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VEHICLE NUMBER PLATE DETECTION AND RECOGNITION USING DEEP LEARNING

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Abstract: Automatic License Plate recognition (ALPR) is an image processing technology which uses a number (license) plate to find the vehicle. The objective is to design an efficient authorized vehicle identification system by using the vehicle number/license plate. The system is implemented on the entrance for security control of a highly restricted area like military zones or areas around top government offices e.g., Parliament, Supreme Court etc. The developed system first detects the vehicle and then captures the vehicle image. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for character recognition. The resulting data is then used to compare with the records on a database to produce specific information like the vehicle owner, place of registration, address, etc. The system and its performance are tested on real images. It is seen from the experiment that the developed system successfully detects and recognizes the vehicle number plate on real images.

Index Terms **- Data Processing, Number plate Detection, Character Recognition.**

I. INTROCUCTION

Traffic law violation has been recognized as a major cause for road accidents in most parts of the world with the majority occurring in developing countries. Even with the presence of rules and regulations stipulated against this, violators are still on the increase. Hence Automatic Number Plate Recognition (ANPR) system is an important technique, used in Intelligent Transportation System. ANPR is an advanced machine vision technology used to find vehicles by their number plates without direct human intervention.

Besides playing a key role in vehicle tracking, Automatic Number Plate Recognition (ANPR) also plays an inevitable role in systems like parking management systems, toll payment processing systems etc., and several systems where authorization is a much needed. It helps security officers to save time by automating the process. There are many problems that could arise through plate detection like the vast variety of vehicles present on a typical road. The vehicle types include cars, motorcycles, scooters, lorries, buses, auto rickshaws, SUVs, mini trucks, vans, tractors etc. Each of these types has a different format and style of plate. To add to the problems, there is the usage of several types of fonts and custom designed plates. The plates are also of different shapes and sizes i.e., all plates are not rectangular, some are trapezoid and other irregular shapes

II. LITERATURE REVIEW

M. M. Shidore and S. P. Narote [1] first used Histogram equalization and median filter for lighting. Sobel vertical edge detection to detect the number plate. Projection analysis is used to segment the characters present on the plate. It isolates each character on the number plate. For recognition work Support Vector machine (SVM) is used. Ravirathinam Praveen & Patawari Arihant [2] proposed a system which consists of three stages along with a heuristics logic filter at the end. Here the author uses the Faster-RCNN approach due to ease of training and ability of identifying small objects at a high speed. Sainan Xiao *et al* [3] discuss a problem to find an effective license plate detection and recognition method due to the different conditions during the image acquisition phase. The proposed method, as a first step, a pre-processing image has been done by converting the RGB image into the color difference space with the color difference formula of the blue pixels which is designed to enhance the LP area. The plate is found using morphological processes, color features, and vertical and horizontal projections to extract the LP. Sérgio Montazzolli and Claudio Rosito Jung [4] proposed approach is a composed by three main steps: vehicle detection, LP detection and OCR, as illustrated without any parameter adaptation or fine tuning for a specific scenario, performs similarly to state-of-the-art commercial systems in traditional scenarios, and outperforms both academic and commercial approaches in challenging ones.

NurA Alam 1, Mominul Ahsan 2, Md. Abdul Based 3 and Julfikar Haider [5] proposed a system for detecting and recognizing vehicle number plates using a convolutional neural network (CNN), a deep learning technique. This system includes two parts: In the detection part, the system segments the number plate region from the image frame. Each character of the number plate is segmented using a bounding box method. In the recognition part, features are extracted and classified using the CNN technique. Ross Girshick Jeff Donahue, Trevor Darrell [6] propose a system which combines two key insights: first, one can apply high-capacity convolutional neural networks (CNNs) to bottom-up region proposals to localize and segment objects and second, when labeled training data is scarce, supervised pre-training for an auxiliary task, followed by domain-specific fine-tuning, yields a significant performance boost. Tran Duc Duan, Tran Le Hong Du, Tran Vinh Phuoc, Nguyen Viet Hoang [7] have used boundary-based approach in which Contour algorithm is used to detect the boundaries of the number plates. Horizontal projection is used to detect and segment rows of number plate and characters are extracted using OCR module. Aniruddh Puranic and Deepak K. T. [8] proposed a system in which contrast extension is used to make the image sharper and then median filter is used for eliminating the unwanted noisy regions. The characters of the identified number plate region are segmented using Regionprops function of MATLAB to obtain bounding boxes for each of the characters.

