

Automatic License Plate Recognition System

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Abstract: In many cities, there are still parking lots and tolling stations that are checking parked cars and toll manually. This old type of enforcement is not fully efficient anymore. It is hard, costly, and time-consuming to physically check for permits. Also, using this way it is more difficult to catch and prevent violations on time. To address this, we are proposing a new system that uses object detection to recognize number plates and Pytesseract for character and digit extraction from the plate. We are presenting a robust and efficient Automatic License Plate Recognition System. We will Web App with a Python program that will automatically recognize number plates from camera captures. This neural network trained is to be able to perform with high accuracy of nearly 90-95 percent in recognizing licenses even in a lower resolution using this system.

Keywords: Object Detection, OCR, Python, Pytesseract, Open CV.

I. INTRODUCTION

Increasing traffic in the cityscape makes it more and more difficult to manage vehicles and prevent traffic violations. The traditional method of manually checking the plates and inputting them into systems can be slow, hard, and labor-intensive making it less and less effective, for both, the driver of the vehicle and for the authorities.

To simplify this problem, we are proposing a solution to create an application that captures images of the vehicles and uses object detection and character recognition to give the user the number plate text, which can then be used to match with the database of number plates.

1.1 Existing Systems

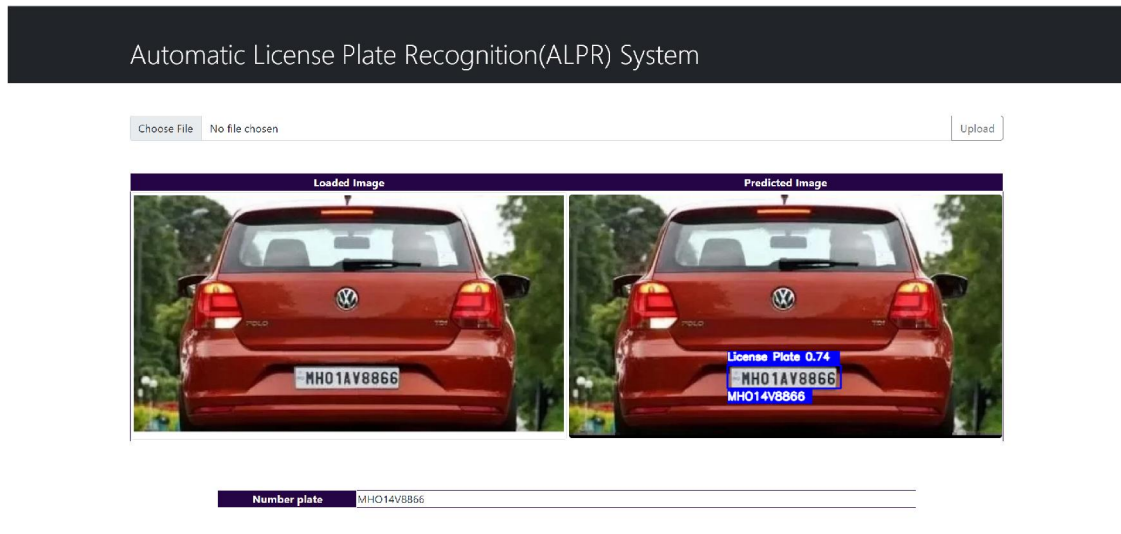
Existing recommendation systems are Tattile ALPR, ELSAG, and Vigilant Solutions.



1.2 Problems with Existing Systems

- Current systems require powerful hardware to work properly
- Requirement of high-end cameras for image capturing and processing
- Plate variations in Indian number plates
- Privacy concerns as those software store images in their databases

