Automatic Car Number Plate Recognition System for Authorization

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ABSTRACT
In present day scenario the security and authentication is very much needed to make a safety world. Beside all security one vital issue is recognition of number plate from the car for Authorization. In the busy world everything cannot be monitor by a human, so automatic license plate recognition is one of the best application for authorization without involvement of human power. In the proposed method we have make the problem into three fold, firstly extraction of number plate region, secondly segmentation of character and finally Authorization through recognition and classification. For number plate extraction and segmentation we have used morphological based approaches where as for classification we have used Neural Network as classifier. The proposed method is working well in varieties of scenario and the performance level is quiet good.

Keywords
Ostu’s Method; ANPR; Character Segmentation; ; DWT; Neural Network.

1. INTRODUCTION
The Automatic Number Plate Recognition (ANPR) is one of the vital applications applicable for security and authentication. In the age of modern era where man power has been replaced by machine power to save time and less utilization of human effort. So ANPR is one of the most automatic systems for authentication of vehicles to a secured zone, public parking, and toll gate or traffic surveillance.

The invention of the ANPR system was in 1976 at the Police Scientific Development Branch in UK [1]. Basically the problem of recognizing number place can be solved in three steps, number plate extraction, character segmentation and recognition. Much work has been done in the past towards number plate recognition. Researchers have done ANPR system with different approaches.

In this paper Authors have proposed a technique called sliding concentric window (SCW), where two concentric windows moving from upper left corner of the image [2]. Another approach by using features like shape, color and texture for recognition has been proposed by Z X Chen et.al [3]. M.S.Sarfraz et al [4] has been proposed a method for tracking and recognition in CCTV footage through localization of number plate through video sequence.

V Shapiro et.al [5] has pre-processing, segmentation and verification was used for number plate localization of car. A horizontally oriented rank-filter of size M × N pixels was moved alongside with the image. Then by using vertical projection was used to detect plate’s vertical boundaries, and finally recognition done

S.L. Chang et al [6] have proposed a fuzzy discipline based approach was proposed for number plate segmentation and recognition. Another method has been proposed based on edge-and color-aided method by V Abolghasemi [7].

A number of methods have been proposed in literature regarding number plate recognition and their application.

In the proposed research article we have divided the article into six sections. Section I about the introduction to the proposed System. Section II- The feature extraction method DWT has been explained. Section III-We have discussed about Neural Network Classifier. Section IV-The proposed method has been discussed. Section V-The result has been discussed and finally Section VI-Here we have conclude the article with the future scope.

2. DISCRETE WAVELET TRANSFORM
Wavelets method has its advantages over other mathematical transforms like the DFT or DCT. Functions with discontinuities and functions with sharp spikes usually take substantially fewer wavelet basis functions than sine-cosine functions to achieve a comparable approximation. Wavelets ability to provide spatial and frequency representations of the image simultaneously motivates its use for feature extraction.

The Haar wavelet transform is a widely used technique that has an established name as a simple and powerful technique for the multi-resolution decomposition of time series. An original image of size N x N is first of all pass through a filter horizontally and vertically as shown in figure 1.

![Wavelet Transform Diagram]

Fig. 1 wavelet Transform

The low pass filtering in horizontal direction and high pass filtering in vertical direction gives rise to LH component, likewise filtering gives rise to four components LL, LH, HL and HH during first level of decomposition [9, 10]. The LL component which represents the approximate coefficients of the decomposition is used to produce next level of decomposition. The sub band HL represents major facial expression features. The sub band LH, the vertical features of outline and nose are clearer than its horizontal features, depicts face pose features. [8-10]
The sub band HH is the unstable band in all sub bands because it is easily disturbed by noises, expressions and poses. And the sub band LL will be the most stable sub band. Here an image and its detail and approximate coefficients are shown in figure 2.

