

# Application Morphological for Vehicle License Plate Recognition

Rong-Choi Lee, Huan-Sheng Wang, King-Chu Hung

**Abstract**—This paper is the use of image processing to develop an automated system to detect the license plate. The proposed license plate recognition system of this paper, including license plate image binary, the license plate location, and segment the license plate characters and character recognition four sections.

In the first part of our license plate location in image processing technology, the input gray scale image of the vehicle, then Sobel edge detection method to find the plate edge, with the final morphological location to find the license plate. License plate image binary part, we use dynamic average gray value method to find threshold, the license plate image grayscale convert binary image. The character cutting part, we use eight neighborhood connected components labeling method to segment the characters of the license plate.

In this study, at last we apply Sim Net neural network to make recognition of the license plates. Finally, license plate recognition success rate 95.69%.

**Index Terms**—dynamic average gray value • morphological • Sim Net neural network

## I. INTRODUCTION

### A. Background

In today's Taiwan, quite frequent use of the vehicle from the traffic problems, such as derivatives: speeding, running red lights, accident and motor vehicle theft cases. Each vehicle has a unique license plate number, when there is a problem that can use to quickly identify the target vehicle's license plate. Once a duplicate license plate must be corrected, in order to prevent others from using false number plate violations, so the original owner of the license plate punished.

The current vehicle identification system can be divided into two parts; it is to install a transponder in the vehicle when the vehicle identification means is read by infrared RF or microwave transmission number. The other is by taking the actual image and then identification the license plate number from the image.

When the vehicle speed exceeds the speed limit or install response may lead to recognition errors. To solve this problem the installation of monitoring systems to capture images of the vehicle license plate number to identify who these vehicles cause poor recognition efficiency. Furthermore,

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transponder may be stolen copy and owners must be self-absorbed, resulting in the identification easily extended. In recent years, PC hardware upgrades to improve speed recognition technology, recognition rate and speed. Vehicle Identification System are: automatic highway toll systems, vehicle factory or building of access control, vehicle parking field management, search for vehicle theft and arrested the illegal vehicles, said the social contribution which can effectively save a lot of manpower and financial resources to waste.

### B. Research Motivation

Development of automated license plate recognition system is intended to replace manpower license plate recognition, judging from the images captured whether the license plate, if there locate the license plate area, then rip out the license plate of the characters were identified. When the recognition system is completed and hope to combine hardware, such as a camera or monitor instrument can capture images and apply research results in practice, automatic license plate recognition after capturing the image, number interpretation, compared with human read the license plate number, then enter the license plate number to check whether the target is also looking for more and more efficient.

In recent years, the rapid growth of Taiwan's vehicles, also causing a lot of traffic problems, such as traffic enforcement and the vehicle lost, police units to invest a lot of manpower looking for a vehicle, the effect is very limited. To traffic enforcement, for example, by automatically speeding and running a red light camera equipment can be offending vehicle camera images through high-speed snapshot down. But before sent photos to the owners, to identify each violation of the vehicle's license plate number and

Also in the stolen vehicle inspection, police patrol units can be set up in important sections through the monitor and police look for other ways, but because of the passing cars on the road quite a bit and the speed is quite fast, the human cannot be in a short time within the license plate number and find out whether it is the correct interpretation of stolen vehicles. Currently inquiry stolen the owner is quite a waste of manpower. The use of license plate recognition system to identify a large number of illegal photos, find the photo number and address of the owner, you can effectively save manpower vehicles, police officers need to visually check the license plate number and then enter, it is an inefficient work.

### C. Research of Related Literature

In the literature [1-6, 18, 19] is the location for checking your license plate. Where in the literature [3] need to find the row and column thresholds, but it easily the influence of light or at night and other factors, it can not find the perfect threshold. In [4] because the image is not in the same position by photography and by the impact of on roads steep slopes.

Therefore, they will not easily match to effectively license. [5] is need to create a reference model, and license plate shall be identified standards, and in a different location photography, so easily lead to license plate recognition errors. In the literature [1, 16] is to use the license plate character recognition, confusion vulnerable to similar characters, such as 1 and I, 0 and O, 2 and Z, 3 and B, S and 5, and so on. Therefore, they are not easy make the license plate characters match, resulting in license plate recognition errors. In [13-17] is for the immediate license plate recognition system.