II. PROPOSED SYSTEM

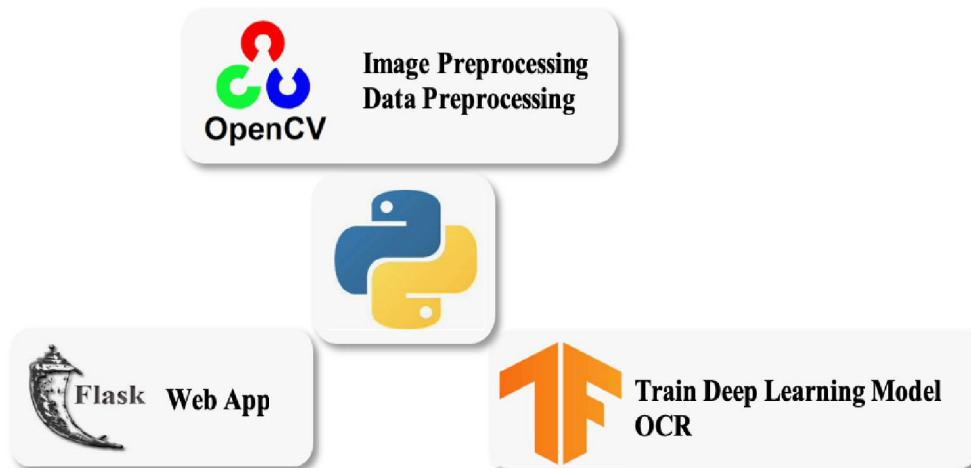


2.1 Benefits of the Proposed System

- This system can work on minimum hardware which is affordable for all levels of organizations.
- This can effectively work on low-resolution cameras.
- Compared to traditional methods, this is superior as it has high accuracy, is faster, and is more efficient.

2.2 Methods

There are size major steps in the development of the proposed software. This uses Flask for User Interface, deep learning models for training our model, and Optical Character Recognition to recognize numbers and alphabets. The hardware requirements of this system include a laptop or a computer running Windows 7, 8, 10, or 11, an x64-bit processor, 4GB or 8GB RAM, with recommended processor Intel i3, i5, or AMD Ryzen3, or 5. A dedicated is also recommended for better performance.



III. LITERATURE REVIEW

Muhammad Tahir Qadri in this anticipates [2] the recognition the OCR techniques is used which is susceptible to misalignment and to various sizes. The affine transformation can be used to advance the OCR recognition from various size and angles. The programmed vehicle identification system using vehicle license plate is exhibited. A series of image processing techniques of the system for identifying the vehicle from the database stored in the PC.

S.Kranthi, K.Pranathi In this paper they [3] proposed that Automatic Number Plate Recognition (ANPR) is a method that catches the vehicle image and confirmed their license number. ANPR can be used in the presentation of stolen vehicles. ANPR can be used in various manners by using to identify it stolen vehicle on the highway.

Abd KadirMahamad In this paper they explained [8] an automatic number plate inspection of letter sets of plate using image processing and optical character recognition. An imperative system has been created of training interface using LABVIEW software.

Kuldeepak et al. In this paper [1] they introduced that high level of precision has been required by the number plate recognition when streets are occupied, and number of vehicles are passing through. In this paper, by optimizing different parameters, they have accomplished an exactness of 98%. It is essential that for the tracking stolen vehicles and monitoring of vehicles of an exactness of 100% cannot be bargained with. Therefore, to accomplish better precision streamlining is required. Additionally, the issues like stains, blurred regions, smudges with various text style and sizes ought to be remembered. This work can be further boundless to minimize the errors because of them.

AmrBadr et al. In this paper [8] Automatic recognition of car license plate number got to be indispensable part in our day-by-day life. This paper mainly explains an Automatic Number Plate Recognition System (ANPR) using Morphological operations, Histogram manipulation and Edge discovery Techniques for plate localization and characters segmentation. Artificial Neural Networks are used for Character classification and recognition.

R. K. Varma [10]A state of art image processing technique for dealing with noisy and substandard Indian number plates, as previously presented models, performs well under controlled conditions such as clear text, fine illustration, and perfect angles. The shoddy images undergo morphological operations and Gaussian rectification as preprocessing. Plate detection is done by applying contours formulated on character cartography and proportionality. Then, the extracted region of interest is filtered and deskewed to pass to the KNN model for character identification. The following work gives an accuracy of 96.22%.

IV. ALPR SYSTEM ARCHITECTURE

Architectural design is the process of creating a model plan or blueprint for the construction of a building or structure. It involves the creation of a conceptual design, followed by a detailed design that includes specifications for materials, construction methods, and engineering systems. Architectural design is typically undertaken by architects or architectural firms who have specialized knowledge in the areas of design, engineering, and construction.