3. NEURAL NETWORK

Neural networks are distributed information processing systems made up of a great number of highly inter connected identical or similar simple processing units, which are doing local processing, and area arranged in ordered topology [11]. An important feature of these networks is their adaptive nature, which means that its knowledge is acquired from its environment through an adaptive process called learning [12]. The construction of neural networks uses this iterative process instead of applying the conventional construction steps (e.g., programming) of a computing device.

Neural networks are typically organized in layers. Layers are made up of a number of interconnected ‘nodes’ which contain an ‘activation function’. Patterns are presented to the network via the ‘input layer’, which communicates to one or more ‘hidden layers’ where the actual processing is done via a system of weighted ‘connections’. The hidden layers then link to an ‘output layer’ where the answer is output as in figure 3. The output is controlled by an activation function [13-14].

3.1 Activation Function

There are many possible activation functions. The most common ones are: the Linear, the Step, the Ramp, the Sigmoid, and the Gaussian functions [15-17]. The last four functions introduce nonlinearity in the network dynamics by bounding the output values within a fixed range. We have used mostly the sigmoid function.

3.1.1 Sigmoid Function:
The Sigmoid function is a continuous version of the Ramp function and provides a graded nonlinear response within a specified range. The most common sigmoid function is the Logistic distribution function that provides an output value from 0 to 1. The value \( \alpha > 0 \) and usually equal to 1. The Sigmoid function definition is shown at Equation 1

\[
f(x) = \frac{1}{1 + e^{-x}}
\]  
(1)

4. PROPOSED METHOD

The proposed methodology has been segmented into three sections Number Plate Region Extraction, Character Segmentation and Classification.

For number plate region extract, first the input image converted to Grayscale image from the color image. Then using the process of Global thresholding (Ostu’s Method) [18-19] we generated a threshold value, based on which the binarization of the image is done. Then we removed the small object consecutively and with the help of dilation operation and connected components, extract the number late region.

The original image and the binary image as well as the extracted number at region has been shown below with the help of connected component region.
In the segment it is required to segment the character by taking number plate region as input. The process of character segmentation has been shown below.

After extraction of number plate region, then it converted to binary images then through pixel information of the character will be segmented. First the sum of pixel in row wise calculated then sum of pixel in column wise calculated. Then from the sum if there is gap between any characters then accordingly the sum is also zero. From the sum value we can segment the character.

For classification purpose we have used neural network classifier. The process of classification has been shown below.

After segmentation each segmented character has been passed to the classifier for recognition of character. For classification purpose we have used neural network classifier. The process of classification has been shown below.

For classification we need to create the database for feature extraction. Here DWT feature has been taken to fed the neural network for training. First of all we collected character A to Z and digit 0 to 9 each with dimension 24x42. Total 36 characters have been processed for extraction of feature through DWT where the Approximates coefficients are feature as shown in figure 13 below. In this way we have considered 252 DWT features for each character. Each features then feed to neural network for training purpose. Then initiate the training with a random weight sets and according to the target we update the weight. After training the updated weights are used to recognize an unknown character using the steps shown figure 14.
5. RESULT ANALYSIS
The experiments have been done using MATLAB R2012b. For simulation we have experimented with different input images with varieties of scenery. For the clarification we have used neural network as a classifier. The structure of neural network has been shown in figure 15. The neural network has three layer input, output and one hidden layer. The input layer has 252 nodes which has been feed with 252 DWT features and output layer having 36 node for the numbers of character. We have used 20 node hidden layers.

![Fig 15: Architecture of Proposed Network](image)

During training we have consider a target to which the input has to be train. During the training we have consider around 200 epoch and in each epoch the error has been minimizes. The performance plot Error vs Epoch has been shown below in figure 16.

We have tested around 20 different images and successfully recognized the character. Here some samples have been shown below figures 17.

![Fig 16: Training Performance Curve](image)

6. CONCLUSION
In proposed method we have recognized the number plate of car vehicle using Neural Network classifier by extracting the DWT features. This technology used in Authorization of car vehicle. The proposed method is limited to car vehicle only.

In future we have planned to improve the performance of the system as well as to recognize the number plate at some hazardous condition, the template, and replace the content with your own material.

7. REFERENCES