### D. Objection

Now people use vehicles in addition to cars, there are light motorcycles, motorcycle, taxi, or the like. In addition to different colors, there are different numbers or English characters. Since the car's license plate format in general, from left to right is composed of two letters and four numbers. License plate format is again one of the previous two letters into numbers. Another license plate format is four numbers plus the combination of two letters. And taxi, bus, truck only five words.

Background noise, such as adaptive or because of the footage in the background there is a lot of complexity, you can locate the license plate can be from any corner of the screen, and in the noise above and below the license plate number, make captures taken out of character deformation identification fails, you must first identify the results will affect the noise after cleared to make identification process.

## II. STUDY METHODS

A license plate recognition system processes start when only the vehicle through the camera to take pictures of the photo camera input the license plate recognition system, the video input of the first proper pre-treatment, and then locate the license plate. If there locate the license plate area, then cut out the license plate character recognition carried out, according to identification results to determine whether the license plate format.

Which also has a license plate character recognition without cutting [2], but must go through the exact positioning of the plates, and the plates after correction angle and size, location out of the plate height, just the height of the characters, and with a fixed size sampling frame windows on the license plate sampling, sample images to be formalized and out of character templates same size, and then all the characters and templates (10 digits, 26 letters of the alphabet) carried identification, identification of the sample after frame moves one pixel to the right. But the license plate characters only six characters, but the identification number will be more than six times, and it is more than 36 characters on each time you make a template identification, there are 36 more than the value of the finished, select the highest value (0 to between 1), the closer a value representative of the closer alignment of the template, and judges whether there is more than the threshold value, if there are more than the threshold value is expressed identify characters, if the sample does not exceed the threshold value indicates that no characters box .

### A. Image Binarization

In order to effectively reduce the complexity and amount of information represented by the graphic image, the image usually is binarized.

At present, the original of Taiwan vehicle image, as show in Fig. 2.1(a), vehicle image of gray level, as show in Fig. 2.1(b). And the use of binary process in license plate recognition method, the rear license plate characters and background. And set a threshold value, the image of the gray level value greater than the threshold value is 1, but less than the threshold value is 0, as show in Fig. 2.1(c). But the brightness of the license plate is susceptible to light, so the optimal threshold value will not be a fixed value, but is often used as the mean gray-scale value to the threshold, but the disadvantage is that if the image brightness distribution is uneven, the averages calculated may differ from the actual threshold value. In addition, the binary method can achieve the best Otsu binarization of evaluation in many literature are good, its main purpose is to find a threshold value, to make a weighted sum of the number of clusters is the smallest variation.

### B. License Plate Property

License plate recognition systems are doing before, due to the countries of the license plate format is not the same, and the object of the research paper is the license plate of the vehicle used in Taiwan, not just black and white license plate number but different characters.

(1) Color: Own car license plates in black and white, white and red taxis, tour buses 5 red and white characters, van bus green and white big business, own a large truck bus own white and green.

(2) The license plate number of words: Taiwan's license plate numbers in English can be a combination of five or six characters, and are located in the middle of the plate. After the plate was positioned objects, objects can be judged by the number of words is not the license plate. Not the same arrangement of different types of vehicles in English and numbers.

(3) Change edge: The levels will be very dense because the license plate through the five or six words, and some of the text and background brightness changes will be relatively large, big changes will focus on some of the pixel license plates.



Fig. 2.1: (a) Original vehicle image.



Fig. 2.1: (b) Image gray level.



Fig. 2.1: (c) Image binarization.

### C. Image Edge Detection

[3] using Pulse Coupled Neural Network to do dynamic vehicle location, and [5] is the use of neural networks to the edge of a particular color combination of the license plate to such detection, can not reduce the portion of the edge of plate.

And [6] using wavelet transform to detect license plate, these are for license plate location moves from the image edges.

