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A Simple Number Plate Detection Technique with Support Vector Machinefor On-Road Vehicles

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Abstract— **A Number Plate Detection Technique is a well-known and widely used tool during current era because of the rapid increase in vehicles day by day. The detection of number plates from traffic videos / images system uses a digital image processing technique for the identification of the car registration number plate on the vehicles. This device is utilized indensely populated region to spot the vehicles which are violating the traffic rules, are handed down in malls to allot automobile parking space, identification of the stolen vehicles and also helpful in crime scene investigation. Image of the vehicle is pre-processed by reading the image from a dataset (b) converting it into a gray-scale image and (b) by removing the noises from the image using Gaussian techniques. This number plate is extracted from the image by implementing the contour enhancement method and on extracted characters, machine learning algorithmsare used to train the model to perform the segmentation. Within the character recognition process, we classify the characters. The proposed number plate detection technique shows significant improvement in accuracy rate when compared with standard existing systems.**

Keywords— ***Number Plate Detection, Digital Image Processing, Gaussian Techniques, Edge Enhancement Techniques, Machine Learning.***

I. INTRODUCTION

In earlier the number of vehicles used were very less. Nowadays, because of the urbanization the vehicles being used are being increased rapidly every year. To reduce the manual work of capturing images and preventing the vehicles from violating traffic rules, the Number Plate Detection for Traffic Videos/Images with Support Vector Machine (SVM) is proposed. This technique reduces the human resources used and also it attains the tasks which are more complex like identifying the automobiles which violates the traffic rules, parking violation, helps in crime scene investigation. In recent years, the machine learning has made enormous strides in coping with the genuine-time quandaries. This makes us to accord with an incipient strategy. To identify the number plate and to extract the characters from it, the mechanisms followed are: i) Automobile registration code localization for segregate the platefrom the picture, ii) Vehicle license Plate orientation and sizing iii) Normalization, iv) Character segmentation, v) Optical character apperception, vi) Analyzing the text from a registered code and vi) Extricate the specific type.

II. LITERATURE SURVEY

Seesam Sreeram et al. [1] developed an effective technique for automobile registered code identification with white pixel detectionmethod. The images of vehicle number plate are captured in various luminance conditions. It's ready to localize one or more plates with diverse variation backgrounds. The color vehicle image is first processed through a picture down sampling and grayscale imaging. After that, region for the required number is extricate using edges identification, binarization and filtering through line density mechanism. This system detects white pixel area, subtract detected area from binary imageto original image, cropping out white pixel area from original image decreases the efficiency of the system because it could be a time-consuming task. Abhishek L et al. [2] designed an accident detection and number plate identification using image processing and machine learning. At first, camera sensor is placed at the front of the car vehicle with average width at the rear is placed at the front a car at a distance 'd'. The gap calculated between the vehicles and alert is given. For calculating the gap, it detects the registered numberof a vehicle. The algorithms used are Support Vector Machine (SVM), Multi-Layer Perceptron, XGBOOST, Histogram of Oriented Gradients (HOG features).

P. Surekha et al. [3] developed an automatic registration number plate identification using image processing and Neural Network. This method mainly concentrates on the

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secure parking at any locality. This method has a biggest challenging partwhich is to log the time and details of the vehicle registered number when the vehicle enters into the gate. The method uses the sensor to switch on the camera and a Graphical User Interface (GUI) for a user who is able to run the whole mechanism. It runs on Raspberry Pi 2b to realize high accuracy. Back propagation in neural network may be quite sensitive to the noisy data and outliers.

Tella Pavani et al. [4] designed a number plate recognition by using open CV-python. It includes many operations like taking pictures, localizing thequantity pad, truncating characters and OCR from alphanumeric characters. The duct belief is to design and develop car plate number for image processing techniques and algorithms to localize the registered number from a plate in an image, to represent the characters in the number plate areused to identify each character of the segment with the assistance of open computer vision library. This can be implemented using K-Nearest Neighbor (K- NN) algorithm. Using K-NN algorithm with large data, the prediction stage could also be slow and need high memory.

