

# *License Plate Recognition Technology Based on Neural Network*

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**Keywords:** Neural Network, License Plate Number Recognition, Recognition Technology, Technology Research

**Abstract:** License plate recognition is an important part of intelligent transportation system. It plays an irreplaceable role in solving the problem of vehicle license plate issuance and improving the level of urban road traffic management. In this paper, the method of vehicle location and character segmentation is studied by using artificial NN algorithm. First, the BP Neural Network (NN) training method is used to complete the fusion model from the image extraction feature parameter set to the sample classification to the input mode selection and output mapping, the calculation and analysis of the rotation distance of the license plate area, and the recognition of the background color of the license plate. Then, the correctness and feasibility of this strategy are verified by the MATLAB simulation experiment results. The test results show that the learning time of the license plate number recognition technology based on the NN algorithm is between 20s and 30s, The recognition time is between 12s and 16s, and the correct recognition rate is above 90%. This shows that the algorithm is excellent in optimizing the license plate recognition technology.

## **1. Introduction**

License plate recognition system is an important part of the digital city, and also an indispensable part of the modernization of a country or region. With the continuous improvement of social, economic and traffic conditions, the number of vehicles is increasing [1-2]. There are many problems in traditional methods. Automatic license plate recognition system is an important part of digital image processing, which has broad and long-term significance in video surveillance, vehicle location and management and other fields. The traditional NN algorithm has many shortcomings, such as the threshold selection is easily affected by noise, the structure of artificial neuron group is simple and easy to achieve real-time requirements and so on. A fusion intelligent optimization search method developed based on statistical learning theory and pattern classification technology

overcomes the problems of large calculation amount, low precision, slow convergence speed, etc. in parameter selection of genetic algorithm, and has been widely promoted and applied [3-4].

Many scholars have done some research on NNs. The research on the fusion NN started early abroad. Since the 1970s, foreign scholars have successfully applied it to the license plate recognition system in the laboratory. In the 1980s, there were some applications, such as vehicle license plate image segmentation and vehicle detection. However, domestic scholars mainly focus on the research of fusion NN based on character pixel and feature extraction, positioning algorithm and edge synthesis and enhancement technology [5-6]. In recent years, some people have also taken fusion image preprocessing as an important link in the design of digital filters, but there is no unified standardization standard at present. Some scholars use fuzzy image processing methods and artificial NN algorithms, from face location to vehicle license plate extraction. Some scholars have realized automatic license plate generation based on pixel point matching. Other scholars use BP training system to test the relationship between vehicle motion state and stationary area and calculate the edge eigenvalue to determine the target position information [7-8]. Some scholars have designed a Bp NMR (SVM) based background noise preprocessing method using support vector machine.

License plate recognition technology plays an important role in modern traffic management, intelligent buildings, urban monitoring and other applications. This paper studies vehicle recognition based on artificial NN. First, the fusion neural algorithm is introduced, and then an adaptive BP (actionreserve) method for vehicle license plate image preprocessing and license plate location is proposed to achieve character segmentation and feature extraction. Finally, the input sample training set is classified and the output results are displayed using MATLAB software programming and Matlab toolbox.

## **2. Discussion on License Plate Recognition Technology Based on NN**

### **2.1. License Plate Number Recognition**

License plate recognition technology plays an irreplaceable role in vehicle detection, automatic positioning, video processing and digitization [9-10]. The function of vehicle license plate recognition. The license plate is an important identity information. Effective segmentation and authentication can help users accurately master the location and size of the target area and other basic conditions. It can be used for image denoising or removal of irrelevant interference, providing a basis for automatic management. The application of license plate recognition technology in intelligent transportation can not only improve the vehicle management and positioning ability, but also reduce the traffic accident rate. The methods of license plate number recognition mainly include the following aspects: first, real-time monitoring. The function of image automatic recognition is realized by analyzing, processing and calculating the image acquisition card. Second, in order to save labor costs and time and resources, the NN system can be used to quickly obtain the moving target information and map it to the training memory in the computer, and the prediction template library and license plate number recognition auxiliary tools can be obtained at the computer end, providing an effective means for intelligent traffic management. License plate recognition technology is an important part of digital image processing, which plays an important role in the whole field of license plate location, vehicle detection and management. It improves the reliability of recognition. NNs can be used to match, compare and classify different pictures collected, greatly reducing the amount of manual calculation. At the same time, more feature information such as texture, color structure and other information can be obtained through a large number of data sets to help the license plate recognition system analyze and process results more accurately and reliably, and improve the level of vehicle positioning technology, Provide effective

methods and means for subsequent image processing of license plates [11-12].

