

## **NUMBER PLATE RECOGNITION**

### **Abstract:**

- In this Project we will be making number plate detection and recognition system for Indian vehicles.
- The proposed system first detects captures the vehicle image then crop the number plate.
- Vehicle number plate region is extracted using the image segmentation and characters are recognized using optical character recognition technique.
- The system can handle noisy, low illuminated, cross angled, non-standard font number plates.
- The morphological transformation, Gaussian smoothing, and Gaussian thresholding the different image processing techniques has been used in the pre-processing stage.
- The contours have been applied by border following and contours are filtered based on character dimensions and spatial localization for number plate segmentation.

### **Introduction:**

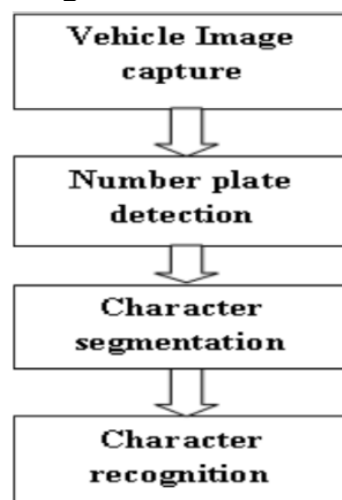
- The increase in vehicular traffic on roads creates a high demand with advancement in technology for traffic management and monitoring. These days traffic monitoring is done by computers using machine learning and image processing. It saves manpower and also accomplishes some complex tasks like counting vehicles on highways, parking violation alerts, database management, blacklisted and stolen vehicle alerts etc.
- Management of vehicles and transportation are tedious and time-consuming tasks. If it is completely operated manually that reflects enormous errors and difficulties. Therefore, it is necessary to develop automatic detection of vehicle number plate by recognition system.
- The need for residential parking spaces, entails as profession management driven approach is rising unfettered. A very large number of the worlds population live in cities and in turn require secure and easy parking spaces which they are use daily.
- The authorized vehicle registered in the parking management system along with owner information is stored in this system. Every time the vehicles enter or leave the parking lot, will trigger real time data reflecting the ingress of said vehicles.
- In recent years computer vision technology has made great strides in dealing directly with real world problems. This enables us to foresee a new era of machine vision applications.

- The aim is to explore the current challenges in machine vision applications and to stimulate the exchanges of knowledge in highly effective and practical machine vision techniques.
- In different parts of India different type of number plates are used till last year there was no standard format, so in order to identify plates low, non-uniform illumination, distant plates, blurry plates, varied fonts etc. need to be taken into consideration.
- In Indian number plate first two characters specify the State of the Vehicle's Registration which can be captured for region identification.
- An image processing system for number plate using morphological transformation, Gaussian smoothing, and Gaussian thresholding technique for character recognition.
- The goal of the project is to extract the vehicle number from images by detecting the plate location and its dimensions in pixels and recognizing the plate content.
- The object detection operation could be used for both plate detection and character recognition.
- For licence plate detection image features like colour information, edges information and textures information are commonly used.
- By transforming the color image into a gray image, it used vertical edge features to locate the Licence Plate and then applied adaptive thresholding technique to binarize the image and used the vertical edge detection algorithm to remove the vertical edges and finally to highlight the license plate region by highlighting the desired information.

### **Methodology:**

The project consists of four major phases:

1. Image capturing,
2. Number plate extraction,
3. Character segmentation,
4. Character recognition.



### Image Capturing:

- Image capturing is the process of acquiring an image.
- It is a matrix with X rows and Y columns represented as function  $f(x, y)$  having intensity values for each colour stored as a small, squared region called pixels.
- The captured coloured image is converted to grayscale image.



COLOURED IMAGE

### Image Processing:

- Due to the complexity the RGB image is influenced by many factors such as noise, blurring.
- Therefore, before the main image processing, pre-image processing must be performed which involves converting the RGB to gray.
- The conversion to gray scale results in reduce size of the image.
- The pre-processing is the first step in number plate recognition.
- The input image is first processed to improve its quality and prepare it for the next stages of the program.
- First, the program will convert RGB images to gray images. Gray scale image, contains 8 bits and each pixel represents one of the 256 values, where the value 0 represents black, 255 represents the white and other values are intermediate shades between black and white.