Young Jung Choong et al. [5] reported a registration code number detection and recognition using simplified linear model. The input image is converted to a meaningful ASCII text which contains a registration code number. This method consists of methods which turns the colorful into grayscale, binarization which further converts gray scale into the black and white version. During this the performance issues are omitted by pre- processing like contrast enhancement, noise filtering, and histogram equalization. The algorithms used are Image Filtering, Template Matching, Connected Component Analysis (CCA). Using CCA, requires high communication performance to get good speed-ups in performance and parallel solution will be very challenging in practice. The system has demonstrated over 90% success rate.

Rupali Gala et al. [6] developed a vehicle number plate detection and identification which utilizes a dynamic algorithm to encounter the registered vehicle number plate from the original images. This first detects registered number plate from the car and then grabs the image. Number plate on a vehicle is localized and characters are segmented and accordingly the recognition is completed with the assistance of a Neural Network. It also identifies the registration code plates written in designed fashion. Neural Networks conventionally need more data than the usual machine learning algorithms, minimum requirement is in thousands, in order to train it requires voluminous of datasamples.

P. Meghana et al. [7] developed an image recognition for automatic number plate surveillance. This technique consists of image processing methodology for recognition of the automobile. The method can be employed in densely populated regions and barred regions inorder to facilely breached traffic violated vehicles with the assistance of their registered number plate.Image of the car is captured and detected using image processing, character segmentation is employed to locate alphanumeric characters on vehicle license number. After that the contoured characters are converted into text using Optical Character Recognition (OCR) method. This technique doesn't gain the efficiency. Using Template Matching, it doesn't allow us to test for rotations and scaling.

Bhawna Tiwari et al. [8] developed an automatic vehicle registration plate identification device using matlab. It's useful for traffic police to spot thesmallprint of a vehicle violating the traffic rules. Its applications also include automatic toll collection system and car parking systems. It is also helpful for storing the photographs nailed by the camera and consequently the numbers along with letters from the registered number code. This device allows the camera to capture an image atany of the day and in any environmental conditions as it uses infrared lighting. A robust flash can be additionallyincluded in cameras, to both flash up theimage and to bring awareness to the convict conscious about his fault. Due to automobile license plate being region specific technology turn to change accordingly, the accuracy level of this technique is incredibly less.

Swati Bhandari et al. [9] devised an Indian vehicle registered number plate detection utilizing image processing. In India the registered number plate is in two colors i.e., yellow or white as background and black as foreground color with numbers written on it in different font styles. The methodology consisting of a system for localization of registered code on a plate for automobiles in India and disjointed the numbers on spot each number on it discretely. It works in two different aspects: one way is to spot the registered vehicle code and the other way is to separate all the registered number from a code and alphabets tospot each of them separately. Thresholding edge detectors are sensitive to noise and inaccurate.

Dr. P. Pandi Selvi et al. [10] developed an approachfor the perception of characters from vehicle registration code images utilizing k-nearest neighbor classifier and Neural Networks. In this system the given image was resized and converted into a gray scale image. The feature extraction process is carried out using bi-partitioning technique. Subsequently, clustering is performed over the partitioned image with the help of modified fuzzy C means clustering algorithm. The obtained characters were then taken into the classifiers for recognition. This method is implemented with Matlab and sample vehicle number plate images are tested. Bi-partitioning algorithm is inefficient and unstable.

Ana Riza F. Quiros et al. [11] devised a mechanismwith K-NN predicated approach for character perception of transport vehicle license plate numbers. This system works with the help of installing an IP camera at heavy traffic areas and allows the video-feed to capture the vehicles. The vehicles which violate the traffic rules are detected by applying the contour techniques the segmented characters from the license plate are obtained. By using different training sets of data and each of these sets consisting of

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different characters each makes the process much more complex and a processing time for system is high.