License plate recognition technology is an important part of intelligent transportation system, and its main functions are as follows:

(1) Improve vehicle management and service efficiency. The original image is preprocessed and filtered to remove the noise interference signal, and the feature parameters are extracted by image segmentation algorithm; the template matching method is used to determine the structure information between characters in the license plate area.

(2) Realize the car anti-theft alarm function, real-time monitoring of driving status and automatic early warning of safety accidents, provide comprehensive and accurate traffic dynamic data support for the traffic police, and timely find and solve the potential problems of traffic accidents. Figure 1 is a schematic diagram of license plate number recognition technology.

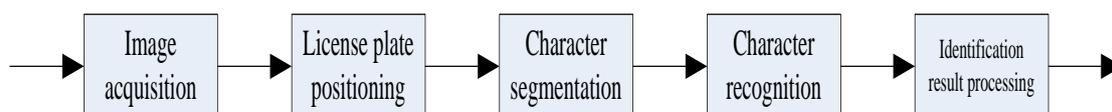


Figure 1. Schematic diagram of the license plate recognition technology

## 2.2. Relationship between NN and License Plate Recognition Technology

License plate recognition technology is an important part of the intelligent transportation system. It plays an important role in solving urban road traffic problems. With the continuous expansion of the number and scale of vehicles, frequent road traffic accidents, and the improvement of the requirements for license plate positioning accuracy, it has been applied in an unprecedented wide range. Compared with traditional pattern recognition methods, NN can classify complex data and realize recognition with the goal of simplicity, convenience and low cost [13-14]. However, due to its high degree of intelligence, it requires human participation to complete a large number of tasks. The development and application of NN can not be separated from image processing, pattern recognition, vehicle positioning and other fields. The main purpose of automatic license plate recognition is to classify vehicles. Therefore, in practice, the application of NN can achieve the above functions. Automatic license plate recognition uses NN algorithm to fuse the collected information of different regions with background noise data. By constantly adjusting the sample size to adapt to environmental changes, the threshold sequence model with specific regularity is constructed by combining the preset image and background noise signal data with the template library. In license plate recognition, the application of NN is mainly to process the image and then convert it into digital signals. The process of automatic vehicle license plate recognition is completed by using artificial vision and pattern classification technology. As one of the advanced computer simulation systems, artificial NN has many advantages, such as no human intervention, easy expansion and fault tolerance, simple and convenient use, real-time online learning, self-organization of network structure and functions, etc. The application of these advantages in license plate recognition can effectively improve work efficiency and save human resources.

## 2.3. NN Technology

NN is a typical nonlinear mapping, which has good fault tolerance, self-learning and self-monitoring characteristics [15-16]. In practical application, it is mainly realized by training the input image. Artificial NN is composed of a large number of complex functions. Each simple function can approach any value or there is a certain degree of overlap between analog quantities to form a simple model structure. It is called artificial NN or multi-layer intelligent layer model, which

is one of the computer systems characterized by strong learning and adaptability and parallel processing function, used in the field of automatic control. NN is a typical multi-layer forward hidden layer and adaptive system. It realizes the change of the connecting weights between neurons in the human brain nervous system by training and learning the input signals. NN algorithms include genetic algorithms and simulated annealing. Among them, the most commonly used method is the combination of direct pattern recognition method and Kalman filtering method. These two methods are a model design idea that has achieved very good results in the field of traditional artificial intelligence research and are widely used. It is designed and implemented based on the principles of mathematical theory and optimal control. Its research object is mainly linear systems, which have strong robustness in practical applications [17-18]. Figure 2 is the structure diagram of NN algorithm.

