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Artificial Neural Network Based Automatic Number Plate Recognition System

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***Abstract*—** This paper deals with Automatic Number Plate Recognition (ANPR) using Artificial Neural Network. The ANPR system includes steps like pre-processing, localization, character segmentation and character recognition. The developed system first detects the vehicle and then captures the vehicle image. The captured image is pre-processed in order to enhance it for further processing. In localization the license plate region is located and cropped from the complete image. In character segmentation images of individual alpha-numeric characters are extracted from the localized plate. In this paper, we proposed Neural Network based character recognition. Scaled Conjugate Gradient Backpropogation algorithm is used for training the neural network. This system is implemented in MATLAB R2014b.

Keywords-*Artificial Neural Network (ANN), Automatic Number Plate Recognition (ANPR), MATLAB.*

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I. INTRODUCTION

Rapid Increase in the automobile traffic on roads, has led to high demand for traffic management and monitoring. And with advancement in technology, nowadays traffic monitoring can be done by computers using image processing and machine learning. ANPR is an image processing technology which uses license plate to identify vehicle. It is simply the ability to automatically extract and recognition a vehicle number plate's characters from an image.This system plays a key role in minimizing traffic congestion. Advanced systems for tracking and identifying stolen, unauthorized vehicles are based on automated number plate recognition technology. ANPR can be used in many areas from speed enforcement and tool collection to management of parking lots. It can also be used to detect and prevent a wide range of criminal activities and for security control of highly restricted areas like military zones or area around top government offices.

II. DESCRIPTION OF SYSTEM`

The ANPR system consists of four stages namely pre-processing, localization, character segmentation and character recognition. In the pre-processing stage the captured image of the vehicle is given as input. The captured image is taken from 3 – 8 feet away from the vehicle. The aim of this stage to reduce useless data and keep the valuable information. In the localization stage the actual number plate part is located in the pre-processed image and localized part is cropped and used for further processing. Character segmentation is a stage where images of alpha-numeric characters are extracted from the localized plate. And finally in the character recognition stage recognizes the character using artificial neural network giving results as the plate number. In simple terms this system takes the image of a vehicle as its input and gives characters displayed in form of string as output.

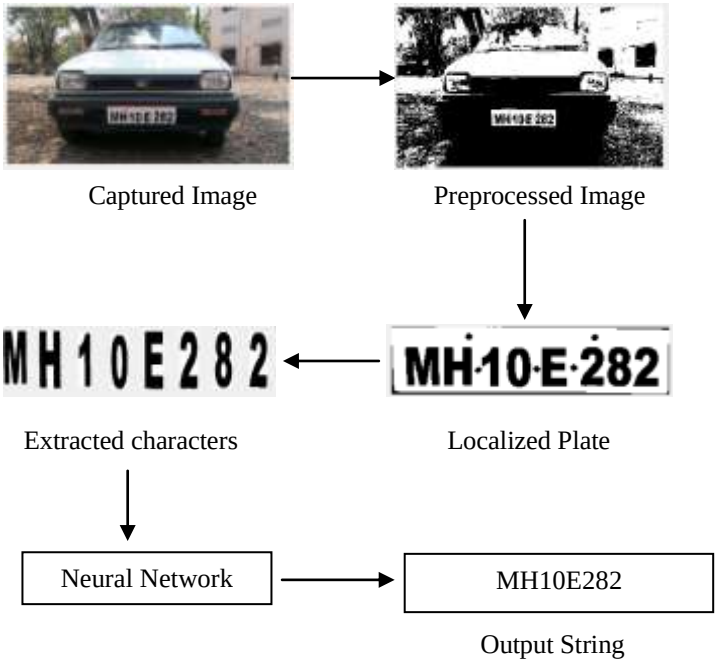

Fig 1:- System Design

III. PRE-PROCESSING

As mentioned before, the system of automatic number plate recognition faces many challenges. So, this step is essential to

enhance the input image and making it more suitable for the further processing steps.

