



## Number Plate Recognition Based on Multi Feature and Character Recognition

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**Abstract:** Intelligent transportation system has become an integral part of the transportation system and it consists of number plate recognition. A recognition system implemented to control the payment of fees in parking areas, highways, airport or harbour cargo control etc. There are considered an approach to identify the vehicle through recognizing of its license plate using multi feature recognition and neural network techniques. Multi feature recognition is to enhance several features of for target. The proposed method use improved character recognition by through setting proper numbers of hidden layers in the character kinds. This method can improve the efficiency and accuracy of vehicle number plate recognition.

Multi pattern recognition is an algorithm for recognition of multi feature concept into the information. Proposed method solves the number plate with colour features as well as texture features and back ground features. By using multi feature concept problem of the ambiguity of character recognition can be solved. After using multi feature concept for number plate positioning, it can be obtained the projection of histogram mainly through a threshold. The result of number plate recognition is to change the plate character in to text character. Using back propagation of neural networks to resolve complex characters number plate and defective characters, and avoid heavy data analysis and mathematical modelling works. Recognition problems of automobile number plate such as character kinds, the numbers, and confusing of words can also be solved

**Keywords:** fuzzy theory; number plate recognition; character recognition.

### I. INTRODUCTION

Number plate recognition technology is an important part of vehicle detection system; Transportation is a rapidly evolving industry. Recently, there has been much tremendous advancement in this industry most notably Intelligent Transportation System (ITS). It has been widely used in many systems, such as road traffic monitoring, parking lots access control, highway electronic toll collection, red-light violation enforcement, finding stolen cars, gathering traffic flow statistics and so on. The main vehicle identification processes are number plate location, information adjustment, character segmentation and character recognition.

Number Plate Recognition consists of three main phases:

1. Number Plate Detection
2. Number plate Extraction
3. Character Segmentation
4. Character Recognition.

This article discusses how to identify the number information from the obtained car number location and how to recognize the characters. Existing methods can solve the license plate template matching by using correlation process. But this method can recognise the number plate by using multi feature recognition and character recognition. Practical application of intelligent transport systems through the camera and other equipment in the dynamic image information was obtained number plate pollution impact, actual road conditions and camera installation angle. These bring us major difficulty for the vehicle number character recognition. The character segmentation is done using line scanning technique, scanning is done from left to right of the plate. After Character Segmentation, feature extraction is performed to obtain the unique features of every character. The BP neural network to solve the character recognition problem is a hot topic in recent years. Proposed method uses improved back propagation, for increasing efficiency and accuracy.

### II. THE PROCESS OF NUMBER PLATE RECOGNITION

The vehicle number recognition technology includes the digital image pre-treatment technology, the vehicle number localization and the car number character recognition technology as shown in Fig. 1.

### III. MULTI FEATURE RECOGNITION

#### A. Fuzzy Theory

Multi feature recognition is a recognition algorithm which recognises the fuzzy concept in to the information. The main three steps to solve the problem of the ambiguity of character recognition are:

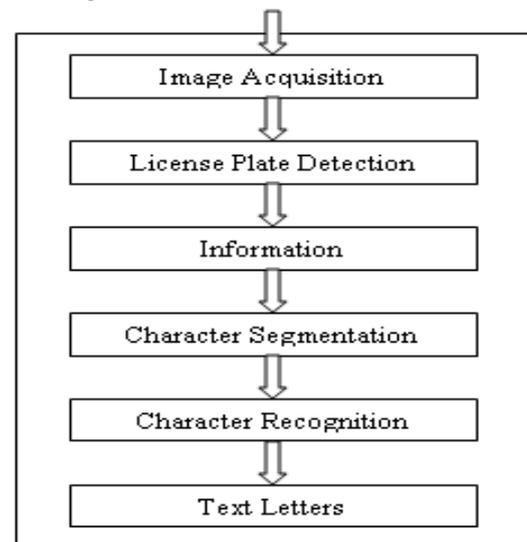


Fig.1: the structure of Number Plate Recognition

Step 1: Identify characteristics of the object extraction. That is extract and identifies features from the identification of objects, and measures these characteristics.

Step 2: Establish standard type of membership function, the standard type is usually the domain of fuzzy sets.

Step 3: Designation recognition decision criterion, and identify the object with this.

