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Vehicle License Plate Detection and Recognition Using Neural Network

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Abstract: **Nowadays, the License plate Detection and recognition is one of the modern techniques practiced by personnel to identify vehicle. The challenging problem on performing detection due to the various plate formats, image captured on different point of view and several illumination conditions during image capture. Researchers are trying to find better algorithm to detect and recognize the number plate within short period of time. The proposed method is to identify the vehicle using its license plate and by image processing techniques to filter the required texts, perception of vehicle license plate at different heights. The results were discussed and applied to a real time testing by capturing and detecting the image instantly in the defined environment.**

Keywords: Character recognition, Vehicle Number/License plate detection, Neural network

I. INTRODUCTION

In today's world, the increase in population over the country becomes a critical problem with the technology handling. As it requires more adequate resource to collect and process information from a huge population for any field. To replace a human personal on their duties gives a relax for the society as the services demand for a very long period of time and human efforts also limited in several cases. For a vehicle identification process in a traffic is daily duty performed by personnel which is a tedious in taking the account of population and the density of population as well. The personnel can achieve only certain efficiency as he is limited and occupied with other tasks also. This results in various mistakes by the drivers and sometimes disobedient people take advantage of it. So, the vehicle number plate or license plate detection is one way to reduce to human effort in order to identify a vehicle in the absence of human personnel. The better way to identify a vehicle in the absence of human is through vision sensor. The vision sensor records visual data which contains information about the vehicle number plate. The format of the number plate varies from country to country. Government has framed certain rules to create a vehicle identification number for a vehicle. The current layout of the vehicle plate should be as followed.

- The first section contains two alphabets which represents the State on which the vehicle is registered.
- The second section consist of two-digit serial numbers which represents the district Road Transport office of the district where the vehicle is registered.
- The third section consists of alphabet represents the time period of registration as they change to next letter when listed serial number is completed.
- The fourth section is a 4-digit serial number represents the vehicle.

A. Deep learning: Deep learning has played the important role in the field of Text detection, Voice recognition, Object detection and Autonomous driving systems. The accuracy and real time applications for these fields were significant than any other techniques that have used before. The results from these applications encourages researchers to apply deep learning in various field to solve difficult or unsolved problems.

II. LITERATURE REVIEW

Nilendu Saha and et al proposed the methodology to recognize the license plate from the state provinces using convolutional neural network have four key layers convolution layer, ReLu (Non-Linearity), Maxpooling and Softmax layer. He Huang and et al., approached the character extraction from the car license plates using softmax layers for different tasks makes the characters to be extracted from image independent of class. Archana Patel and et al., described the frame work to detect bike riders without and with helmets using convolutional neural network and transfer learning techniques. The Neural network model is based on VGG-16 which is 16 layered CNN model where only the convolutional layers were taken from the model. Mohamed Ben Halima and et al., proposed the frame work which uses tensor flow and CNN model having several layers distinguished for feature extraction and fully connected layers for license plate detection. Then another CNN model for characters recognition has been proposed having four convolutional layers and two fully connected layers. The proposed frame work achieves greater efficiency for AOLP and Caltech data sets. Binay Binod Kumar and et al., stated that the designing of license plate recognition and detection using hybrid technique from neural network and template matching. They carried out pre-processing followed by plate segmentation and character segmentation using connected component analysis. Then recognition of image by feed forward back propagation neural network. Youguang Chan and Yuxin Shi proposed a new algorithm based on convolutional neural network and visual features for plate detection. The method is divided into two steps first stage, uses the fused features extraction method to extract candidate bounding box from the original image. second stage uses a cascaded convolutional neural network to judge the candidate bounding box and makes correction and adjustment to the size of candidate box. Mukesh Takur and et al., proposed a cooperative approach using genetic algorithm and neural network for vehicle license plate recognition. The genetic algorithm is used to detect any type of plate's area and artificial neural network is used for recognition of any font style of character.

Based on the literature study, it is found the most of the works were aimed at either recognition of the license plate using neural networks or they use edge detection and other

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morphological operations for detection of the license plate followed by character segmentation using neural network. As discussed above the detection of license plate from real time image remains as a complex job and conversion of these natural text into digital forms remains difficult. The other open source datasets were reviewed and based on those datasets the image acquisition was planned. The chapter I explains the overview introduction and chapter II details about the literature review and studies of current trend, chapter III illustrates the problem identification and objective. The chapter IV illustrated Methodologies and proposed work. The chapter V explains the results discussed in the proposed model and chapter VI conclude the paper with future scope.