The architectural design process typically begins with a needs assessment, which involves determining the requirements of the client or users of the building. The architect then creates a conceptual design, which includes sketches, renderings, and models that illustrate the proposed building's form, function, and aesthetics. The conceptual design is refined through feedback from the client and other stakeholders, as well as technical considerations related to engineering and construction.

Once the conceptual design is finalized, the architect creates a detailed design that includes specifications for materials, construction methods, and engineering systems. This includes plans for foundations, walls, roofs, doors, windows, and other architectural elements. The architect also works with engineers to design the mechanical, electrical, and plumbing systems, as well as other specialized systems such as fire suppression, security, and audio-visual.

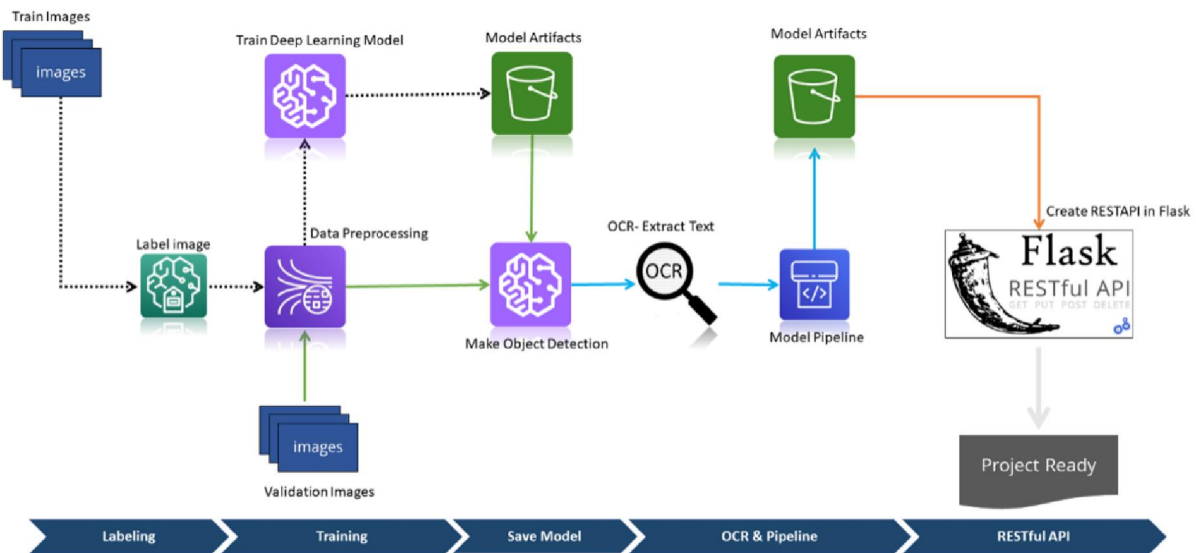
Architectural design is a collaborative process that involves coordination with other professionals such as engineers, contractors, and subcontractors. Effective communication and collaboration among all parties are essential to ensure the successful completion of a project.

The functions of architectural design include:

Determining the needs and requirements of clients or users of the building

- Creating a conceptual design that illustrates the form, function, and aesthetics of the building.
- Refining the conceptual design through feedback from stakeholders and technical considerations
- Creating a detailed design that includes specifications for materials, construction methods, and engineering systems.
- Balancing considerations such as aesthetics, functionality, sustainability, safety, and cost
- Ensuring compliance with relevant building codes and regulations

- Coordinating with other professionals such as engineers, contractors, and subcontractors
- Managing the construction process to ensure the building is constructed within budget and time constraints.
- Ensuring that the building meets the needs of the client or users.
- Providing solutions to technical problems that arise during the design and construction process.



The proposed ALPR System has the following six steps as follows:

Labeling

For building the license plate recognition we needed data, for that we needed images of vehicles where their number plate appeared on it. As images are a very unorganized form of data, we needed to process them and organize some form of organized data for the algorithm to work on it.

We labeled the images using the LabelImg image annotation tool.

LabelImg is a straightforward and basic tool to label a few hundred images to create a dataset for computer vision model training. The annotations can be saved as XML files in PASCAL VOC format.[4]

Labelling of data is a manual process which must be done for all the images being used for testing. This step has direct impact on the accuracy of the model

Output of this step is an XML file, the file contains information such as the file name, file path, image dimensions, type of file and the most important information used for training of the model i.e., the bounding box.