Fei Xie et al. [12] reported a method predicated on automobile registration code detection and its character perception algorithm using a backpropagation Neural Network and combined feature model. The main advantage of this is it works for an image captured with weak illumination and also works with high accuracy for the images taken from the complicatedbackgrounds. In this, the accuracy for recognition of a license plate is 97.7% and consuming time for recognition is also very less which is 46.1ms.

Jatin Gupta et al. [13] recommended a system that detects the plate which has written multiple languages on it. It mainly discusses about the different nations using different notations. This research suggests to use YOLOv2 sensor along with the ResNet attribute extractor. This work also tested for the precision value achieved with 99.57% and classification of 99.33%. This work gives the best approaches to detect and classify the characters even based on the international vehicle registration plates.

Zhenbo Xu et al. [14] developed a system which detects a number plate end-to-end from the largely available dataset at that time which is a CCPD largest publicly available vehicle plate dataset. Andalso, further operations such as comparative studiesand finally gives declaration that this modeloutperforms all the other models in their study also calculated an accuracy which gives 98.5% at 61fps provides relatively high resolution.

Sergio Montazzolli Silva et al. [15] designed an approach to identify the number plates from the distorted image that is to identify from an image which consists multiple vehicles to use the oblique views from the data. It useda Convolutional Neural Network (CNN) in order to identify the registration number which were present on those plates in a single attempt. It compares the data and also helpful for the commercial usage in order to identify from them both.

Rayson Laroca et al. [16] made a robust system for identifying number plates in YOLO by considering the moving vehicles and defining the number of frames used per second.

Sergey Zherzdev et al. [17] devised a system in order to a system via deep neural network that is using a LPRNet (License Plate Recognition Viz. Deep Neural Network), which is a light weightConvolutional Neural Network with motivation from the detection of Chinese number plate system this work is developed. It doesn't use Recurrent Neural Network (RNN), but this LPRNet devised work used to build the embedded systems from a neural network of a deep learning mechanism.

Yi Wang et al. [18] identified a system which process the images with four insights such as re- sampling of the frameworks in an image, abundant additional character segmentation, considering the vertex information which helps us to improve the recognition capability, weight sharing capability which is in very less in datasets.

Satadal Saha [19] reported vehicle license plate recognition system as well as its capabilities in identifying the various number plates which are in various geographical location along with each of the algorithm's advantages and disadvantages.

Eduardo Todt et al. [20] presented a system which performs detection of a plate with the help of YOLO object detector it makes an efficient post- processing rules in order to search a system with the help of the building blocks which are constructed around the image. This operation is performed mainly on the public datasets, whichoccupies very less space by using the methodologies proposed.

III. PROPOSED SYSTEM

The intended structure will admit the number plates even an image is captured in cross angled. The development of the proposed model starts from the collection of image dataset. The images will be of different sizes and are captured in different environments with different angles. So, inpreprocessing the image we reduce the size of the image by performing edge detection and also convert the RGB image to gray scale image inorder to reduce the pixel size. As the challenge is to pre-process the large datasets which were captured in different angles as well as in different environments. Initially, the conversion of original image i.e., RGB image into Gray scale image is carried out.

In order to identify the images, we need to perform five different mechanisms viz. 1) to read an image from the dataset and convert it to a gray scale image 2) to apply filtering technique such as bilateral and find the edges for localization 3) to find contours and apply masking on to an image in order to find a number plate region and 4) to use optical character recognition methods to identify with bound boxes using pytesseract for converting into string format.