III. PROBLEM IDENTIFICATION

Based on the Literature survey, the following problems were identified in the number plate detection.

- The variation in camera perspective
- The Format and styles of the number plate changes with different vehicles as per the user's wish.
- The image produces error in identifying as in case the camera produces poor quality images.
- The dataset collected has given considerations with few details and variety of light conditions.

A. Camera Perspective: Camera Perspective would be one of the major problems in order to identify the vehicle plate. As the cameras are fixed at a particular place the chance of acquiring perfect perspective image from a vehicle is difficult in real time environment. Also, the speed of the vehicle makes the images blurry. During image processing the image acquired from these scenarios didn't deliver expected output. The perception of camera and image capturing methods plays a vital role.

B. Font and Styles: Certain font styles are cursive and legibility of these font styles becomes hard while detecting. Some font style is harder to recognize at their regular orientation. Also, govt and other regional people use regional language fonts on their vehicle and this will be very harder if we are including only English alphabets in our dataset.

C. Image quality: On the other hand, the image quality becomes a factor for an erroneous detection. The systems are typically used outdoors and therefore can be exposed to extreme weather conditions. The image should produce a better quality in order to achieve the expected results. If the quality of the image is compromised the quality of results also would be worse. A robust system is required to ensure repeatable, reliable results.

D. Objectives: Based on the literature survey and problems identified, the objectives are refined as follows

- To propose a number plate detection algorithm based on Neural network in real time and increase their accuracy.
- To extract the text from the license plate image irrespective of their style and font.

Most of the works in license plate detection uses edge detection or connected component analysis for the detection of license plate. Edge detection is most commonly used for the detection of license plate from the input image on low computational but edge detection consumes a lot of time due to its complex computation. Also, they are sensitive to noise and they are diffracted by the existing edges in the noisy image. For character recognition template matching can be used after segmentation in order to recognize the letters and numbers precisely as it is widely used for pattern recognition machines.

IV. PROPOSED WORK

Image processing is a method employing the conversion an image into its digital form and perform some operations on it to get an enhanced image. Data require pre-processing techniques to ensure accurate, efficient, or meaningful analysis. There is various type of data pre-processing techniques. The raw captured image cannot able to use to detect text so the captured image has to undergo image processing to enhance the information it contains.

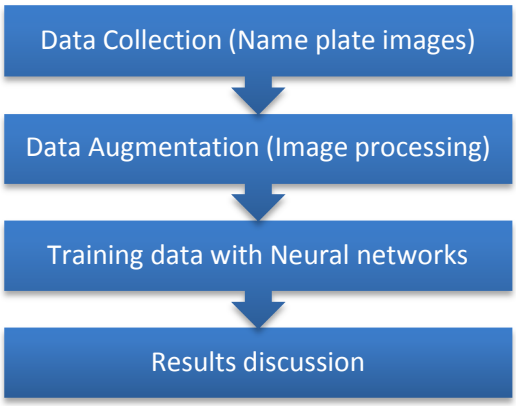

Fig.1.Overall process Flowchart

Image processing has 5 important steps as shown in table 1.

Table.1. Image Processing technique

S.No	Image processing technique	Description
1.	Visualization of given dataset	To Detect the objects that are not visible.
2.	Sharpening and Restoration of image in dataset	To develop the image better quality
3.	Image recovery	Image data recovered from test data.
4.	Image pattern measurement	To measure different pattern in the image dataset.
5.	Image Recognition	To identify the object in the proposed image data set.

A. Proposed frame work: The following block diagram shows the overall framework of the proposed algorithm.

Table.2. Camera Specifications

S.NO	CAMERA	SPECIFICATIONS
1	Logitech C270 HD Webcam	Video: 1280 x 720 pxl Photo: 3.0 MP
2	13MP CMOS camera	Video: 1280 x 720 pxl Photo: 13MP

1. Data collection: Instead of using the available data set we have collected data. The data has been collected

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using two cameras whose specifications are listed below. Around 250 images were collected using Logitech C270 HD Webcam and 250 images were collected using 13MP CMOS camera. The webcam was placed at the height of 25cm from the ground and by varying the distance from the car, images were taken. Similarly, the CMOS camera was placed at the height of 150cm from the ground and the images were in the real time. The images were taken during day time and late afternoon in order to train the date set in varying illumination condition. Also, the date data are collected at 20cm and 150cm (5ft. approx.) heights and various length from 1 to 7m to overcome the problems related to the camera perception. The sample data collected are given below figure 2 &3.