Following are the steps involved in Pre-processing:

- Conversion of input RGB image to Grayscale image.
- Using median filter of size 3x3 to remove salt & pepper noise.
- Calculating the Gray threshold.
- Conversion of Grayscale image into binary image using the calculated Gray threshold value.
- Performing closing operation on the image to remove small gaps from the image.

Fig 2:- Captured Image

Fig 3:-Preprocessed Image

IV. LOCALIZATION

Basically localising is an algorithm that decides which part of the vehicle image contains the number plate. In this stage, location of the license plate is identified and the output of this stage will be a sub-image that contains only the license plate.

Firstly in this algorithm we look for all the rectangular areas in the vehicle image. Once we obtain all the rectangular areas from the image we filter out the remaining rectangular areas. The best possible number plate location is found out by comparing the height by width factor of the actual number plates to the rectangular areas obtained by this method. It is observed that the system showed best results when height by width factor was set between 1.5 and 6.

Fig 4:-Number Plate Located.

Fig 5:-Extracted Number Plate

V. CHARACTER SEGMENTATION

This stage is meant for segmentation of the characters from the number plate image. The output of this stage is a set of monochrome images for each candidate character in plate. In this step, we extract the images of individual alpha numeric characters from the localised plate using connecting element algorithm. In this we use Regionprops function of Matlab to find out all the connected characters in the image. To filter out the images of individual characters we use different features of the characters like size, aspect ratio and position. We look for Connected elements whose size is less than 30% of total size of image. And also the aspect ratio should be within 1 to 6. So using these properties we finally get the images of individual characters from the localised number plate image.

Fig 6:- Segmented Number Plate

VI. CHARACTER RECOGNITION

The goal of this stage is to recognize and classify the binary images that contain characters received after the segmentation step. We have used Artificial Neural Network for character Recognition. For the sake of classification, some features must be collected from the characters. In character segmentation, the individual characters are cropped into different sub images that are the raw data for the following feature extraction routine. The size of the sub-images are not fixed since they are exposed to noises, which will affect the cropping process, to be vary from one to another. This will cause the input of the network become not standard and hence, prohibit the data from feeding through the network. To solve this problem, the sub-images have been resize to 50 by 70 and then by finding the average value in each 10 by 10 blocks, the image can be down to 5 by 7 matrices, with fuzzy value, and become 35 inputs for the network. The characters of various fonts are trained using Artificial Neural Network Pattern Recognition App in Matlab. For our project we have trained almost 30 sets of various fonts of each character i.e. A to Z and in similar way numbers from 0 to 9.

VII. TRAINING AND TESTING NEURAL NETWORK

Artificial neural network is trained by using extracted feature vector obtained from 530 sample images of alpha numeric characters including alphabets A-Z and numbers 0-9. Since we have used supervised learning approach the output target

vector is set accordingly so as to adjust the values of weights and bias in the neural network. In this paper we have proposed a neural network consisting of two layers, one is the hidden layer and the other is the output layer. The number of neurons used in hidden layer are 75. Scaled Conjugate Gradient Backpropogation Algorithm is used for training purpose.

