License Plate reader with PUC Details using Image Processing and Deep Learning

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***Abstract*- As each vehicle is uniquely acknowledged by its license plate, the Transport System places a high priority on finding and recognizing of license plates. The news is constantly reporting on accidents and missing cars. Authorities must acknowledge all of these unlawful acts. As a result, research into the identification and recognition of vehicle number plates is ongoing. However, identifying a vehicle's number plate has always been difficult for a number of reasons, such as brightness changes, shadows cast by moving vehicles, erratic license plate character types, different plate styles, and color effects caused by the surroundings. In this system, Number plate of vehicle is detected from a live video or an image. There is image preprocessing and segmentation done on the live video or number plate image. Deep learning model methods are used, the characters from it are separated and then each character gets recognized. This helps to collect the vehicle overall project then the capabilities of different techniques into one integrated automatic system are summarized. This kind of systems can be implemented on the roadside and makes a real time comparison between passing car and list of stolen cars. This detected license plate number could also be used in car parking systems. PUC which stands for Pollution Under Control, where emission levels of vehicles and the regular renovation of the PUC certificate is done or not is verified and the details are shown. This will help in keeping an overall check on vehicles and the task which most of the places do manually to check the PUC certificate for checking status, can be verified quickly and the fine can be implemented as per so.**

***Keywords*- Image Processing, Deep Learning, OCR, Flask, HTML, CSS, PUC.**

I. INTRODUCTION

With the number of vehicles expanding on road, the leveraging process of transport related laws other an existing automated ways is not simple to approach. This situation doesn't imply to only one application, but applies across the board in parking areas of apartments, malls or airports. where the vehicle has to stop to pay the toll or parking fees. This could be used in highways where the vehicles are speeding and the fine needs to be cut for particular vehicle. Thus, there is extensive scope of enhancement available in this case. Now, "Image processing" is commonly used by a huge range of application and in different types of electronics like a mobile phones, computers, hi-tech cameras. The images characteristics can be changed with the least amount of effort such as contrast enhancement, finding borders, measurement of intensity and applying different mathematical methods to make the photographs more and more enhanced. Although these techniques could be impactful, the person who consumes them find controlling them easy in a dump format, but getting to know the basic principles behind the effortless image processing schedule is rare but important. The increasing emissions are the critical threats overall leading to global warming and pollution. To curb this mostly in the sector of transport and vehicles, Government of India decided to insist certain limitations or estimated value parameters for vehicles differing in range. According to the Central Motor Vehicles Act of 1989, every vehicle must adhere to these rules, so that the emission levels are under check with a PUC certificate. Reducing pollution is a big challenge overall and to ensure all the vehicles are under controlled limit and not exceeding the legally estimated value is what is important. Because only being a law following and abiding citizen isn't important, but taking care of your environment in curbing the pollution and doing your own little part pays for a long way.

II. LITERATURE REVIEW

The authors in [1] discuss to implement an Indian vehicle number plate detection and recognition using image processing systems to work with difficulties such as varying illuminated images, bright or dark objects, cross-angled or skewed number plates, noisy images, etc. The authors in [2] discuss a proposed methodology for preprocessing, license plate localization, character segmentation and recognition. The authors in [3] discuss a cutting-edge technique for improving the accuracy rate of deep learning models trained using an extensive database for CCTV image-based vehicle license plate recognition. The license plate area, which is of interest, is included in the image that can be obtained using the model. The authors in [4] propose a model/system that focuses to optimize and improve the efficiency of ANPR. The system is trained for car and number plate recognition and the software is built using python. The authors in [5] profoundly emphasis on ML algorithms such as K-Nearest Neighbors (KNN) as manual efforts of humans will decrease along with the error rates. The authors in [6] discuss a