The plate is generally the easiest method is to detect directly the edge of the image to grayscale Fig. 2.1(b), which may be used Sobel Filter matrices  $M_x$  and  $M_y$ , using follow (1) and (2) formula, they can find out from the part of the image in a horizontal or vertical edges, as show in Fig. 2.2.

$$M_x = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad (1)$$

$$M_y = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad (2)$$

$$G = \begin{bmatrix} g_1 & g_2 & g_3 \\ g_4 & g_5 & g_6 \\ g_7 & g_8 & g_9 \end{bmatrix} \quad (3)$$

$$P_x = \left| \sum_{n=1}^9 G_n M_{x_n} \right| \quad (4)$$

$$P_y = \left| \sum_{n=1}^9 G_n M_{y_n} \right| \quad (5)$$

$$P = P_x + P_y \quad (6)$$

G represents a point on the map and the pixel grayscale eight neighboring pixels value, multiplied by the sum of  $M_x$  and  $M_y$  respectively after the  $P_x$  and  $P_y$ , using (4) and (5) formula, the sum is the result of edge detection, as (5) formula P.



Fig. 2.2: Image edge use Sobel method.

#### D. Morphology

Morphology of the use of images to analyze the shape of the structure, in order to strengthen the structural characteristics of the image as is license plate localization. Morphology have (1) Erosion, as show in Fig 2.3(a). (2) Dilation, as show in Fig 2.3(b). (3) First erosion and then expand (opening) method, as show in Fig 2.4(a). (4) First expand and then erosion (closing) method, as show in Fig 2.4(b).



(a) Image erosion.

(b) Image dilation

Fig. 2.3: erosion and dilation operation



(a) Image open.

(b) Image close.

Fig. 2.4: Open and close operations.

Table 1: Eight neighborhood connected components labeling

1	4	6
2	5	7
3	8	

We used eight neighborhood items marked connectivity issues to take into account the order of the license plate characters, as show in Fig 2.6, the leftmost characters start number. So we find from top to bottom, and then from left to right.

Eight neighborhood connectivity labeling objects, we should determine whether the object is connected around, and whether the object has done linked marked. If there are no marked pixels and pixel itself is connected to the same thing, if there is already marked, you must indicate the two identical objects become the same thing.

Eight connectivity labeling process, from the search direction of a non-zero pixel  $P(i, j)$  do labeled, Table 1 represents the position in the following Table 2, black plaid represent P5, it also represent  $P(i, j)$ , its expressions as formula 7.

Table 2: Represents the Table 1 position.

P1	P4	P7
P2	P5	P8
P3	P6	P9

In Table 2 Mathematical expressions, the following expression.

$$\begin{bmatrix} P1 & P4 & P7 \\ P2 & P5 & P8 \\ P3 & P6 & P9 \end{bmatrix} = \begin{bmatrix} P(i-1, j-1) & P(i-1, j) & P(i-1, j+1) \\ P(i, j-1) & P(i, j) & P(i, j+1) \\ P(i+1, j-1) & P(i+1, j) & P(i+1, j+1) \end{bmatrix} \quad (7)$$

The eight neighborhood connectivity labeling of four (P1, P2, P3, P4) positions. In accordance with the order of inspection, when P (i, j) not indicated number and relative positions P1, P2, P3, P4 number are zero, then P (i, j) for a new object give the new object number. If Pn the position of non-zero, then the same as P (i, j) the number and Pn. If i was not continued to check the remaining four positions, P5 also been compiled.

After eight neighborhood connectivity labeling procedure, to obtain upper, lower, left, right boundary coordinates and pixels of objects. After searching for the end of the article you can find a number 1, and then get object ID to get the object boundary coordinates.

### III. STUDIES THE ARCHITECTURE

Process license plate recognition system is divided into three parts: (1) License plate location: From the image in the region of the license plate may be positioned out. (2) Character cut: to determine whether the area has been targeted for the license plate, and capture the license plate characters. (3) Number identification: Identification in license plate characters.

#### A. License Plate Location

License plate recognition in image input part contains the license plate after treatment license plate location, license plate may be produced objects, similar to the license plate and then determine the shape of the object, were cut characters.