**B. Extraction number plate multi features**

To enhance quality of car image for better results in further operations on the Number plate, Image Pre-processing operations are performed on the original car image. Initial positioning plate by color range detection and color on the edge of the detection method, then blurs each region using the parameterization membership function which the image division produces. In the process of number plate recognition, with the actual situation of, there are texture features, color characteristics and background characteristics, to extract the multi feature of these features vectors.

**C. Extraction Texture Features**

In this paper, as Neural Network is used for character recognition, Feature Extraction is an important step for training and simulating the Neural Network. Feature Extraction is performed on each segmented character. Because the vehicle number region has the massive vertical textures, the place of scan line passes, gray scale relief or undulating Frequency set. But no number plate, scan line is flat and frequency is not high.



Fig.2: Number Plate Extraction from the captured image

Set handler function is:

$$g(x, y) = |f(x - d, y) - 2 * f(x, y) + f(x + a, y)| \quad (1)$$

$(x \in (1, M), y \in (1, N))$

Where  $f(x, y)$  is original image,  $g(x, y)$  is processed image.

**D. Extraction color Features**

The first step in color recognition of license plates is to perform color feature extraction. It consists of obtainment of valid license plate regions, reverse color identification and color space conversion. Because of different regions, different types of number plate color is not uniform, there are black, blue, white and yellow licences. Extract color features [3], first of all is to get the background colour of the region. In the of transforms the colored pictures in to gray

plan, the black number plate and the blue color number plate present the black bottom mispronounced character the characteristic, then carries on the color space the transformation.

Because in the RGB color pattern various colors luminance value different can have the change along with the strength of illumination, but the vehicles image illumination condition is along with the natural environment influence, so the RGB mode identification plates will be many bias. In this paper, using HSV color space transformation [4] to extract number plate color features. By Using the following conversion formula to convert RGB color pattern in to HSV color pattern.

$$V = \frac{1}{3(R+G+B)} \quad (2)$$

$$S = 1 - \frac{3}{R+G+B} [\min (R, G, B)] \quad (3)$$

$$\theta = \cos^{-1} \left\{ \frac{(R - G) + (R - B) / 2}{\sqrt{(R - G)^2 + (R - B)(G - B)}} \right\} \quad (4)$$

$$H = \begin{cases} \theta & \text{if } B \leq G \\ 360 - \theta & \text{if } B > G \end{cases} \quad (5)$$

HSV is a sense of color space, which H represents hue, S represents saturation and V represents the value of bright. In this color space, H and the S two components have contained the image color information, therefore, use only two color components H and S can be distinguished from the blue and yellow, only use V can be distinguished from the white and the black. Because the multi feature color histogram obtains the initial information only contains 218 bins, the domain  $U^c$  constitutes with the image in color bins value, using trad

$$\mu_c : U^c \rightarrow [0,1], \quad C^c \quad (6)$$

Expresses the membership value degree of c, fuzzy color feature extraction function using the Cauchy function for calculating the membership function as following

$$\mu_c (C^c) = 1/[1 + [d(c, C^c) / \sigma]^\alpha] \quad (7)$$

Which  $\sigma$  represents all quantification color the mean distance, d is the spatial Euclidean distance of c and  $C^c$ .

In the experiment, the background under the same conditions, example when  $\alpha \in (0.8, 1.2)$ , average retrieval precision outside the region depression very quick, so it can replace with 1 to simplify operations. Multi color feature extraction using the following formula:

$$h_n(c) = \frac{h_{n2}(c)}{\max_{C^c \in U^c} h_{n2}(C^c)} \quad (8)$$

Which  $h_{n2}$  is the fuzzy color information of region n The synthesis formula is as follow:

$$h_{n2} = \sum_{C^c \in U^c} h_{n1}(C^c) \mu_c(C^c) \quad (9)$$

**E. Extraction Background Features**

The extraction process of background features is actually the process of image segmentation; it uses the multi-dimensional characteristic space to divide. The threshold value division expression is as follow:

When

$$T_k < f(x, y) \leq T_{k+1} \quad (k = 0, 1, \dots, n)$$

Then

$g(x, y) \square k$ . Which expresses the different color division threshold value. And then the original image is divided into  $n$  \*  $n$  size of base unit (General set  $n = 8$ ).