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proposed methodology which works with steps- Building RCNN model to detect number plate, Detection, Character Segmentation, Recognition, Save to the database. The authors in [7] talks about using Text-line construction and RBF method to do localization and also Radial Basis Function Neural Network (RBFNN). The authors in [8] are mainly focusing on detection and recognition of multiple cars license plate from a single frame. License Plate detection based upon the summations of mathematical morphology pointers and edge statistics giving high quality results. The authors in [9] showcase a plan leveraging a system based on deep learning method where SSD algorithm is mixed up with K-Nearest Neighbors algorithm and CNN classifier, for searching out the stolen or suspicious vehicles without intervening any humans in between. The authors in [10] find out the methods and techniques used in ALPR and constructive analysis of related studies in that same respective field. So that the decisions can be made by the same system designers. It consists of two main approaches which are Multi-stage and Single-stage. In discussing [11][12] Deep learning and machine learning techniques are considered with a priority on specialized features of extractions and classifications. In paper [13] author used three different character recognition algorithms, K-NN, SVM, and Tesseract, each having its own set of hyper parameters for optimization, were utilized after Gaussian smoothing and Gaussian thresholding. In article [14] Yolo method is used in the proposed system for license plates detection, which involves the use of various filters and the segmentation of the characters. Within the coverage area of a network of cameras installed, this paper [15] proposes a vehicle route monitoring system that identifies and detects moving objects. The system gathered information from cameras, processed that data, and then informed the user with the route and current location of the desired car.

III. System Design

A. Design Details

The following procedures are commonly used to categorize ANPR (Automatic Number Plate Recognition) work: character segmentation, character recognition, and number plate extraction. In the subsequent character segmentation stage, just the number plate portion of the entire input image is identified and processed further. Each and every character is split and segmented during the character segmentation phase. In the character recognition phase, each character is recognized based on a choice of defined character features. The segmentation sector separates out the characters in a singular manner. And after that recognition part recognizes the characters giving up the output as the plate number of particular vehicle. In general terms, this system takes in the photograph of a vehicle with Indian standard number plate

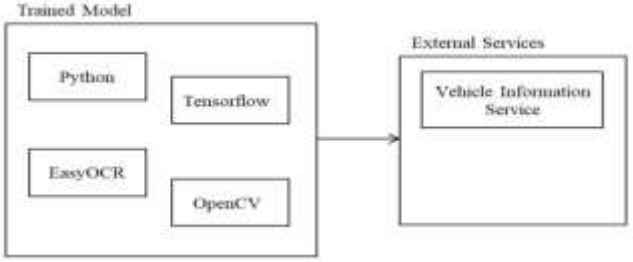

Fig.1 Basic Overview

as its input and produces the characters portrayed in the form of computer data as its output. Localizing is an algorithmic function that regulates what aspect of the vehicle's image is the number plate. The algorithm finds for a same background color of integrated proportion and contrast as a means to differentiate objects on a vehicle. The API link used for fetching the owner's vehicle registration and Pollution Control Status details, can be generated on own or an already existing API could be used. When API is accessed within the code, extracting store data, sharing and displaying required data becomes easier. Here, the registration number acts as a unique key which after submitted, the further details are displayed.

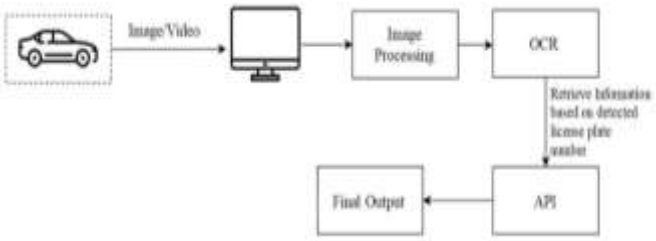

Fig.2 Trained model and External services

IV. Methodology

A. Analysis and Framework

The steps necessary for creating the plate number detection project are described as follows:

1. Labeling- First the image is collected. Then, using open-source, Python GUI-developed service called Image Annotation Tool, annotate the photographs for object tracking of number plate. Data is then saved in XML format.
2. Training and Saving the Model- For the conversion of data from an unorganized manner to organized one, the diagonal area of each photo/image needs to be extracted for the data conversion to take place later on.
3. After the object detection model training procedure is complete, an image is cropped to incorporate the license plate number, which is also described as the region of interest (ROI), and the ROI is then provided to the Python-based Optical Character Recognition API Tesseract. (Py Tesseract).
4. After that accuracy of image is tested and further we extract the text from it. Everything is put together and Deep Learning Model is built.
5. The API link needs to be used in the flask deploying process which is used to show the vehicle's basic information as well as the PUC status and the emission count of hydrocarbons and pollutants released from the vehicle causing pollution are compared with the estimated value are also shown. According to the fuel type, the vehicle either being petrol based or diesel based, the components will differ and for petrol the hydrocarbon emissions will be shown and for the diesel it is Light Absorption Coefficient.
6. In the last step, when the module is ready, model is deployed and hosted on web using Flask. Here, WSGI plays for Python web application development. It is the common interface between web servers and web applications.

