

# License Plate Recognition System

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**Abstract**—This paper proposes a license plate recognition system, where the neural network concept to be applied. The identification of license plate is on the basis of character. In order to make the system quickly and accurately the proposed system has designed a corresponding workflow and complete through the PC. When using license plate recognition systems, photographic lens will return successive still images. The system includes a main algorithm before image processing, detection and capture license plate location, license plate cutting element, license plate element feature extraction, as well as license plate recognition and other components several parts.

When looking at the license plate, count the number of color changes in the image of each horizontal line. Through the qualifying threshold selected area can discover out the license plate placement. The initial size of the region of localization results will serve as the basis to judge detect abnormal number plates, conditional iteration binarization, modified, and re-search. Whereby the plate to achieve better positions, but also enhance the accuracy of the cutting plate element. In the plate element cutting part, we use comparative characteristics of the target element and background to detect the color change, to identify elements borders and cutting.

**Keywords:** *convolutional neural network* , *character recognition* , *license plates*

## I. Introduction

A license plate recognition system is common in the art of image processing application theme. Style license plate recognition system, most builds on the stationary photographic equipment, with computer links, mutual transfer of information for computing. The main reason is based on the application side of the system, such as e-parking space management systems, vehicle traffic violation detection systems, as well as the stolen vehicle identification systems. When setting up these types of systems, it can be inferred that the vehicle will be predicted route passing by the common sense, and makes the license plate information falls within the scope of the system to detect. Therefore, as long as with the license plate recognition system set up fixed monitors, directed at a specific angle photography, you can get the approximate location of the license plate image in advance and return, and then computing the results obtained.

Email Alerts website with stolen vehicles, stolen vehicles, but when someone cannot be traced, the parties can broadcast their vehicles through the site have been stolen, use similar to the concept of universal search, use of the device in the country equipped with the system of all over, Detective measure and record the license plate number and location information. If a person has had a license plate, image capture somewhere matching system through GPS Update Web site and map

information, even if there is no stolen vehicle tracking device, which can find the missing vehicle movements accurately.

## II. License plate recognition system flow

The main calculation process license plate recognition system, from the input image, can roughly be divided into five parts: before image processing, detection and capture license plate location, license plate element segmentation, feature extraction element plate area, license plate character identification and so on.

In the image pre-processing stage, in order to solve related problems you might encounter before finding the license plate location, the system will make the appropriate image pre-processing. Which contain the region of interest (Region of Interest, ROI) setting, with the capture angle correction, ROI rotation correction, ROI grayscale conversion, ROI Gaussian smoothing, the initial ROI binarization seven works, and sequentially performed. License plate recognition system is based on mobile perspective, static target detection and image correction angle. On the other hand, when the system narrows the display area, the user can tell the system to detect the target of desire approximate location.

In the final step of image pre-processing, we can get an ROI binary image of the license plate information included. The system enters the license plate position detection stage. Because some of the effects of external factors, such as license plate light, dirt, and damaged, resulting in images obtained prior to treatment as expected, that the calculation of the license plate location in the system, get the wrong results. Therefore, in order to capture the exact location of the license plate is out, this paper proposed conditions of use iterative binarization method, the main purpose is to amend the binarization result is not good enough. After the system has been the position of the license plate, the rectangular marquee will indicate the detected position of the license plate, and according to its aspect ratio (based on rules of thumb may be), and limit the number of iterations, eliminate plate marquee abnormal result, two amendments the value of the threshold value of the image ROI Gaussian smoothing again after binarization.

## III. Image pre-processing

Broadly speaking, in the field of image processing, many algorithms are included in the process image pretreatment step. Its purpose is to make the following algorithms have better results, faster processing speed, or to be more in line with the image of the required information, and other algorithms. Among a wide range of applications in the algorithm, the former license plate recognition in the field of image processing is particularly common, study its content because that contains the target

image. In addition to the license plate itself, there are others, such as complex background information, environmental factors, where the target, and the target of the state itself and its surroundings, and so on. With the main algorithm is how to apply the results of the former premise, try to use the appropriate pre-treatment methods, thus becoming with license plate recognition systems. In recognition of the license plate area, a common type of image pre-processing to its target, it may roughly include the following categories: first, to reduce the amount of image information, such as grayscale conversion, color filtered, Restriction detection range.