### GRAY SCALE

- In this noise removal section, will remove the noise image, while maintaining the sharpness of the image.
- A large amount of data is available in gray level images, and all data may not be significant.
- The edge detection is important part of processing and is done filtering, differentiation and detection. In order to remove noise, the image is passed through filters.
- Conversion of coloured to gray scale results in change in brightness and is measured by derivatives, the second derivative is zero for maximum change the differentiation stage considers the locations where there is a significant change in intensity and detection stage, localize the points where there is a significant change in intensity.
- After the number plate localization, optical character recognition is performed using segmentation, feature extraction and number recognition.
- Gaussian kernel is used to smoothen the image. This technique is highly effective to remove gaussian noise.



### SMOOTHER IMAGE

### **Image Cleaning:**

- At the end of the previous stage of image pre-processing, a binarized image, with values of either 0 or 255 is returned using inverted adaptive gaussian thresholding.
- The binarized image is the input to the detection and recognition stage.
- Edges characterize object boundaries which are useful in segmentation that is the process of partitioning digital image in to segments to identify the objects in a scene.
- The basic step in accepting a vehicle Number Plate is to see the size of the plate and we are performing transformation to find the edges and contours in the image and loop through each contour to identify number plate.

### **Threshold:**

- In this method, two distinct levels are awarded to pixels that are above and below to the selected threshold value.
- To separate the object from a background image is converted in binary form. Gray level threshold is a simple process.
- The value of threshold (T) is selected and compared with the pixel of the image. It also transforms the input image.

### **1. Morphological Transformation:**

- These are the operations based on image shapes and are performed on binary images.
- The basic morphological operations are Erosion, Dilation, Opening, and Closing. The different functions provided in OpenCV are used.
- Structuring element is to create output of same size. Using dilation and by adding pixels to the boundary of the object to increase the thickness of the edges.
- Using Shrinking operation, thinning the image to eliminate irrelevant parts.

### **2. Contours:**

- Border following also known as contour tracing algorithm is used for generating contours. Contours are the curves containing all the continuous points of same intensity.
- These are very useful tools for object recognition. OpenCV provides `cv2.findContours ()` functions for this feature.



**CONTOURS Based IMAGE**

### **3. Plate Localisation:**

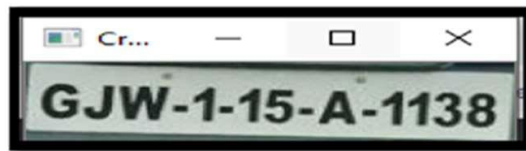
- Plate localization plays an important step in the project here we will crop the rectangle part after looping through each contour and then we will clean the image contour and feed it to pytesseract to recognise the numbers and characters.
- A bounding box is added to each number plate in this phase.
- If any of the plates suffer from distortion of angles, it performs affine transformation, a mapping between two spaces which is used to preserve line and marks.
- The parallel line preserves its parallelism after the conversion. The ratio between the lengths of the dwelling points on a straight line is maintained.
- The angles within the lines and lengths inside the points, however, are not maintained.



**Vehicle Number Plate Localisation**

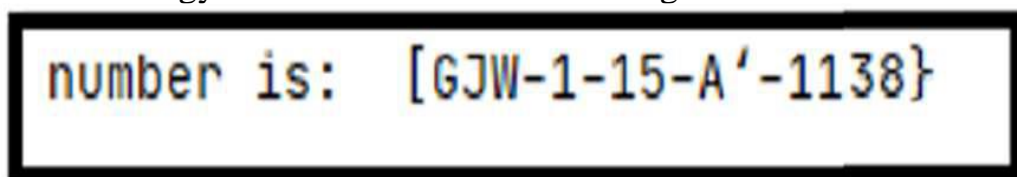
### Plate Segmentation:

- The separation of the number plate plays an important role in the project.
- We get each character with a picture of a number. In this phase two types of segmentation horizontal vertical segmentation are used.
- The vertical segmentation is performed on the number plate for vertically segmentation of the characters. It is followed by horizontal segmentation to get character from the plate. The fig. below shows the segmented plate.
- Character segmentation is a bridge between a number plate extraction and character recognition.
- In this, different characters on a number plate area are segmented. Various reasons such as lighting variance, plate frames and rotation are those which hinder the segmentation work.
- A segmentation method is also known as a boundary box analysis. By this method, characters are assigned to connected components and these are extracted using the boundary box analysis.
- The segmentation process is completed upon reduction of noise in the image.