Fig2.Sample data at the height of 150cm

Fig.3.Sample date at the height of 25 cm

2. Data training and Detection: After data collection, the images are analysed and then data training process is started. After analysing the data, the images are stored in a separate image directory. The data training starts by annotation of the data collected. The collected data are annotated using Image Labeller. The rectangular region of interest (ROI) label, poly line ROI label, pixel ROI label and scene label was easily provided by the image labeller application in a video or image dataset. Since the License plate are most commonly in rectangular shape, we chose the rectangular region of interest.The Collected data are imported from the image directory.

Table.3. Algorithm to train name plates details

Algorithm: To train with name plates

Input: Augmented image
Output: Model
 	
Step1: Import name plate dataset
Step2: resize of image into (227x227)
Step3: Model define
Alexnet_model()
add_layers() #lstm and softmax
model_compile()
Step4: Model parameter configuration
No.of epochs: 15
Images per GPU: 1
Step5: Model save
Step6: predict model with MATLAB
application

A new ROI is defined and we chose a rectangular ROI and labeled it. These labels contain two components: the label name and the region created. Then the region of interest was selected for the imported images from the directory. The Region of interest was selected separately for every image imported. After annotating all the images, they must be exported to the workspace for further object detector training, semantic segmentation, or image classification. Exporting can occur in two form either as ground truth or in the form of table. We exported the labeled images in the form of table. After the images are annotated and exported to the workspace the variable is created. The variable is saved as a mat file. The Then annotated data is trained using convolutional neural network. Initially, the convolutional model used here is Alex Net and to train texts and numbers. And the Transfer learning was followed to train name plates for the vehicle by using the collected images. The algorithm for the name plate training is shown in Table 4.

3. Feature extraction and pre-processing: To extract a rectangular portion of a license plate, the imcrop function is used. The license plate is programmatically cropped by specifying the size and position of the crop region. For cropping the image, the information about the size and the position of the license plate are required. The bounding box provides x coordinate, y coordinate, length and width information about the license plate. The cropped image is then preprocessed. The image processing techniques proposed in Table 1 carried out over the cropped image to transform as digital image and operations are performed in it to get enhance image and extract the useful information

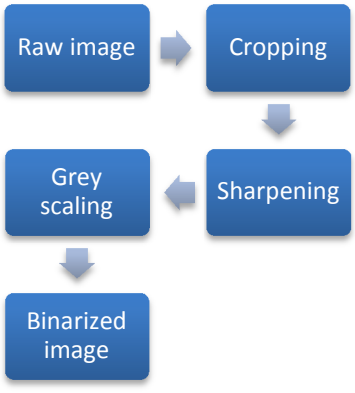

Fig.4.Proposed Image Processing flow diagram

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The various process held in the preprocessing are grey scale conversion, OTSU segmentation, Binarization, and sharpening.

Fig.5.Sample Name plate detection by ROI tool.

from it. To enhance the cropped image, image sharpening is carried out. The cropped license plate is an RGB image which is a M*N*3 array of color pixel, where each color pixel is a triplet which corresponds to red, blue and green. 24 bits are required for the storing of a single-color pixel of an RGB color image. When a image converted to gray scale it contains M x N array of value scaled to represent intensity value and it requires only 8 bits for storing of a single pixel of image. The intensity value of greyscale images for a pixel may vary from 0 to 255. Thus, it requires less memory to process comparing to RGB based image. Also, it is easier to process many images with the single channel image comparing to the three channel-based images during image processing. The grey scale license plate image is converted into monochrome image.

4.Text detection and Extraction: To detect text and extract the information from the image and image processing techniques were followed. The images collected are together trained into the network model. The trained model, the text will be extracted from the detected results. The extracted texts would be stored in a .txt format file for a review and also a window shows us the extracted result. The figure (6) shows that the flow of the region of interest export for the detected text from the captured image.