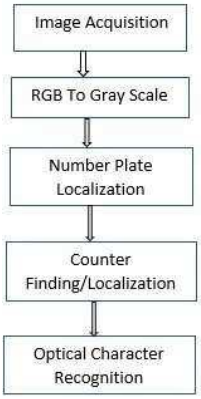

Fig.1 Block diagram of proposed system

For the experiment purpose, the proposed system considered a public dataset which is obtained from Kaggle consists of mostly the car image and few bike images whereas the implementation is helpfulto identify both the

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vehicle types. The original images dataset is mounted onto the google drive where we access the images from a drive due to software requirements, and to work virtually on colab notebook. The figure which is represented below is all about obtained from image dataset library.

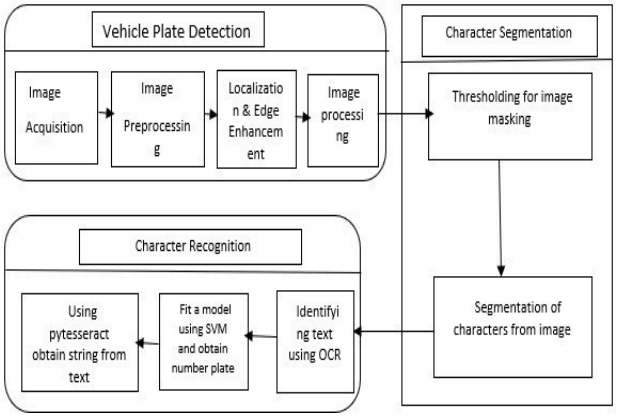

Fig.2. Proposed Architecture

Fig. 3. Original image – vehicle

Fig[3] is the original image of a car which is captured by a camera found at Data-images dataset

A. *Conversion of color image to gray scale*

By considering the original image which is a color image that occupies more pixel size in the memory. In order to reduce the pixel length of an image, the image is converted into grayscale image. These conversions are made with the help of computer vision libraries. This conversion is helpful for the further process.

Fig [4] shows the gray scale image which is obtained after preprocessing, RGB to gray scale conversion on Fig [3]

B. *Applying filters*

In this phase, filters are applied on a gray- scale image in order to reduce the noise being produced in the background. Then, canny detection is utilized to find the edges present in the noise filtered image. The image displayed using matplot function is given below:

Fig.4. Gray scale image

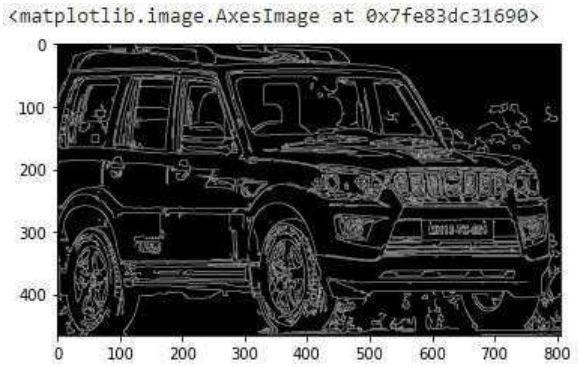

Fig.5. Localized image - vehicle

Fig [5] shows the localized vehicle image, which is obtained after applying noise reductionalgorithms as well as the edge detection algorithms to localize the edges on Fig [4]

C. Finding Contours and Apply Mask

The process performed on localized image key points are identified and they are sorted in order to find the bounding polygons around the number plate in which the size of polygon (assumed) to be four, when matched it with the location, matrix points are obtained. For masking, contours around the number plate region are drawn, used bitwise operators and then the image is displayed.

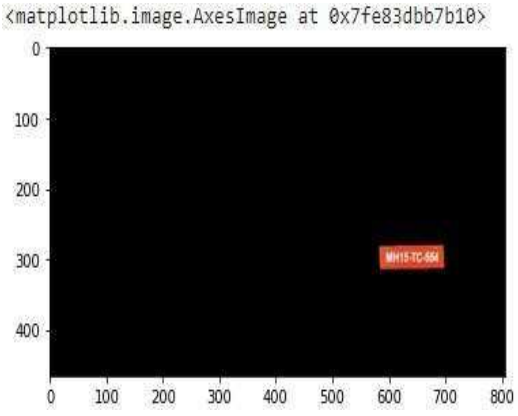

Fig. 6. Masked image

Fig [6] shows the contoured image which is masked in order to visualize only the number plate region on Fig [5]