### Character transformation and Recognition:

- This is the most important and basic phase of the system it detects individual characters.
- The separation is based on extracted features OCR technology is used for letter recognition.
- In pytesseract it is a mechanical or electronic translation of images of handwritten or typed text in text edited.
- The method of character recognition is completed by using feature extraction to extract the features of characters and their different classification techniques.
- A machine learning algorithm is used for recognition of characters from the number plate.
- The Output of License plate has shown below which pytesseract methodology which is Tesseract – OCR engine has:



**NUMBER EXTRACTED**

## MY PROJECT

- **In my project there are 2 files:**
  - Number Plate Detection – Will simply detect number plate.
  - Number Plate Recognition – Will return the number plate.
- **I have used 3 library:**
  - OpenCV
  - Pytesseract
  - Numpy
- **OpenCV:**
  - Computer vision is a process by which we can understand the images how they are stored and how we can manipulate and retrieve data from them.
  - OpenCV is the huge open-source library for the computer vision, machine learning, and image processing one can process images and videos to identify objects, faces, or even handwriting of a human.
  - When it is integrated with various libraries, such as Numpy which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV.
  - Applications of OpenCV: There are lots of applications which are solved using OpenCV, some of them are listed below:
    1. Face Recognition
    2. Automated inspection and surveillance
    3. Number of people – count (foot traffic in a mall, etc)
    4. Vehicle counting on highways along with their speeds
    5. Interactive art installations
    6. Anomaly (defect) detection in the manufacturing process (the odd defective products)
    7. Street view image stitching
    8. Video/image search and retrieval
    9. Robot and driver-less car navigation and control
    10. object recognition
    11. Medical image analysis
    12. Movies – 3D structure from motion
    13. TV Channels advertisement recognition



- **Pytesseract:**

- Python-tesseract is an optical character recognition (OCR) tool for python.
- It will read and recognize the text in images, license plates etc.
- Python-tesseract is a wrapper for Google's Tesseract-OCR Engine.
- It is also useful as a stand-alone invocation script to tesseract, as it can read all image types supported by the Pillow and Leptonica imaging libraries, including jpeg, png, gif, bmp, tiff, and others.
- Additionally, if used as a script, Python-tesseract will print the recognized text instead of writing it to a file.

- **Numpy:**

- NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.
- It also has functions for working in domain of linear algebra, fourier transform, and matrices.
- It is the fundamental package for scientific computing with Python. It is open-source software. It contains various features including these important ones:
  1. A powerful N-dimensional array object
  2. Sophisticated (broadcasting) functions
  3. Tools for integrating C/C++ and Fortran code
  4. Useful linear algebra, Fourier transform, and random number capabilities
- Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data.
- Arbitrary data-types can be defined using Numpy which allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