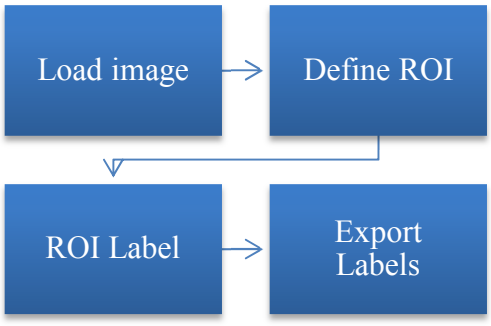

Fig.6.ROI capturing step process

OCR systems are able to produce better results in terms of text detection and extraction. The OCR model trained for a specific language can be used for the same language it has been trained. The main advantages of OCR technology are that it saves time, decreases the errors and minimizes the effort. Hence OCR is used to extract text from the pre-processed license plate. The OCR trainer in the MATLAB software is used to create a new language set.

B.OCR Training: The images are imported into the OCR trainer. The region of interest is selected from each image. The OCR Trainer app an inbuilt app in MATLAB makes easier to label character for the training and to create the class labels for our dataset. The following figure (7) shows us the

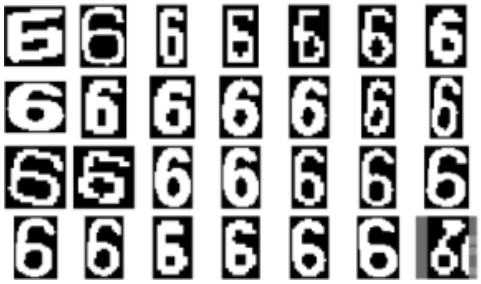

Fig.7 OCR training for different characters.

V. RESULTS AND DISCUSSION

The captured data is collected and trained with the neural network model. The results are shown in the fig.8 & 10 about the accuracy and loss comparison respectively. It is inferred from graphs that the mini batch loss decreases as the number of iterations and epochs increases. Also, the accuracy increases when the number of iterations and epochs increases. The training was stopped when the graph started plateauing. Then the model is tested with a captured image shown in fig.11.

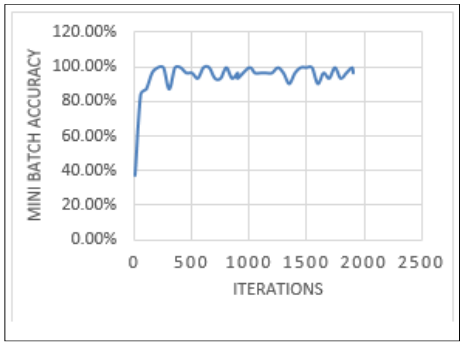

Fig.8.Graph Minibatch Accuracy vs Iterations

Fig.9. Proposed model Processed image

Now the model able to detect the number plate and then process it. The finally processed image is shown in fig.9 & 12. Simulations are run to find the effectiveness of the proposed algorithm. The following figure shows the detection result of the captured image.

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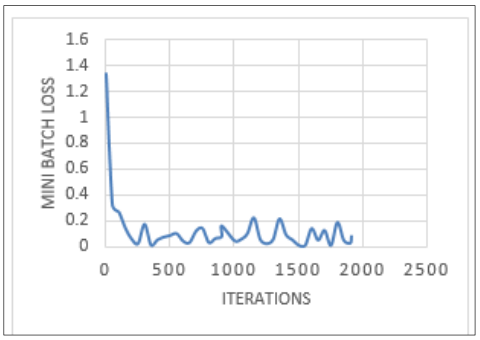

Fig.10.Graph Minibatch loss vs Iterations

Fig.11.ROI based Number plate detection

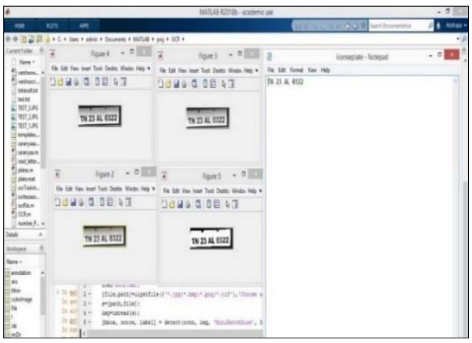

Fig.12. Final detected sample output

VI. CONCLUSION:

The paper is mainly focussed on the detection of number plate details through ROI approach. From the experimental result, the use of neural network for detection of license plate was effectively discussed. The detection accuracy is increased while compared to the edge detection or template matching techniques. In the proposed work, the collected data for training and testing were limited. OCR comes to the rescue and helps in reducing errors in detection of text from natural images. More number of data can be used to further improve the accuracy of proposed ROI approach in number plate identification. To improvise the ability of the model to detect the license plate from real time surveillance clip with orientation capabilities and to try with other regional languages since some of number plate also contains regional letters.

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