#### B. Edge Detection

Enter the license plate photos are color images (R, G, B). The color images into grayscale image in G.  $G(i, j) = 0.3 \times R(i, j) + 0.59 \times G(i, j) + 0.11 \times B(i, j) + 0.5$ , the value is between from 0 to 255. Then from grayscale images G edge detection, edge detection use Sobel filter available in Fig. 3.1.

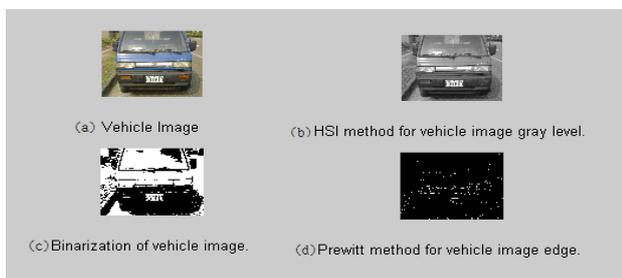


Fig. 3.1: (a) Original image. (b) Image gray level. (c) Image of binarization. (d) Sobel method to edge map.

Sobel filter image after beginning operation of Mx get vertical and My edge map, using follow (8) and (9) formula, as show in Fig. 3.2 and Fig. 3.3 the license plate image grayscale map to find vertical edge map.

$$M_x = \frac{1}{4} \begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} \quad (8)$$

$$M_y = \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} \quad (9)$$

Then for a license plate in the text and the background of some of the high brightness contrast, given a threshold binary, the value of each pixel on the vertical edge of the map, the threshold value of 1 or greater, the image is white. Is less than the threshold value was 0, the image is black. The original image is turn into the binary pattern.

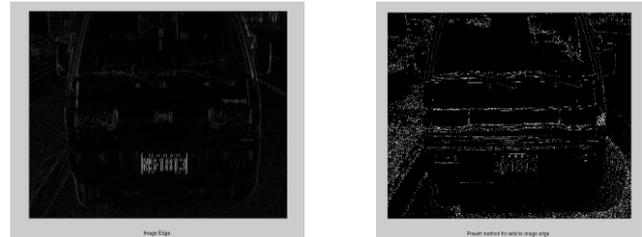


Fig. 3.2: Image vertical edge map. Fig. 3.3: Image vertical edge map of Sobel method.

Before you get the binary edge image map, using the principle of morphological, will fill the gap between the edges of the plate, while the other noise filter to clear its action is divided into three steps: (1) License plate image in the horizontal direction of closing. (2) License plate images after breaking the horizontal direction (Opening). (3) License plate images of breaking through the vertical direction (Opening).

#### C. Determine the License Plate of Image

Finally, the use of the eight neighborhood connected components labeling method for the original image to find the location of the license plate.

Every object record images upper, lower, left, right and the number of pixels. Because the license plate will be taken as the angle and distance affect the aspect ratio of the license plate. After the morphological of break and close three steps will affect the object area ratio. In order to do the exact character and the least restrictive license plate cutting width and height? With the following three criteria to select a plate objects.

$$\text{height} = \text{lower} - \text{upper} + 1 \quad (10)$$

$$\text{width} = \text{right} - \text{left} + 1 \quad (11)$$

$$3 \leq \frac{\text{width}}{\text{height}} < 6 \quad (12)$$

$$\frac{\text{Total Pixels}}{\text{width} \times \text{height}} \geq 0.6 \quad (13)$$

$$\text{width} > \frac{\text{column}}{8} \quad (14)$$

The upper, lower are image of top, below, width is image of width, height is image of high, the "Totall Pixels" word is image the number of pixels of sum.

When (13) value closer 1, indicating that this item will be closer quadrilateral. The aspect ratio (12) falls within a range

the object will be closer to the shape of a rectangular plate. Objects meet these conditions, there may be as part of the license plate image.

But some parts, such as the left-most digit of 7 or right most character is L, are likely to be closed will be filtered out before do opening action part of the character, again just to be able to fully capture the background, not the background is the text interrupted during binary reverse judgment, make the background even as an object.