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D. Thresholding

Thresholding is used to separate the image from a background image and the values threshold (T) are considered to calculate thethreshold value from an image and compared with the pixel range of other images. It performs transformation on the input image

(G) to an output image of a binary format(H) which is been segmented. Threshold calculates the image variation in their foreground and background pixel ranges.

$$H(a, b) = 1 \quad \text{If } G(a, b) \geq T$$
$$= 0 \quad \text{If } G(a, b) < T$$
$$H(a, b) = 1 \quad \text{For Foreground}$$
$$H(a, b) = 0 \quad \text{For Background}$$
$$T = \text{Threshold}$$

E. Support Vector Machine

Support Vector Machine (SVM) is an algorithm consisting of two class labels predicted on supervised learning which gives a superior conduct than other classifiers. In image classification, SVM plays a key role in classifying the images. Bestow to the research have disclosed thatit is proficient of delivering high relegation precision.

Support Vector Machine of a generalized linear classifiers gives the high accuracyto our model as well as fit easily into any kind of model. It is well suited for a high dimensional data and also for the data modelling tasks.

F. Easy OCR

OCR technique is used to identify the characters from a cropped image and the text from an image is displayed on to the screen with the fontHERSHEY_SIMPLEX, with the help of original image on the image with a bounded box as given inFig.7.

Fig.7. OCR Image

G. Pytesseract

Pytesseract is a deep learning library whichis used to extract characters and digits from a vehicle license plate. For this extraction, pass config file which consists of all the details to print both text and numbers in order to convert the image file to a string format.

Pytesseract is a combination of Tesseract-OCR engine and hence it allows all types of files to read and process them further. It had many operations such as noise removal, blurring the image, maskingthe image, applying bounding points to identify a particular region, erosion, edges detection, skewing of an image, template matching mechanism in order to identify the string characters present in the image. It is a Long short term memory network which works similar to the Recurrent Neural Network.

Fig.8. Cropped Number Plate Image

MH15-TC-554

Fig.9. Image to string

Fig [8] represents cropped number plate which is then converted to text format using Pytesseract andthe extracted text is shown in Fig [9].

IV. DISCUSSIONS

In this model, a dataset is considered which consists of different vehicles images on the road. Manually, the image is selected from the dataset and processed by converting the image which is in RGB to gray scale format that reduces the number of pixel size from the image being stored and the image is also blurred in order to background disturbances from the on-road vehicle. Consequently, a bilateral filter is applied in order toreduce the noises from the image and then canny detector is used to locate the edges from a number plate.

From the located edges on a number plate,now find contours for an edge copy vehicle and grab the values of contours. Once the contour values are grabbed, perform sorting, apply thresholding mechanism on the location of the plate region and display the contours.

For the sake of identifying only the text plate from the entire vehicle, masking is performed and fit itto Support Vector Machine. Finally, grab the number which is of image format with the help of pytesseract library and obtain the text region from image using text to string conversion with configuration by applying page segment mode(psm).

V. CONCLUSION & FUTURE WORK

The current era is completely based on thetechnological advancements and traffic management is always a challenging task in our country. From the survey, it is

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clearly understood that, the existing systems are susceptible to noise and producing results with less accuracy rate. Hence, the proposed system is carried out with morphological operations, adopted Support Vector Machine and utilized pytesseract for classification and identification.

The proposed work facilitates to capture images in any location irrespective of the angle and the weather conditions. It also identifies and detects the number plate from the image by classifying the characters in the license plate that paves a way to convert image into text format with the help of pytesseract.

In future aspects, this method can develop a system which detects a number plate from videoby increasing the number of frames per second.

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