**F. Fusion of Multiple Multi Features**

For the analysis of the three characteristics, it expresses these three characteristics confidence weight coefficient with

$W_i (i = 1, 2, 3), if W_1 + W_x + W_3 = 1$  the more notable characteristic value, the more effective modalities for the classification, the lower error probability  $P_i(e)$ . The weight coefficient formula is:

$$W_i = \frac{(1 - P_i(e))}{\sum_{i=1}^3 (1 - P_i(e))} \quad (10)$$

Then the confidence of i-plate number plate is:

$$P_i = W_1 * m_1 + W_2 * m_2 + W_3 * m_3$$

According to the calculated confidence, the maximum value of the confidence region as Area number plate, figure3 is a number plate recognition error curve, which the dashed line represents the traditional way, the solid line represents the way of using fuzzy theory to multi-features fusion.

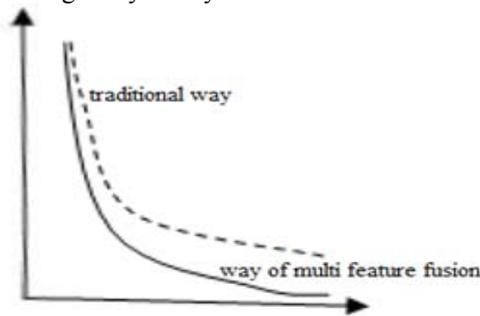


Fig.3: plate area recognition error graphs

**IV. CHARACTER RECOGNITION DESIGN**

This step is the main part of the system and is called as Character Recognition step, where segmented characters are recognized. Character recognition is also called as Optical Character Recognition (OCR). Traditional methods used for number plate recognition were OCR “Optical Character Recognition” and “Formula Based Recognition”. After uses multi features for number plate positioning, it obtained projection histogram mainly through a threshold, according number plate characters are combined with a fixed width and proportional spacing, to separate the characters. But in practical application, the final result of number plate recognition is to change the plate character into text character. Using back propagation neural networks to resolve complex characters number plates and defective characters, and can avoid heavy data analysis and mathematical modeling work. The information is stored and processed in parallel; improve the speed of character recognition greatly.

**A. BP Neural Network Algorithm**

BP neural network typically consists of input layer, hidden layer and output layer, neurons between adjacent layers are all interconnected, but neurons within the same layer are not connected. BP neural network algorithm is transforms certain sample input and output into non-linear

optimization to solve. It is based on the gradient descent algorithms using iterative algorithms for weights.

In an L-n-node network, suppose there is only one output y, then the error function is as follow:

$$E_x = \frac{1}{2} \sum_t (y_{jk} - \overline{y_{jk}})^2 \quad (11)$$

Which  $y_k$  is the output of k samples,  $y_{jk}$  is the output of unit j. Then the total error is:

$$E = \frac{1}{2n} \sum_{k=1}^n E_k$$

The final formula is as follows:

$$\delta_{jk}^t = \sum_m \delta_{mk}^{t+1} (t)_{my}^{t+1} f'(net_{jk}^t), \frac{\partial E_k}{\partial (t)_{jk}} = \delta_{jk}^t O_{jk}^{t-1} \quad (12)$$

**B. Construction of BP Neural Network**

**First step:** Determine the network layer

Solve the problem of non-linear data, need to increase the Number of layers to further reduce the error, improve accuracy, But it will also produce more neurons nodes and connection weights, There will be more adjustment and operation. According to the actual situation in China, general license plate first character is a Chinese character, the second character is English letter, The third, fourth, fifth, sixth, seven characters are English or digital, So adopt three BP nerve network of the layers[6], that is the input layer, the hidden and output layer.

**Second step:** Selects the S transfer function

Because the BP network non-linearity approaches ability is a manifest through the S transfer function, so the hidden layer and output layer activation function used Signmid that is namely logarithm S transfer function. In the test, First time only uses 16 groups of ideal signals to carry on the practice for the network; the second time uses a randomly generated 16 sets with noise signal, and then uses 16 group ideal signals, testes on the same network.

**Third step:** Select the initial weights and learning rate

The selection of initial weights and neural network learning rule local minimum, whether it will be able to restrain a large relation with the length of training time. The initial weight selection time takes the stochastic function seed, use the random function srand () random number. Because in each circulation training produces weight change quantity by study speed decision, and smaller learning rate can increase system stability, So according to the actual situation, so choose the initial value of learning rate in (0.01,0.7), The connection takes random numbers between (-1, 1), The initial value of the expected error random number between (0, 1).