In order to accurately capture the license plate characters, the need to expand the scope of license plate location. First set  $\Delta H$  and  $\Delta W$ , using follow (15) and (16) formula.

$$\Delta H \leq \frac{\text{height}}{5} \quad (15)$$

$$\Delta W = \left\lfloor \frac{3 \times \text{height} + 6 \times \Delta h - \text{width}}{2} \right\rfloor \quad (16)$$

Renew:

$$\text{Upper} = \text{Upper} - \Delta H \quad (17)$$

$$\text{Lower} = \text{Lower} + \Delta H \quad (18)$$

$$\text{Left} = \text{Left} - \Delta W \quad (19)$$

$$\text{Right} = \text{Right} + \Delta W \quad (20)$$

With renew Upper, Lower, Left, Right to retrieve the object, using follow (17) and (20) formula. It has expanded to capture the character completely fall within the scope of the text and the background is not part of the interruption.

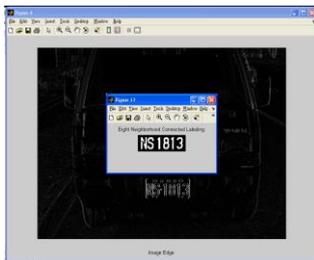


Fig. 3.4: License plate extract.

#### D. Segment the License Plate

After it find the license plate, segment the license plate, as show in Fig. 3.4.

#### E. Characters Extract

Although the second part of the license plate recognition aims to capture characters, the characters in the license plate capture objects out before capturing characters, must do the reverse binarized determination, recalculation capture out of the number of characters, this item may be determined whether the license plate.

#### F. License Plate Image Binarization

Use binary license plate do binarized as show in Fig.2.2 (c). The main purpose is to reduce the image binary image of the large amounts of data volume, with a threshold to P grayscale image converted into binary. Whereby the complex background images and objects to be captured separated.

$$0 \leq P(i, j) \leq 255 \quad (21)$$

$$\text{Binary}(i, j) = \begin{cases} 1, & \text{if } P(i, j) \geq \text{threshold} \\ 0, & \text{other} \end{cases} \quad (22)$$

How to find the threshold is a big problem, most of the paper is the use of Otsu binary on to find the optimal threshold value, and in order to save the amount of calculation can also be used when the average gray-scale threshold value.

From the table can be found in the threshold value as environmental conditions change in the recorded image, so you can not use the fixed threshold value, in order to reduce the amount of computation, the average value of the use of gray-scale values as a threshold, you can get very good effect.

Whether the image average grayscale value of binary method, as show in Fig. 3.5(b), we are used a threshold for the image of binary, you cannot succeed in capturing the character or the character and background separation. We employ dynamic mean value binary method make the image binary operation, as show in Fig. 3.5(c).



(a)Original license plate. (b) Binarization license plate.



(c) Dynamic mean value of binary license plate.

Fig. 3.5: Original and Mean value binarization and dynamic mean value binarization license plate map.

So we are doing a dynamic binary, the main aim is to make each pixel has its own threshold, in order to achieve separation of text and background. The main approach is to calculate the image around each pixel of the gray scale mean value to each pixel when the threshold value, can improve the above problems.

Calculation of dynamic binarization threshold, first obtain the height and width of the image. Where in the height is equal to the number of images row, column width equal to the number of images. When we want to find a threshold, to calculate the average value of the yellow grayscale range, set the threshold value greater than or equal to a threshold value, less than the threshold value is set to 0.

Using the above methods to obtain binary pattern, although the increase is very computationally intensive large increase, the resulting binary pattern of the text and background can completely cut out.

#### G. Binary License Plate Reverses Determination

Generally speaking, we have chosen to do black and white characters cutting, so we must be able to determine the license plate after binarization will produce black and white or black and white. And choose the black and white characters that we need to do the cutting.

First Object, after binarization produce a binary image, let B1 is a binary image. It is additionally generated Inverse binary image B2 (B2=1-B1). Binary map obtained after B1 and B2 respectively communicated with eight neighborhood connectivity labeling way to find the largest object, this object may be part of the license plate backgrounds.

