the other hand, the same neural network will need only 100 input node for grayscaled images.

The individual characters of the license plate number are now the only regions of interest left. We segment each sub image and apply a bitwise_not mask to flip the image to black text on white background which Tesseract is more accurate with.Finally we will apply a small median blur to eliminate any remaining noise.

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**Figure 5**. Segmented characters of the image

**3. Recognition of character using Tesseract OCR**

Pre-processing techniques are required though for the accurate use of the tesseract-OCR. It can be used to recognize both structured and unstructured data.

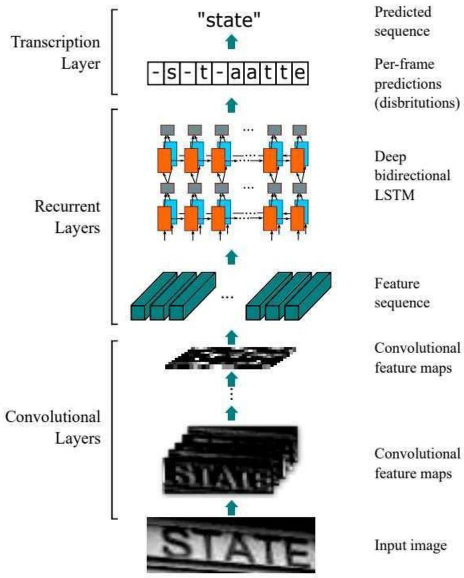


**Figure 6**. Structure of the Tesseract-OCR

This neural network architecture implements and combines feature extraction, sequence modeling, and transcription into a unified framework. This model does not need character segmentation. The CNN extracts features from the input image.

## IV. EXPERIMENTAL RESULT AND DISCUSSION

Images trained with Yolov4 using R-CNN and an input of 8000 iterations had a validation accuracy of 98% and an error rate of less than 1.


**Figure 7**. Image with more unwanted texts in the license plate

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License plate Recognition : 80%
Characters on license plate: V0DKAA
Characters read : V0DKAA
Character recognition was: 100%

We can see here that the license plate was smaller and full of unwanted texts.


**Figure 14**. Slightly noisy and blurry image from dashboard

License plate Recognition : 88%
Characters on license plate:KR696969
Characters read : KR696969
Character recognition was: 100%

### 4.1. Result using video

We can see below a screenshot from a video where license plate recognition of both of the cars are done as they are moving , even when they are in the same frame.


**Figure 15**. Result from 1 frame of a video

As the video proceeds, the license plates and the characters are detected. It depends on the frame they are at which moment.

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**Table 1**. Accuracy of proposed ALPR model

| **ALPR Model** | **License plate recognition** | **Character Recognition** |
|---|---|---|
| Ours | 98% | 81% |
| [9] | 85% | 80 |

## V. CONCLUSION AND FUTURE WORK

The program that has been developed here using YoloV4 to train images has had 98% validation rate with an error rate of less than 1. This license plate detection model enables detection and recognition of characters in different types of environments and on multiple types of license plates. Pre-processing techniques have been used such as gray scaling, Gaussian smoothing, Thresholding by Otsu's method and other morphological transformations in order to make the recognition of characters in the license plates easier. We have tested the program with further 30 samples of images and obtained 92% of accuracy in license plate detection and 81% of accuracy in detection of characters. Our future works will be to enhance the character recognition program by training individual characters so that the Tesseract-OCR would work more efficiently.

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