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B. Details of hardware and software

Python - open source Software inbuilt library such as
1.Scikit -learn(scilearn) –A Machine learning library for executing, training and testing performances based on the
2.cv2/opencv - Image Processing library to implement various operations on the image and also to amplify the image.
3.Keras – It is used for both machine and deep learning of the image also for model building and training purpose.
4.Tensorflow – A Machine learning library used to proficiently work with multi-dimensional arrays which is the image read in numpy format and also provides the ductility of computation across machine and huge datasets.
5.OCR Model - Python OCR is a technology that perceives and pulls out text in images such as scanned documents and photographs using Python. This can be done using the open-source OCR engine Tesseract. The most commonly OCR tools that are used is the Tesseract
6. Rapid API- A software or tool to create our own API's which can be used for projects. The user has the option to keep the API Public or Private, giving access to a few members, as per his/her choice. This APIs can be modified accordingly with our own data and could be used further for same purpose.
7. Flask - Flask is a web framework written in Python, it develops web applications very easily. It has many special features like URL routing, template engine. It is a WSGI web app framework.

C. Proposed Method

First Cascade Classifier is used for detecting the vehicle's number plate region.
Then there is a plate detect function used to detect number plate and cropped region is returned to function which will be called by another function named display image.
Image parameter is then taken and converted from BGR color code to RGB color code and displayed it on screen using matplotlib and the car and cropped plate image is shown.

Contours method of cv2 library is used to find boundary points of an object in the image and create a rectangle around them.
Cropping of image takes place using image segmentation.
Now to calculate the accuracy, ML and DL libraries such as tensorflow ,sklearn and keras are imported.
While the model is still training, augmented image data helps augment images in real time.
F1 score defined functions help train the model with precision and accuracy. Model is trained and dimensions are performed.

At last to get the vehicle owner information, libraries such as REQUEST, xmltodict, JSON are used to convert the data into useful information and then the trained model is saved using pickle.
The API's play a huge role in providing the data, as new application components can be integrated into the existing architecture and could be made accessible for displaying that particular identity's data of the vehicle.

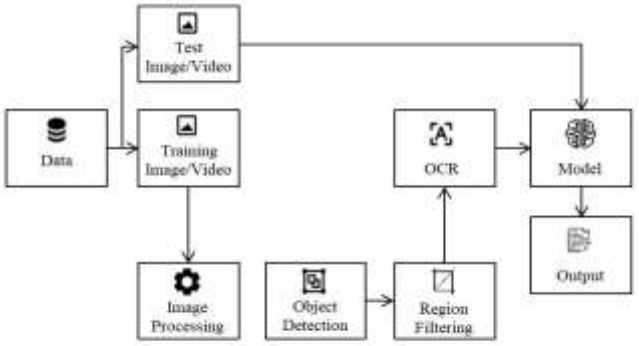

Fig.3. Architecture for number plate detection

D. Flowchart of the process

The below flowchart describes the process through which the cropped and segmented image can be achieved. The received image can be used for various purposes like identifying stolen vehicles using the API which contains the database of vehicle information.