If B1 has the largest objects, use B2 is what we need black and white binary pattern, so that B3 = B2, which can be obtained from the scope of the license plate background B1. If the object has the largest area of B2, so B3 = B1, can be obtained from the scope of the license plate background B2. From B3 binary to identify bit in the range of the license plate background objects, to retain articles having a certain height and width, and capture them. Rip out the text if there are five or six, then this thing is very likely that the license plate, the identification numbers do. If the number is not captured five or six, it means that this item is not a license plate. The image do eight neighborhood connected components labeling objects, you can get information on each object. Identify all objects in the highest height value Max H do reference, will be less than (0.7 \* Max H) objects as noise cleared, the stay may be text objects are part.

#### I. Identification Number Plates

Before the license plate number identification process, you must first capture the character map out action after it do normalization, remove the characteristic values from the character map. The use of feature values to identify the learning stage or stages, so that the initial value of the former SimNet network learning taken by each license plate characters and produce appropriate weights, while the latter use these weights to identify the work.

#### J. Imaging Feature Values

With the most basic way to get from the image distribution characteristic values, the following steps: capture the character of the binary pattern, the image size is row x column. The characters of image formalized into a fixed image size. Preset feature matrix zero matrix of size 40x24. Characteristic matrix sampling the binary data into the feature points on the graph, and then the feature vector X is changed 0 into -1, characteristic value acquisition is complete.

#### K. SimNet

In recent years, neural network class played on classified information is a very important role. Neural network [7 -12] are based on human thought and brain activity and construct a mathematical model similar to brain function. Neural network has a similar human brain cells to each other by a number of simple and continuous composed of neurons, and parallel processing operations between them, and its architecture has its regularity. And bypass SimNet network, which for a two-tier neural network, namely input layer and the output layer; input layer for receiving various characteristics of the input and the output layer is used to represent the input by those who are classify the case. In input layer and output layer to complete the link. In order to avoid a value in the input

vector has had tremendous value, and thus control the overall output, and therefore the proper normalization is necessary, in this study for each input neuron will formalize -1 to the interval 1.

Each character map feature values upon acquisition, you can get the feature vector values, when the identification characters can use the following matrix multiplication representation, using follow from (23) to (26) formula..

$$X = [x_1 \ x_2 \ \dots \ x_n] \quad (23)$$

$$Y = [y_1 \ y_2 \ \dots \ y_n] \quad (24)$$

$$Y = F(X \cdot W) \quad (25)$$

$$F(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}, -1 \leq F(x) \leq 1 \quad (26)$$

X is a feature value vector, W is a weight matrix, Y are output units, F(x) is an activation function, can limit the output neurons between -1 and 1. Required identification weight matrix W, available learning stage to produce weight matrix. W's in the learning process must first set the X and T. Suppose a learning collation characters S samples, the samples were each character must be classified, an A input characters X, you must make A representative output neuron 1, the other output neurons classified as -1, and the classification results into T, T are target values.

- (1) Set the initial value of the X, T.
- (2) After the initial value is set, the first to produce an initial weight matrix W, using follow (27) and (28) formula.

$$X = X / \text{norm}(X) \quad (27)$$

$$W = X^T \cdot T \quad (28)$$

- (3) The weight matrix W learning and correction phases, using follow from (29) to (32) formula.

$$Y = X \cdot W \quad (29)$$

$$dY = T - Y \quad (30)$$

$$dW = X^T \cdot dY \quad (31)$$

$$W = W + dW \quad (32)$$

- (4) Repeat (3) step of the process, after 10,000 cycles of operation or when the error is less than the critical value dY end of the learning phase.
- (5) The right weight matrix obtained by dividing the Norm (X) obtained number of new matrix, as follow (33) formula.

$$W = W / \text{norm}(X) \quad (33)$$

Updated finished W matrix, this matrix W can be used in the identification license plate number.

L. Experiment process

During the experiment, the license plate recognition system is divided into two stages, the first stage and the second stage of the plate positioning the cutting process are the same characters, the goal is make the image cut out the license plate characters, not the same part of the third stage, after the completion of license plate location and character cutting, the first characters of the binary pattern directly to the archive, and then do the training sample plates. The other is to make the character binary pattern character recognition.