III. RESEARCH METHODOLOGY

ANPR system consists of three modules; 1) Data Processing, 2) Detection of number plate, and 3) Character recognition. In this paper ANPR working for Indian cars is presented. Images are taken out with different illumination conditions, different backgrounds, orientation.

Fig. 1 DFD

3.1 Data Acquisition and Processing

3.1.1 Dataset and preprocessing

We have used 500 vehicle photos to build our custom dataset. This dataset will be used to train our deep learning model. We marked the coordinate of the license plate on the photos using annotation tool in labelImg. This tool helps us to save coordinates in an XML file. Glob is used to set up path of the XML file and Elementtree is used to parse the XML file. Then this XML file data is transformed to CSV format with help of pandas library.

3.1.2 Data Processing

Preprocessing includes methods of license plates geometric and topological characteristics transformation. Data normalization is used in machine learning to make model training less sensitive to the scale of features. This allows our model to converge to better weights and, in turn, leads to a more accurate model. Normalization makes the features more consistent with each other, which allows the model to predict outputs more accurately.

3.2 Number Plate Detection

Most countries have their plates to be rectangular. However, in India, as mentioned before, plates come in all shapes and sizes. As for sizes, the mean size of plates within different vehicles varies with cars having a mean size of 500 mm x 120 mm and two wheelers having 200 mm x 100 mm. Taking these factors into consideration, we decided that the best way to go about this was to label rectangular bounding boxes for all plates, even the oddly shaped ones. We used InceptionResNetV2 model to train this network. Over multiple training examples, this method of labelling and training worked, and the system was able to find the plates. We also found the best number of epochs for training to be 500.

Now we have used InceptionResNetV2 Output to build an object detection model. First, we have flattened InceptionResnetV2 output, then some operations are done on these outputs. Now we have used a model function to create a new model. Compilation is done with loss='mse' and optimizer = tf.keras.optimizers.adam(learning rate = 1e-4).

Over multiple training examples, this method of labelling and training worked, and the system was able to find the plates as shown in **Fig 2**

```
    return image, coords

In [14]: path = './test_images/index3.jpg'
         image, coords = object_detection(path)

         plt.figure(figsize=(10,8))
         plt.imshow(image)
         plt.show()

(96, 137) (220, 160)
```

Fig. 2: extracted number plate

3.4 Character Recognition

The major problem in character recognition is the vast number of fonts used in plates. We figured the best way to address this is to train a network to find the letter/number from a cropped image of the character. This way, the network can learn features associated with each letter/number, and can thus be used for covering various fonts, including those used in the painted plates. For this, we employed a pytesseract for classification.

This method worked very well and gave satisfactory results. However, confusion did occur between characters with similar features such as O and Q, I and 1, O and 0, S and 5 and even A and 4 in some cases. We got the following result after passing the picture from the pytesseract module as shown in fig 3

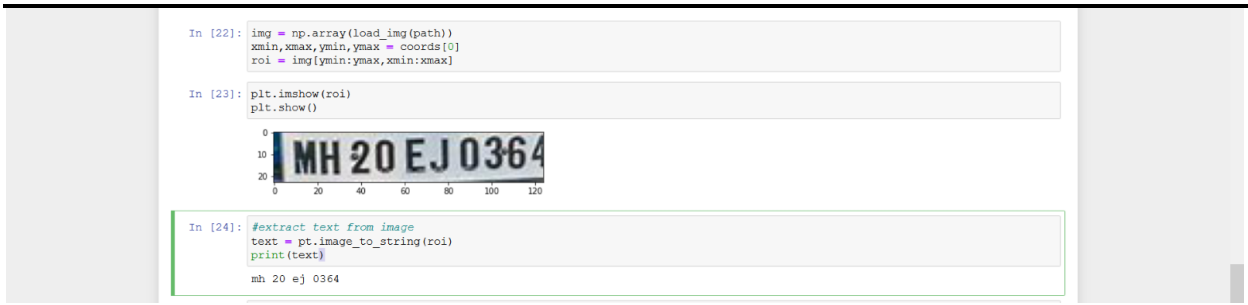

Fig. 2: number plate recognition

IV. CONCLUSION

Database of the image consists of images with different sizes, background, illumination, camera angle, distance, etc. The experimental results show that the number plates are extracted faithfully based on the TensorFlow detection model with a success rate of 85%. The character recognition phase using the pytesserect module works well with a success rate of 80%.

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