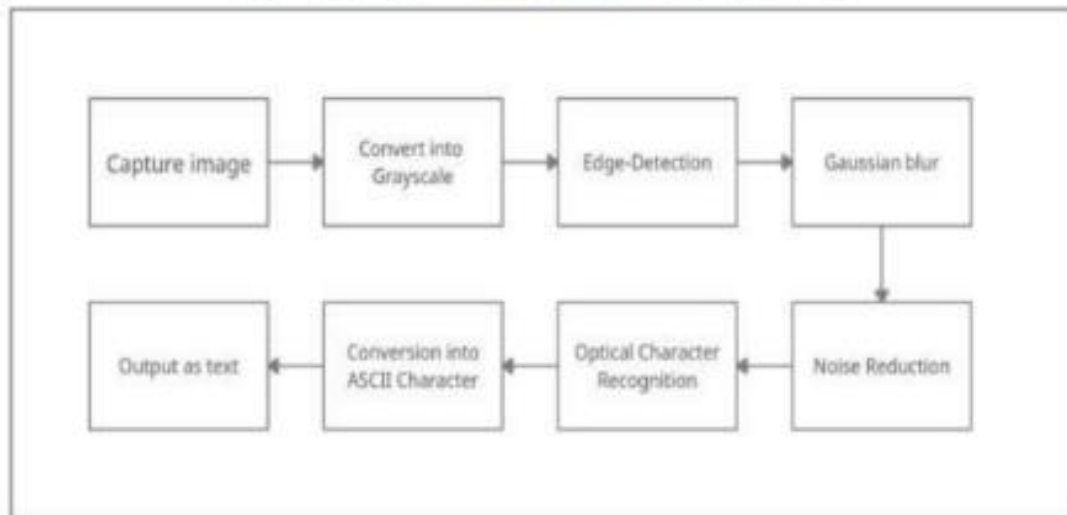
**To install the library:**

Open terminal/ command prompt and type:

~pip install pytesseract

~pip install opencv-python

~pip install numpy



**To run the code:**

**Step 1:** Import the library We are using OpenCV and numpy and tesseract

**Step 2:** Load the tesseract file

**Step 3:** Read the image

**Step 4:** Convert that image into gray

**Step 5:** Apply filter to reduce noise

**Step 6:** Edge detection

**Step 7:** Contour Detection

**Step 8:** Sort the contour according to area

**Step 9:** Find perimeter of the contour

**Step 10:** Find the no. of side

**Step 11:** If size is 4 then it is rectangle same as licence plate. Crop the original image.

**Step 12:** Convert image to string.

**Step 13:** Print the string

**Example:**

Image 1:



Image 2:



Image 3:



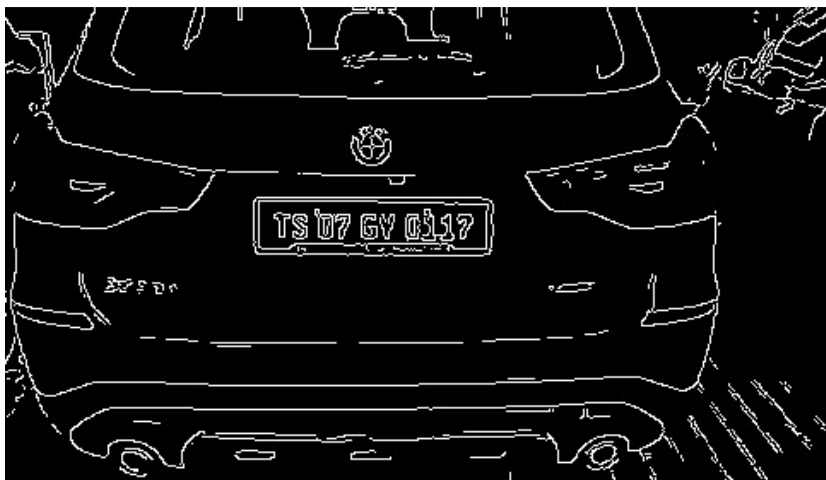
Image 4:

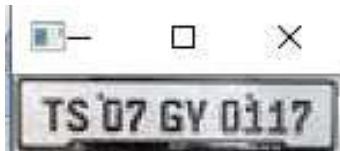
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### Future Work:

- The project can be further exploited for vehicle owner identification, vehicle model identification traffic control, vehicle speed control and vehicle location tracking.
- It can be manually and cost effective for any country.
- For low resolution images some improvement algorithms like super resolution of images should be focused.
- Most of the Vehicle Number Plate focus on processing one vehicle number plate but in real-time there can be more than one vehicle number plates while the images are being captured.
- In multiple vehicle number plate images are considered for Number plate Recognition while in most of other systems offline images of vehicle, taken from online database are given as input to Number plate Recognition so the exact results may deviate.
- To segment multiple vehicle number plates a coarse-to-fine strategy could be helpful.

### Example:





### Conclusion:

- A low cost, efficient automatic vehicle identification system has been proposed that uses a license plate for identification.
- It consists of two steps: the license plate detection and the character recognition.
- In the first stage, the license plate candidates are generated based on vertical edges to detect the license plate considering high-density.
- The system is accurate for detection and recognition.
- The proposed system works well but there is still scope for improvement.

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