We parse the XML file into a CSV file using the python library xml.etree, pandas and glob. We individually take each file, and we find the binding box. We, then, extract xmin, xmax, ymin, ymax and save those values in the form of an array, which is then saved into a CSV file.

Now the unstructured data has been transformed into a structured data.

Data Processing

As the test images might be of different size, we first need to resize the image into a specific size 224×224 which is the standard compatible size of the learning model

We the split the data into training and testing set using numpy and sklearn.

Deep Learning for Object Detection

We are using Inception-ResNet-v2 as a pretrained model for image classification and object detection.

Inception-ResNet-v2 is a convolutional neural network that is trained on more than a million images from the ImageNet database [5]. The network is 164 layers deep and can classify images into 1000 object categories, such as keyboard,

mouse, pencil, and many animals. As a result, the network has learned rich feature representations for a wide range of images. You can use classify to classify new images using the Inception-ResNet-v2 network [6]. We are now ready to train our model with pre-trained weights and save it to our systems.



Pipeline Object Detection

This is the final step in the objection detection, now we are putting together and get the prediction of the given image. We draw a bounding box on top of an image, with four points mentioned earlier. This rectangular bounding box bounds the number plate in the given image.

We will get an output image and the coordinates of the bounding box which can be used for further processing.



Optical Character Recognition (OCR)

We will be using tesseract to recognize text from the bounding box. Tesseract is an open-source optical character recognition (OCR) platform. OCR extracts text from images and documents without a text layer and outputs the document into a new searchable text file, PDF, or most other popular formats.[7]

Limitations with Tesseract [9]:

- Tesseract is prone to errors if the separation of the foreground and background of the image is not significant.
- Tesseract does not support all file formats by itself.
- Tesseract does not recognize handwriting.
- Tesseract does not have a Graphical User Interface (GUI), which means that you have to connect it to your existing GUI or have one developed.
- The OCR is not as accurate as some commercial solutions available to us.
- Poor quality scans may reduce poor quality recognition.

Now, we extract number plate text from image, we start by loading our image and converting it into an array. We crop the bounding box with its coordinates. This bounding box is the major region of interest.



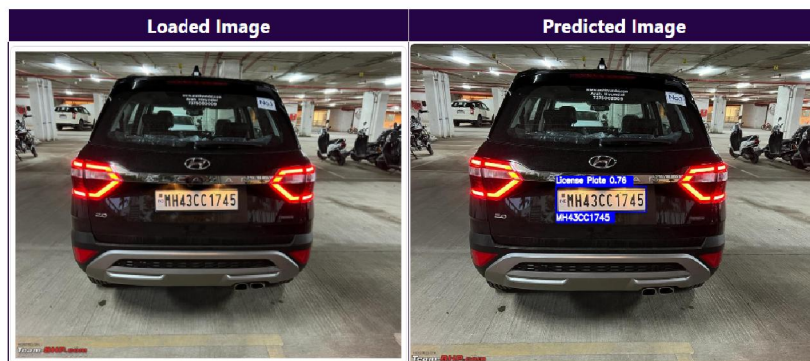
Number Plate Web App

We will use python to create interface for the user to interact with. We create templates for the interface. We also need to upload the file; we will receive it using flask and save it in our folder.

Now when we are uploading picture of car with plate number, our model predicts the bounding box, crop it simultaneously, save outputs. To display it on web we will modify our page and add text future to save text as well.

Automatic License Plate Recognition(ALPR) System

Choose File No file chosen Upload



Number plate MH43CC1745

V. CONCLUSION

As the number of vehicles on the road continues to grow, effective vehicle tracking has become crucial for traffic control, surveillance, and tracing stolen cars. Real-time license plate detection and recognition are essential for this purpose. However, recognizing license plates in developing countries is particularly challenging due to variations in font style, size, color, background, and non-standard characters. A deep-learning approach can help address these issues and improve license plate recognition efficiency. The approach has been validated using images captured under varying conditions and can benefit law enforcement agencies and private organizations in enhancing homeland security. Future work may involve further training and validation of the existing algorithm using the hybrid classifier method, as well as enhancing the system's robustness to handle varying weather conditions.

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