Such algorithms are usually by reducing the complexity of the image information, in order to speed up the processing speed of the system subsequent steps, or through narrows the detection range, and at the same time retaining the probe target, thereby enhance the operation of the system next steps results. Second, adjust the image intensity of the type of information, such as edge gradient enhancement, histogram equalization, Gaussian blur, change the image contrast and the like. This type of algorithm is mainly aimed at highlighting the probe target, removing noise, reducing the extent of the environmental impact of the images are like.

#### IV. License plate position detection and capture

Images used in the license plate recognition in the field of pre-processing, and image information required for the main algorithm, there is a great dependency relationship. Therefore, most of the major front engagement image processing algorithm, the results will directly affect the accuracy of subsequent individual steps. If the effect of pre-treatment is not ideal, it will make the system get very bad results coming in every aspect. This section describes the ROI image after treated before the system is how to find the image of the license plate location.

##### 4.1 The level of variation labeling

In recognition of the license plate, the Statistics image color change amount per one horizontal line, screening, and marked in line with those. When searching for an image of the license plate location, it is more common practice. For a binary image, its concept and the progressive scan video input, calculate the number of black and white change each horizontal line. The use of plates arranged in a minimum amount of change in character, with a maximum change amount, the threshold is set double, in line with a horizontal line mark.

Figures 1 and 2 are arranged in the plate characters, changes the least number of black and white horizontal line times (12 times), and the plurality of times (36 times) in combination, and the statistics and labeled as follows:

$$peak_{yn} = peak_{yn} + 1, \text{ if } pixel_{yn,xn} \neq pixel_{yn,xn+1} \quad (1)$$

$$M(yn) = \begin{cases} 1, & change_{min} \leq peak_{yn} \leq change_{max} \\ 0, & otherwise \end{cases} \quad (2)$$



Figure.1 A schematic arrangement of the license plate characters and the minimum number of changes



Figure.2 A schematic arrangement of the plate and the maximum number of character changes

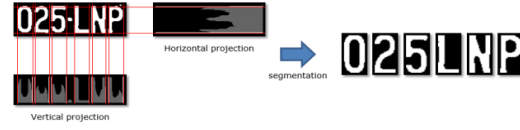


Figure.3. Binary characters processing

Equation (1) shows the number of changes in the level, when the pixel values of scanning the horizontal axis, the axis for each position, compared with the next pixel value, if the pixel values are different, a change of plan, not vice versa counts. Equation (2), a flag indicating the state, the amount of change when a shaft located within the range set, it is considered a candidate axis label up, above the lower limit of the amount of times that contains faulted tolerance to prevent interference plate around the calculated amount of information.

##### 4.2 License plate cutting element

License plate element cutting methods used in this paper, the general common boundary marks cutting method. Taking into account the non-existence of various license plate characters there may be cut out of the article, in continuation of the license plate element identification phase, the system can distinguish why all cutting objects. This part will be described in detail in the following sections. Compare the practice, some people takes advantage of special license plate block features cutting mode, no need to cut out the character and conduct complete identification. Some people object communication method is used by the license plate area output and further independent object identification.

To capture the license plate location, often have interconnected characters, or characters around excessive noise and other adverse factors, so that the cutting element effects are less than ideal. However, the proposed conditions via Benpian iterative binary processing, the system as long as the use of a simple boundary markers mutilation, you can get a very good output.

#### V. Identification of character

##### 5.1 Introduction

This paper proposed plate element identification method, the concept is derived from the convolution neural network. He is a feed-forward neural network. Convolution network is inspired by biological processes, and is changing Multilayer Perceptron is designed to use the minimum amount of pre-processing. Convolution network was originally inspired by the neural mechanisms of visual design. It is designed to identify the two

dimensional shape of a multilayer perceptron.