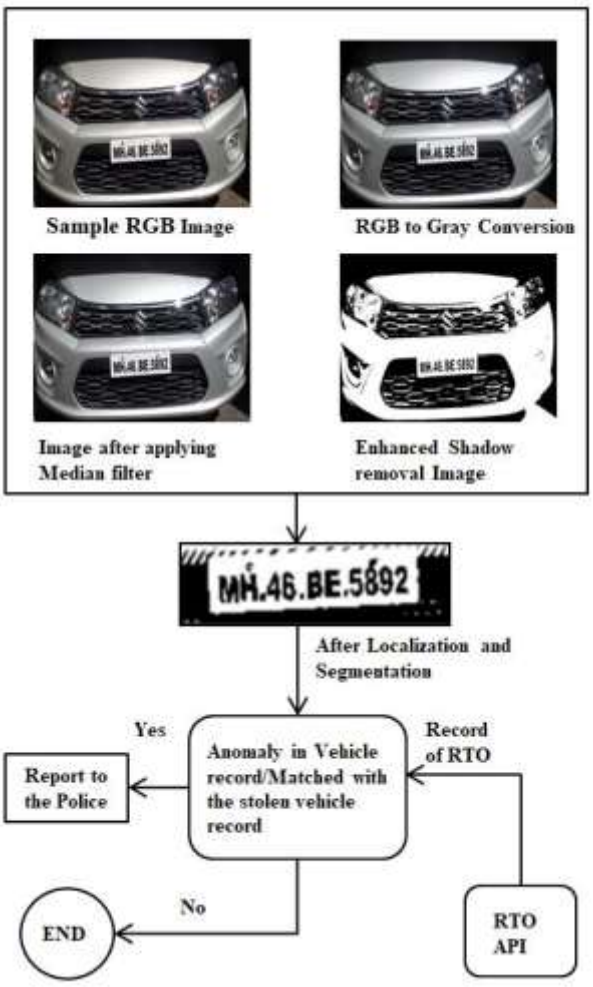

Fig.4. Flowchart of the process

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V. RESULT

A. Vehicle RC Verification

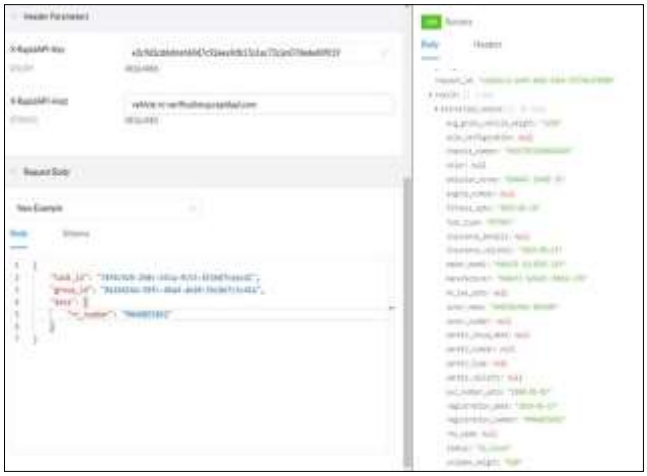

Fig.5. Verification API

The Fig.5 shows customized API interface which gives car details such as make, model, color, owner name, registration date etc.

B. Detection from an Image using Tensorflow & EasyOCR

We have used two key libraries for ANPR:
First, Object detection to find a region of interest.
Then Easy OCR to extract the text.
Real time webcam feed grabs image of a plate.
Tensorflow Object Detection will be used to detect the plate trained on the dataset.
EasyOCR to extract the text and implement a size filtering algorithm to capture the largest detection region.

Fig.6. Detection from an Image using Tensorflow & EasyOCR

TABLE 1
PARAMETERS

Input Parameters	Output Parameters
Image (can have any amount of noise or unnecessary data).	Detects vehicles (with and without) license plate.
Images with some skew or invisibility in some portions may be present.	Number/license plate region is detected and tracked.
Video feed (can have a still or a moving subject whose information/text needs to be tracked).	Decodes license plate, vehicle make, model, color and more.

C. Flask Web App details

Fig.7. Flask web App Home page

In Fig. 7, a frontend framework is displayed where the vehicle image can be uploaded in PNG, JPEG, etc. types of formats.
Also an image can be captured at the very moment and uploaded directly which will fetch the vehicle details acquired by the model and display it as shown in Fig. 8 and TABLE 2 shows necessary Output parameters for carrying out the fine collection process.

Fig.7. Details of ANPR

TABLE 2
DETAILS FETCHED USING API

Input Parameters	Output Parameters
Registration Number Of the Vehicle	1.Registration Number 2.Registration Date 3.Chassis Number 4.Fuel Type(Petrol/Diesel) 5.PUC Status(Yes/No)

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V. Conclusion

The vehicle number plate detection and recognition methods are briefly described in this project. This machine learning systems play an essential role in the development of a smart commuting network. Along with it, this shows the ease in the process and the pocket friendly way to develop an all-in-one system that is a summation of deep learning technologies and machine learning to provide an ultimate solution to complications humans face in their tasks. Along with these, if this process gets implemented in highly polluted areas and every single vehicle goes through gets checked, it might help the pollution get in control, rather than the certificates getting checked manually or not getting checked at all.

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