M. Input Image

Experiments with a single license plate license plate photos is fixed proportion of 500x666 pixels (row = 500, column = 666). Experiments photograph license plate location is not necessarily located in the center of the image, it will not affect the outcome of the license plate location positioning, but the camera angles and distance will affect the results of positioning.

N. License Plate Location

The license plate of location, as show in Fig.4.1 white part.

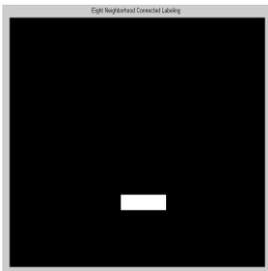


Fig. 4.1: White is license plate of location.

O. License Plate Edge and Extraction

In Fig 4.2 is the license plate use Sobel method edge and at upper is extracted the license plate.

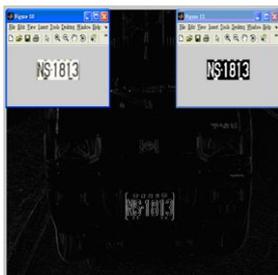


Fig. 4.2: License plate Sobel method edge and extraction.

P. Character Recognition

In the license plate character recognition identification process is the most important part of this research on the character recognition using SimNet network as identification purposes. In this study, using a mix of English and Mathematics neural network, the packet into 10 digits (0 to 9), and 25 kinds of letters of the alphabet (26 letters of the alphabet, the numbers 0 deduct the same letters O).

Must first character image normalization and standardization of action is mainly to adjust prior learning SimNet network characters or character recognition height, and then adjust the width of the characters in the image

according to size ratio. During the experiment, the character image height adjustment for the 40 pixels (image size is 24x40), weight value ratio will be adjusted to 30 pixels (image size is 18x30) obtained false positive rate can be reduced at the end, similar characters (such as 8 and B, 0, and D, etc.) are able to correctly identify.

IV. VEHICLE LICENSE PLATE RECOGNITION OF RESULTS

Experiment recognition results, all license plate images 232, correction license plates recognition have 222 successful, recognition rate about is 95.69%. Most of characters have faded or scratched, resulting in incomplete capture. Identification fails reflective image on a license plate characters, resulting in incomplete capture. Most characters have faded or scratched, resulting in incomplete capture is when noise into the non-character. A license plate location is too large, failed to capture. Number of characters captured less than four or more than six, was determined not to license plates. There are problems in removing the screw part by other non-character objects. Impact, resulting in some of the character image is cut off. Range of license plate location is too small; the license plate image is incomplete. This recognition rate are higher than [9, 10] articles in reference, as show in Table 4.

Table 3: Experiment data.

Experiment	Successfully /all sheets	Recognition rate
Result	222/232	95.69 %

Table 4: Recognize rate compare.

Paper No.	Recognize rate (%)	sort number
This article	95.69	1
[11]	94.2	3
[12]	95.33	2

V. CONCLUSIONS

In this paper, in order to identify the license plate grayscale value change text and background for many of shots out of the picture (including license plates of different colors), to observe the change of its edge part of the text, and then use the morphological processing, the license plate area capture it. No fixed way to search windows license plates, because the photographs in the vehicle, it is impossible to remain at the same distance, the angle can also cause changes in the license plate.

Identification license plate recognition success rate imaging features video input values will be affected. In the previous part of the license plate location out of the license plate, license plate images are not just in the background and text, Histogram not simply divided into two clusters, and usually gray-scale values of other non-text, and then through the usual binary image will become noise, filtered through some non-text processing, such as: internal purge of non-background noise, noise connected with screws, and find the true height of the text.

Some studies uneven brightness distribution license plate images, the use of Otsu binary method, may be because most of the license plate the shadows caused by the characters are connected, or uneven illumination can not capture the full character. In order to complete separation of text and background, use dynamic binary method to calculate the threshold value of each pixel, so when faced with the license plate on the shaded image or uneven illumination, but also can rip out the full text. Finally, the character image, using SimNet perform character recognition test result. Finally, license plate recognition success rate about 95.69%.

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