MORPHOLOGICAL IMAGE PROCESSING FOR LICENCE PLATE RECOGNITION USING IMAGE TO TEXT CONVERSION

H Harshitha1, Kushalatha.M.R.2, Nagesh B S 3, O. PrudhviTej 4, Rakshith S 5
Department of ECE,
Nitte Meenakshi Institute of Technology, Bangalore

Abstract: **In recent years, vehicle number plate recognition system has become a crucial role in the development of smart cities for vehicle management, investigation of stolen vehicles, and traffic monitoring and control. License plate recognition system has three stages, including license plate localization, character segmentation, and character recognition.The objective of this paper is to focus on the design of an intelligent and efficient License plate Recognition (LPR) system that would recognize the characters from the license plate after the input image is processed using various processes such as thresholding, edge detection, and morphological transformations like dilation, opening, erosion etc. Once the image is processed, the characters are recognized using Machine Learning (ML) algorithm. Later, the characters are matched against the data stored in the database where all the details pertaining to the owner of the vehicle is stored and the check is issued for the same.This paper presents the implementation of image to text conversion. Paper describes the various steps required to extract the text from any image file and create a text file which stores the information extracted from image file. It considers the shortcomings of various other applications and overcome them by applying the variable level of image processing and filtration. The CV2 OpenCV library using Python language is used for image processing and Machine Learning Algorithms (K-NN and SVM) is used for text extraction from processed image. The variable level of image processing ensures that different images get different levels of treatment in order to produce optimized text results.**

Index Terms **– License-Plate, OpenCV, Machine learning algorithms.**

I. INTRODUCTION

In today's world, especially in countries where population is high like India, with the increasing number in the vehicles, there is an increase of traffic in metropolitan cities and towns. To manage the traffic in such given places has become a hectic. Moreover, the people are not patient enough to be bound by the traffic rules, which often they end up breaking it.

Earlier, there was no surveillance system deployed in the traffic junctions to find out the vehicle number and the person details who has not followed the traffic rules. The traffic police had the responsibility of noting down the license plate number of the vehicle which did violate the rule. Police were using either the simple camera to capture the vehicle image or they used to write it down on a paper. Later, they must go through the registry to note down the person's name and details to file a complaint for the vehicle number. Now this involves a lot of human effort. There is a good possibility that victim may escape the sanction if the data is mishandled or lost.

So, the objective of this project is to design an intelligent and efficient Automatic Number plate Recognition (ANPR) system which is an application of morphological image processing that would recognize the characters from the license plate.

A.BRIEF HISTORY OF TECHNOLOGY AND CONCEPT:

Morphological Image processing:

Morphological image processing is the process which is used to perform several operations on an image, toextract someinformation from it or to get the image, which is enhanced by performing several operations like pre-processing, enhancement, edge detection etc obtained from paper [1] etc.

It is a process in which input will be an image and output will be image or characters which are extracted from the input image.

Image processing includes the below steps:

- Importing the input image using acquisition tools.
- Analyzing the image and manipulation using morphological image processing techniques.
- The output can be a transformed image, or a report based on image analysis.

II. RELATED WORK

In the paper[1] they have usedmapping algorithms like Sobel, Canny and fuzzy logic, convolution and medium filtering are applied on images of vehicle license plates, using non-linear feature extraction and spatial mapping.Main idea of this system is to design and develop image processing techniques and algorithms to localize the license plate in captured image, and divide the characters from that number plate and to identify each character. In this paper[2] they have used K-NN Machine Learning. The paper[3] uses the system that first would capture the image of the vehicle, captured images are then extracted by using the segmentation process which includes OCR technique.The process is done by implementing steps such as image acusition, gray processing, image binarization, and number plate recognition in MATLAB. The paper [5] uses the Sobel filter, morphological operations and connected computer analysis for extracting the text from vehicle number plate.This is based on CCA and spectral analysis, and then character recognition based on SVM technique. The paper [9] De-noising of number plate is done using various filters. The characters of number plate are segmented by CCA and ratio and analysis as well. Finally, the recognized characters are compared using techniques such as SVC, Extra tree classifier, LR+RF, and SVC+KNN. In the paper [12] they developed an ANPR system that performs better in a variety of tough settings than prior proposed ANPR systems.According to our findings, we were able to produce solid results with LPD accuracy of 99 percent and LPR accuracy of 95 percent, similar to commercial ANPR systems such as the Open-ALP Rand Plate Recognizer.There is a different methodology in paper [13], because of differences in viewpoint, shape, color, different formats, and non-uniform illumination conditions at the moment of image acquisition, the Vehicle License Plate Recognition (VLPR) process is difficult.