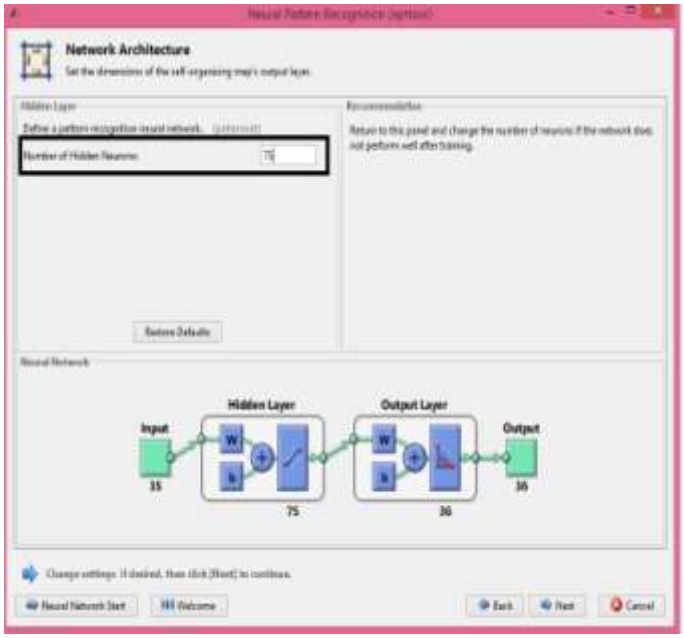

Fig 7:-Scaled Conjugate Gradient Backpropogation

Out of the 530 samples, 370 samples are used for training the neural network, 80 samples are used for validation and remaining 80 are used for validation purpose.

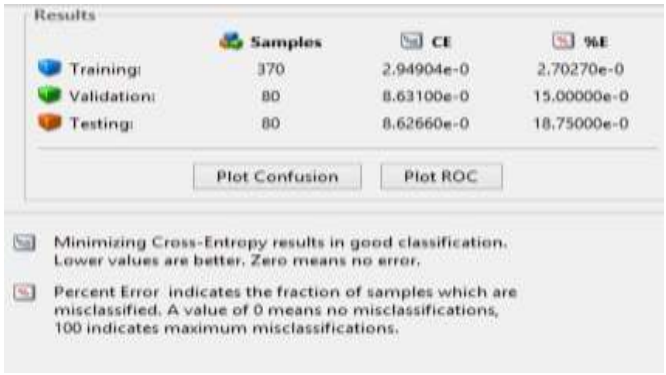

Fig 8:- Training of neural network

After training, it is observed that the best validation performance is observed at epoch 10. The following graph depicts the performance of neural network during training, validation and testing.

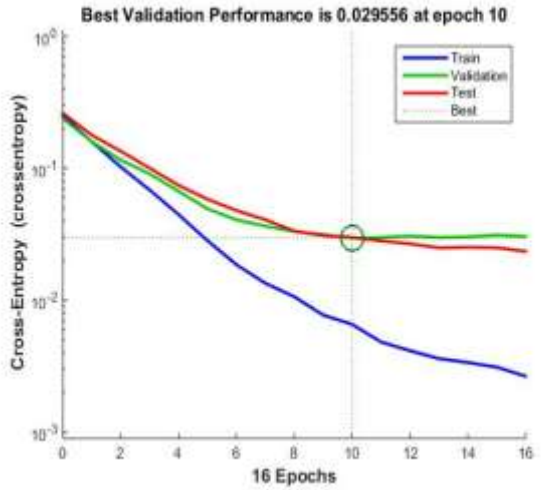

Fig 9:- Performance plot

VIII. RESULTS

The proposed system has been simulated in MATLAB R2014b. In order to evaluate the ANPR algorithm, 50 number plates of different fonts and size were used. Out of which 45 number plates showed accurate results. In 4 number plates, a single character was falsely recognized and in remaining 1 number plate two characters were falsely recognized. The accuracy rate of the system is 90%.

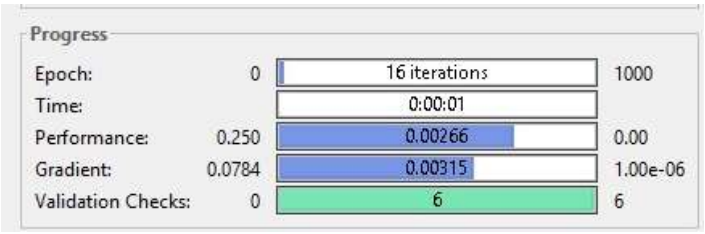

Fig 10:-Learning progress of neural network

Fig 11:- Tested Number Plate

IX. CONCLUSION

An efficient system has been developed to localize the number plates from the image of a captured vehicle. A neural network based character recognition system has been implemented to identify the all the characters in the number plate. The Scaled Conjugate Gradient Backpropogation algorithm used showed good results in case of slight variation in some characters due to noise. The system performance can further be improved by increasing the number of training samples of each alpha-numeric characters.

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