**Fourth step:** Determine the number of the input layer neurons Because waited the characteristic vector dimension size which the recognition the character extracted to decide the input level integer, so the features of the character is divided into 4 \* 4 of 16 regional. The BP neural network input layer neuron number is 16.

**Fifth step:** Determine the number of hidden neurons

The more of the number hidden units, the more accurate Of the network approximation given function, but the number

Are more, and the complex calculations will increase, so network training convergence speed will be slower. Conversely, if the number of hidden neurons too small, it will Led to iterations increase and reselect the weights, even instability. Therefore the implicit strata neuron integer determination is very important. The number of hidden level neural subsided following formula is:

$N = \sqrt{n + m + a}$  Which n is the number of the input layer neurons, m is the number of output layer neurons, N is the number of hidden neurons, a is the number between 0 and 9 , After repeated testing, using 16 as the neurons number of the neural network hidden layer is appropriate.

**Sixth step:** Determine the number of output layer neurons Because the character number of need to identify determines the number of the output layer neurons. Combining the characteristics of our license plates, the first character represents the province, expressed by a simplified Chinese character, Therefore this region expressed with 35 Chinese character characters. The second character is the alphabetic character that is 26 capitals latter. The following five by the Chinese characters and 10 Arab figures 0-9 composition. So the output situation requires use of 71 characters, using binary encoding output this 71 characters, need for 7 bit binaries. Therefore chooses 7 to take the neural network output level neuron the integer.

**C. Initialize the Neural Network**

The weights of input layer and hidden layer, hidden layer and output layer is initialized by BpNet () functions. The output node number is determined by input signal p through intermediate nodes. After nonlinear transformation, produces the output signal y k, the deviation between the neural network y output value and hope output value t. To reduce the error, I can adjust the connection strength W ij between the input nodes and hidden nodes, the joint intensity between implicit strata node and output contact, and threshold.

**D. Character Recognition**

Character recognition process will be identifying the characteristics of the character input as the input neurons, first calculate the input and hidden layer coding table the variance of each unit, select the smallest variance as the output of the output layer. In 200 vehicle image information, obtains the car license localization after fuzzy processing, obtains the car license character after the character division, the final recognition results shown in Table1.

Table. 1 Characters recognition Ratio

	Character District	Letters District	Letter Numeral Mixing Zone
Total Number plates	200	200	1000
Correctly Identified Number Plates	184	186	935
Recognition Ratio	92%	93%	93.6%

Table. 2 Characters recognition results

NN	Numerical Rate	Alphabetic Rate	Accuracy
BP NN	70.00%	62.00%	66.67%
LVQNN	90.00%	96.15%	94.44%



Fig.4: Extraction of number plate information

**V. CONCLUSION**

Number plate recognition based on multi feature and character recognition has been successfully implemented by using MATLAB. The proposed method proved its robustness by solving the two major problems that is number plate location and character recognition, improves accuracy and recognition rate of the license plate recognition. According to the special nature of China's automobile licence, this paper has carried on the special classified design and hence gives good approach for its future research for estimating the distance and speed of the leading and/or lagging vehicles.

**VI. REFERENCES**

- [1] Chen Zhen-xue. Research on Method and Application of Target Recognition Based on Feature Saliency [D].Huazhong University: PhD Thesis, 2007, 15-60.
- [2] LI Xue-bin, SUN Xuan-chao.Method of blurring vehicle license plate Enhancement and location based on texture and color analysis [J]. Micro computer information, 2009, 25(3): 273 -275
- [3] WANG Feng, LIU Zhi-fang, MAN Li-chun.Color recognition of license Plates using fuzzy logic and learning approach [J].Journal of Optoelectronics . Lase2009, 20(1):84-88
- [4] Kakumanu M, Makrogiannis S, Boubakis N.A survey of skin color Modelling and detection methods [J].Pattern Recognition, 2007, 40:1106-1122
- [5] Chun-Ming Tsai, His-Jian Lcc.Binarization of color document images Via luminance and saturation color features [J].IEEE Transaction on Image Processing, 2002, 4(11):434-451
- [6] Shao Liangshan, Wang Jun, Sun Shaoguang.Study on the fitting ways Of artificial neural networks [J].Journal of Coal Science & Engineering.2008 (7):334-337

- [7] CHEN Ke-hua, RUAN Qun-sheng. The method of vehicle license plate Recognition based on BP neural network [J]. Fujian computer, 2009, (4):97-98