III. SOFTWARE USED

A. Python

Python is a general purpose, dynamic, high-level, and interpreted programming language. It supports Object Oriented programming approach to develop applications. It is simple and easy to learn and provides lots of high-level data structures

B. Numpy

Numpy is a Python library for array manipulation. In Python, we have lists that are quite similar to arrays, however they can be quite sluggish. Numpy aspires to be 50 times faster than Python lists when it comes to arrays. It's called import Numpy when it's imported.

C.Matplotlib

Matplotlib is a graph plotting library in python that serves visualization functionality. This library is imported as *from matplotlib import pyplot.*

D. Scikit-image

Scikit-imageis a python library comprising of various image processing algorithms. It contains algorithms for filtering, mathematical morphology, segmentation, analysis and more. It is also designed to interoperate with Numpy**.**

E. Scikit-learn

Scikit-learnis a python library for machine learning applications. This consists of various classification and regression algorithms such as *random forests, k-nearest neighbour, k-means,support vector machine,*etc. Here, we have made use of *SVC* and *KNearest Neighbor* for SVM and KNN algorithms to recognize the characters from segmented license plate.

Hardware Requirements

- RAM - 4GB Recommended.
- Processor – i3 and above
- Web Camera

Software Requirements

- Operating systems – Windows 7 and above
- Editor – PyCharm (Latest version)

IV. ALGORITHM FOR LICENSE PLATE DETECTION

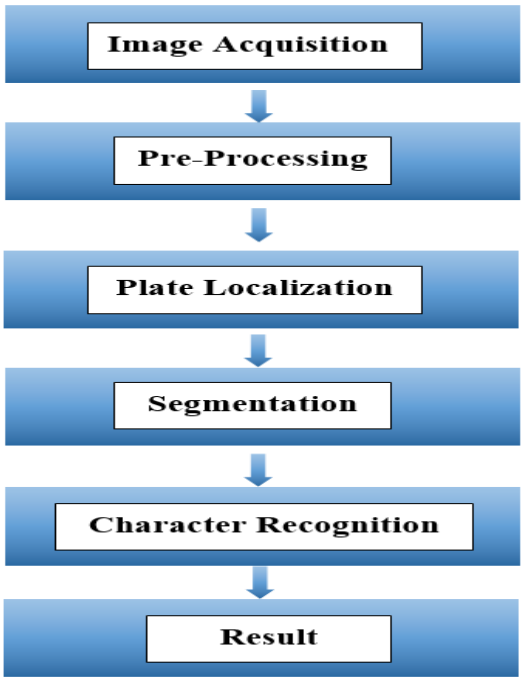

Figure 1: Depicts the algorithm used for the License plate recognition.

A. Methodology

Image Acquisition: Image acquisition is the process of obtaining an image from the camera. This is the first step of any vision-based systems. In our current project, we acquire the images using a digital camera facing towards the incoming vehicles.

Gray Conversion: The input image in RGB is converted to Gray-scale.

Filtering: The Gray converted image is **Median** filtered for the purpose of smoothening of the image. Also, it is applied to denoise the image where any presence of noise in the image could affect the further processing.

Thresholding: The process of conversion of RGB or Gray image to binary image is called Thresholding. **Otsu** thresholding technique is employed for the purpose. It is very effective in handling illumination changes as it is dynamic.

Morphological operations: The binarized image undergoes morphological processing techniques such as **Dilation, Opening** and **Erosion** in the successive stages to make image ready for the license plate area detection by enhancing the object characteristics in the binarized image.The structuring element selected for the operations is a rectangle.

Extraction of plate area: The extraction of license plate is done by **Connected Components Analysis (CCA)**. This labels the image and finds all the connected regions in the processed image. The particular region is marked as a license plate region when the connected region matches our pre-fed dimensions of the plate. The plate area is extracted in this stage referred as **Region of Interest (ROI)**.

Segmentation: The characters in the license plate are segmented. Segmentation is the most important processes in the license plate recognition. This is achieved by **Connected Component Analysis**. We assume that characters in licence plate are having a height between 35% to 70% and width between 2% to 15% of the license plate.

Prediction of characters: For the character recognition to be possible, the feature extraction plays a vital role. In our project, for the feature extraction, the data attributes are of the size 20*20 pixels which are 2 dimensional and these have to be converted to 1 dimensional attributes. And the attributes are named as *image_data*, the labels are named as *target_data*. Now it is time to train our ML model using the data loaded.**K-NN** and **SVM** are the algorithms used for prediction of characters.