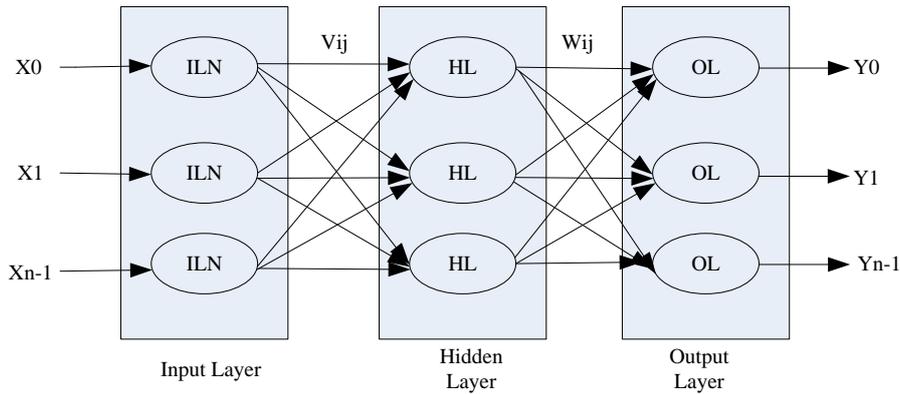


Figure 2. Structural diagram of the NN algorithm

Artificial neurons are composed of one or more interconnected units. Each neuron will collect the identified original data and map it to a specific location (i.e. node) to form a corresponding output value function. When the collected real state input is obtained, the corresponding relationship curve can be obtained to represent the information of each node of the neural structure, thereby realizing the process of acquiring knowledge, processing and expressing experience from the human brain. After a certain input sample  $x$  is sent to the input layer of the single hidden layer feedforward NN, If the input of hidden layer neurons is  $z$ , the output of hidden layer neurons is:

$$a^y = \sigma(z^y) = \sigma(Tx_i + bI) \quad (1)$$

Similarly, if the input of the output layer neuron is  $z$ , the actual output vector of the output layer neuron is:

$$a_i = \sigma(z^o) = V\sigma(Tx + b1) \quad (2)$$

The process described above is also called feedforward process in NN.

### 3. Experimental Process of License Plate Recognition Technology Based on NN

#### 3.1. Technical Process of License Plate Recognition Technology Based on NN

NN is a typical computer system that simulates the structure and functional mechanism of human brain nervous system. It has many advantages, such as strong ability of parallel processing information, good robustness, and the ability to obtain ideal results by nonlinear fitting of input data. As the vehicle license plate recognition mainly relies on visual judgment to obtain the recognized image sequence feature parameters and map them to the NN, so as to achieve the goal of automatic

classification of vehicle license plates, using the structure design of the artificial neural system can easily use the NN model and training algorithm to achieve the recognition process. This paper mainly uses the license plate recognition method based on NN (as shown in Figure 3), uses BP algorithm to preprocess the image, and compares the segmented image with the threshold interval set by the system to determine whether it is a character.

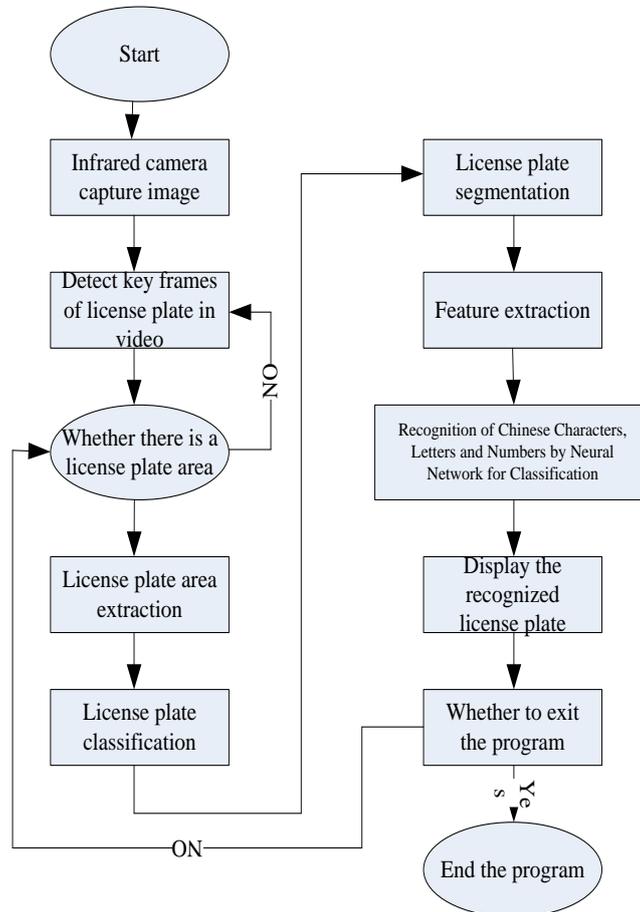


Figure 3. Technical process of license plate number identification based on NN

### 3.2. Functional Test Steps of License Plate Recognition Technology Based on NN

The license plate recognition system based on NN used in this paper is to collect the license plate information, extract the characters, pictures and other feature points in the image, and then use the specific area to calculate its template to match to the sample set. Firstly, through MATLAB software, the selected feature points with high similarity to the training, or large data sets with large non difference and high similarity probability are input into ANSYNX to establish BP (adaptive standard) NN algorithm library. Test the two identified parameters, and judge whether the method can achieve the expected effect and operation stability according to the data results.