This network structure for translation, scaling, inclination or common forms of distortion are highly invariant. Neurocognitive matching a visual pattern into a number of sub-mode (feature), then enter the feature flat hierarchical type connected processing. It attempts to model the vision system, enabling them to have a displacement of an object or even a slight deformation of the time, to complete the identification.

## 5.2 CNN Structure

Convolution network is to identify two-dimensional shapes and a specially designed multi-layer perceptron, the network structure of translation, scaling, inclination or the common forms of distortion are highly invariant. The good performance of the network in a supervised way to learn, the structure of the network connection and the main sparse weights share two characteristics, including the form of constraints as the following:

1. The feature extraction. Each neuron layer of acceptance from the local domain, are highlighted input, thus forcing it to extract local features. Once a feature is extracted, as long as it is in relation to other features are approximate preserved, its precise location becomes less important.
2. The feature mapping. Each layer of network computing is characterized by a plurality of maps, each of which feature maps are planar form. Plane alone neurons share the same set of weights outstanding under the constraints, this structure has the following beneficial effects.

## 5.2 CNN Learning

The Convolutional neural network is a multi-layer neural network, each composed of a plurality of two-dimensional planes, and each plane of a plurality of individual neurons. The network consists of a few simple elements and complex element, denoted as S- and C- yuan RMB. S- S- surface composed of elements coming together, S- S- together to form a polymer surface layer, represented by Us. C- yuan. Where has a similar relationship between C- and C- surface layer (Us). Any intermediate level network layer in the series of the S- and C-layer is made, and the input stage contains only one layer, which directly accepts two-dimensional visual model, the sample feature extraction step is embedded interconnect structure of the convolution neural network model.

Generally, Ourselves for the feature extraction layer, input of each neuron and the local receptive field is connected to the previous layer, and extract the local features, once the local feature is extracted, it is the positional relationship with other features also will determine; Uc is a characteristic mapping layer, the network layer is composed of a plurality of features each compute maps, each feature is mapped to a plane's weight of all neurons equal planes. Feature mapping structure using an influence function of the nucleosome sigmoid function as the activation function convolution network so characteristic map has shifted invariance. In addition, since the weight of neurons shares a mapping surface, thus reducing the number of free parameter network, reducing the complexity of network parameters. Convolution neural networks, each feature extraction layer (S- layer) are followed by a request to the local average and the compute layer (C- level) Secondary extraction, feature extraction twice this unique structure makes the network In identifying the input samples have a higher tolerance for distortion.

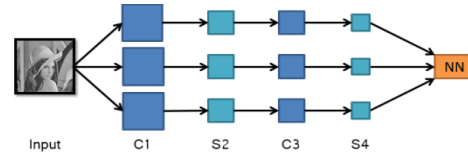


Figure 4. CNN learning model.

Where the input C1, S4 to C5, C5 is fully connected to the output, C1 to S2, C3 to S4 is one to one connection, S2 to C3 symmetry to eliminate network, removing part of the connection, allowing feature map more with diversity. Note that the convolution kernel size C5 and S4 to output the same, the only way to ensure that the output is one-dimensional vector.

## VI. Conclusions

This paper proposes license plate recognition systems. On image pre-processing stage, set the region of interest, so that the icon size of the system in the future process of streamlining many. With pretreatment the license plate position detection phase of convergence, iterative design a set of condition binarization calculation processes to help amend the image binarization result.

The license plate location, license plate characters cut rates more accurate, better output performance. On the other hand, the main algorithm for placing the license plate number. Applications of the concept of convolution neural network, whereby as an integrated classifier. The experimental results of the feature table have about 9 percent of the ability to identify, and test data can be independently distinguished over nearly 90 percent of the license plate components. The experimental results demonstrate the image has good recognition result.

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