OUTPUTS

Figure 2: It shows the input image that was captured from a digital camera. The illumination variation can be seen in the image.

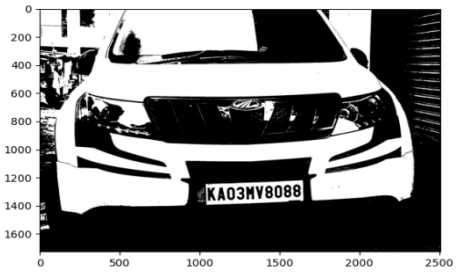

Figure 3: This is the Binary image.The input image is Filtered for the purpose of smoothening of the image.Also, it is applied for denoising of the image. Then the filtered image undergoes thresholding where gray-scale image is converted to binary image which is represented by 0's and 1'S. This is pre-processing of the image.

Figure 4: This shows the image after undergoing all the Morphological operations like dilation, opening and Erosion.

Dilation strengthens the edges of an image. Opening removes protrusions (extensions) in the image and erosion is applied to remove unwanted regions so those regions are considered while looping through the regions in search of license plate during plate localization. Here the width of the characters is widened for better segmentation.

Figure 5: This shows the Extracted License plate image from the complete image of the vehicle by plate localization process. Now these characters undergo segmentation.

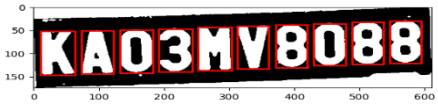

Figure 6: This is the segmented image where the characters are segmented and widened. This is obtained by looping through the objects of license plate and comparing the dimensions of objects with the reference dimensions (Width of the character is assumed to be between 2% to 15% and height of character is assumed to be 35% to 70 of the license plate). Now these characters haveto be recognized by the ML algorithms and are saved in a separate text file.

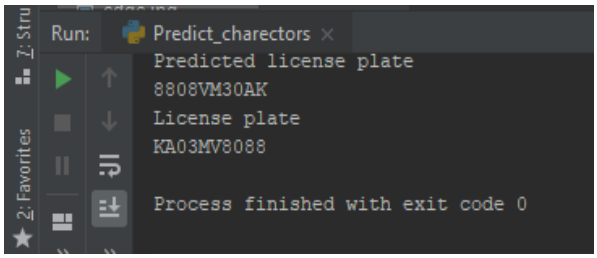

Figure 7: It shows the output of the code, where all the characters of the segmented image is recognized and finally saved in a separate text file. That can be used for any further needs. This is obtained once when all the characters are predicted using the trained models and sorting the recognized characters in the right order as in license plate.

V. RESULT

The code is developed, where the vehicle image is taken as the input and different levels of filtering and other morphological operations are applied on the image to reduce the noise and mask all the unwanted regions, only the rectangular license plate is concentrated, and finally the license plate characters are recognized by the ML trained model and saved in separate text file.

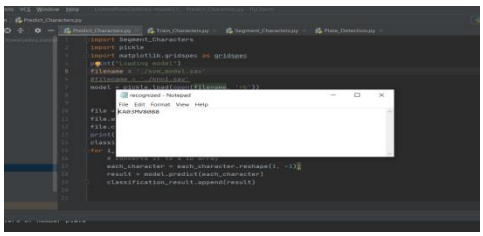

Figure 8: This is the image where it depicts how the recognized characters are written to a text file.

VI. CONCLUSION

The aim of out project is to study the Morphological classification and develop one of the applications. So, we have put license plate recognition system in place. Our system detects the license plate region from an image, which is contains the vehicle number, which is followed by character segmentation and character recognition. We tested our design on a variety of photos and discovered that it was successful at recognizing them. The concept was created with the automation of license plate detection in mind with the application of Morphological transformations which helps in better localization of license plate and in the process of character segmentation which plays a vital role in the whole project. Because when the segmentation process is deteriorated the characters may be left out which leads to the incorrect referring of the license plate.

The automation of the license plate recognition system for securityreasons that could replace the current system of manual entry. This project was a success in recognizing the license plate characters ofa vehicle although it has got its own limitation of image processing. The quality of an image comes into picture talking of its efficiency. So, the input image must be of most quality for better localization and could be with less illumination differences. Although median filtering can overcome the problem of illumination, it is better we have image of great quality. So, the digital camera that captures the image must be able to produce great quality pictures with the visible edges at least not for naked eye.

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