## 4. Experimental Analysis of License Plate Recognition Technology Based on NN

### 4.1. Function Test Analysis of License Plate Recognition Technology Based on NN

Table 1 shows the function test data of license plate number recognition technology.

Table 1. License plate recognition technology test

Number of test rounds	Learning time(s)	Recognition time (s)	Correct recognition rate (%)
1	24	12	96
2	30	13	97
3	21	16	94
4	25	11	92
5	28	15	95

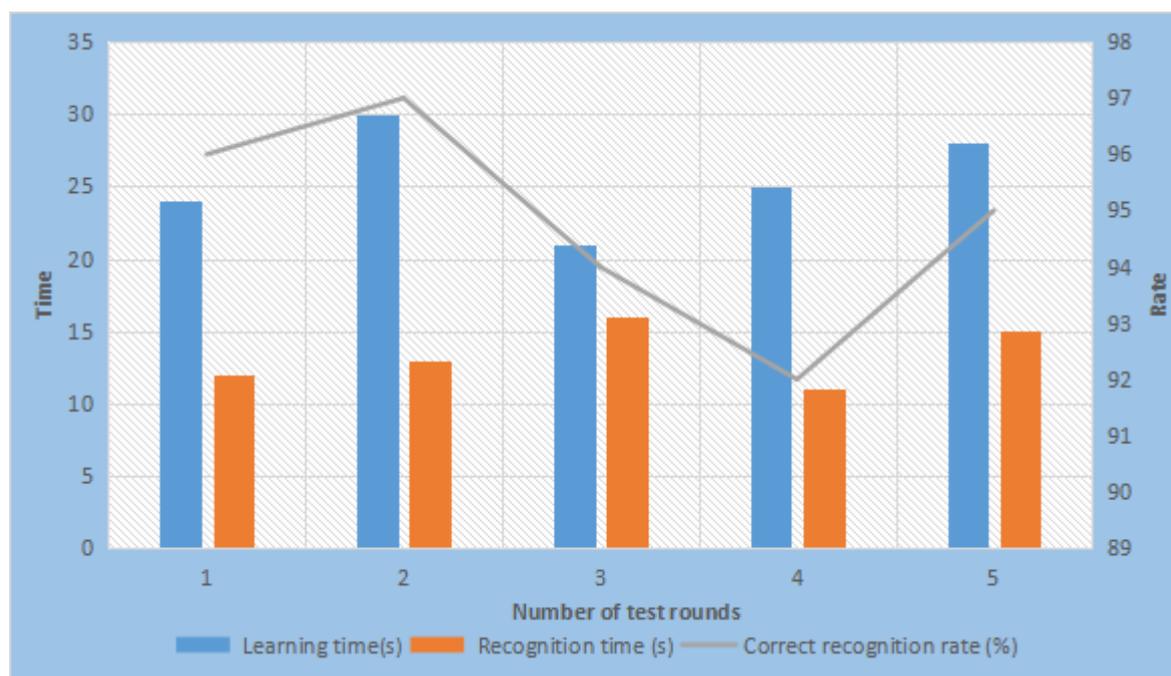


Figure 4. Performance test of the license plate number recognition of the NN algorithm

The basic principle of NN is to imitate the human visual system. By simulating and designing the biological neural system, it has the ability of perception and learning to varying degrees. The human eye recognition technology mainly depends on the image acquisition and processing module. This paper uses BP algorithm to realize the function of license plate location character recognition. The MATLAB language program is used to compile the objective function and set the threshold value, so that after achieving the ideal effect, the final result can be obtained by inputting the neuron data set in the NN and outputting it to the system control training factor, so as to track and judge the signal. It can be seen from Figure 4 that the learning time of license plate recognition technology based on NN algorithm is between 20s-30s, the recognition time is between 12s-16s, and the correct recognition rate is more than 90%. This shows that the algorithm is excellent in optimizing the license plate recognition technology.

## 5. Conclusion

License plate recognition system is an important part of intelligent traffic management, and also an indispensable basic technology in the development and application of modern automobile industry. This paper first introduces the fusion NN algorithm, then analyzes and studies the traditional PID license plate recognition method, and uses MATLAB to collect the data for statistics and processing to obtain the results. After that, Matlab software is used to simulate the license plate

character segmentation and positioning, license plate automatic recognition and other functional modules to achieve the desired effect of the system. Finally, experiment tests and performance evaluation are conducted on the set target image.

### Funding

This article is not supported by any foundation.

### Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

### Conflict of Interest

The author states that this article has no conflict of interest.

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