



## Color license plate localization algorithm research based on moiré principle analysis

Shanhong Zhu<sup>1</sup> and Pei Tang<sup>2</sup>

<sup>1</sup>School of Computer and Information Engineering, Xinxiang University, Henan, China

<sup>2</sup>School of Art and Design, Xinxiang University, Henan, China

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### ABSTRACT

The traditional license plate localization algorithm uses the gray image texture feature, the texture feature of gray image features and limitations bring great difficulty in getting a license plate localization algorithm. In view of this, the color of license plate localization algorithm based on the moiré principle is proposed. Firstly, two-dimensional wavelet decomposition for image, sliding windows is small ripple bedding features of images; And at the same time convert low-frequency subgraph RGB color components as HSV color value, extract color feature, and get a comprehensive feature vector; Secondly, wavelet variations positioning license plate area; Finally to locate the license plate positioning results of late correction processing and output. The algorithm adopts the comprehensive characteristics of localization, overcomes the drawback of using single feature localization and limitations, an can be seen from the results of this algorithm can accurately extract the license plate location information from the background image.

**Keywords:** License plate location; small ripple bedding; color features

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### INTRODUCTION

License Plate Recognition (LPS) is one of the critical parts in the Intelligent Transportation Systems(ITS) and it occupies an important place in surveilling and manipulating the transportation. Vehicle license plates recognition system consists of three modules in general--license plate location, character segmentation and character recognition, of which prompt and accurate location to the car plate is the prerequisite of ITS. At the same time, it is the critical technology in improving the recognition rates.

The accurate location and extraction of license plates are very important. So far the common methods of license plate location include method based on color, based on gray-scale image and based on artificial neural network. In general, the method based on color will make the input RGB color image converted into a color image HIS, and then make the further location. However, when the color of the car plate area is close to the nearby color, usually the method based on the gray-scale image uses edge detection operator license plate to produce vertical and diagonal texture, while the disadvantage is that the non-unify of the license plate contrast under different lighting conditions will make the shapes and texture features not obvious, so it will influence the location results. The method based on artificial neural network need every extracting pixel feature inputted into neural network to study. As for the large amount of calculation, the license plate location will take a long time, and deal with the local convergence as well.

According to this, we put forward the Color License Plate Location Algorithm based on the Wavelet Texture Analysis. First of all, we pursue two-dimensional wavelet decomposition, calculating the wavelet texture feature

within the sliding window image. And then we use the changes of the wavelet to locate a license plate region. At last we check and manage the license plate and output the positioning results. This algorithm adopts comprehensive feature localization, so it overcomes the disadvantages and limitation of the single feature localization. From the results of the test we can see that this algorithm can extract the license plate location information from the background image. Here is the flowchart of the Color License Plate Location Algorithm based on the Wavelet Texture Analysis.

## COLOR LICENSE PLATE LOCATION ALGORITHM BASED ON THE WAVELET TEXTURE ANALYSIS

### THE WAVELET ANALYSIS AND TEXTURE FEATURE OF THE LICENSE PLATE

The multi-resolution changes of wavelet can resolve the signal at any dimension into different frequency band. Now we take the color license plate image as our subject investigated, use the Wavelet haar to two-stage decomposition, so as to decompose wavelet domain in the image to the subgraph signal which is in different spatial resolution, frequency characteristic, and feature. T represents the wavelet coefficients which are transformed once for a sub-band wavelet coefficients position(X, Y). A is taken from the set {LL,LH,HL,HH}; LL represents that horizontal and vertical directions are both low frequency; LH represents that horizontal direction is low frequency and vertical directions is high frequency; HL represents that horizontal direction is high frequency and vertical directions is low frequency; while HH represents that horizontal and vertical directions are both high frequency. Sub-frequency range-{LH,HL,HH} is increased from the edge of broad wise, endwise, and diagonal direction. The texture characteristic of license plate location can be well reflected in high-frequency wavelet coefficient for the obvious edge characteristics in license plate character regions, so it provides critical basis for license plate location. At the same time, color information is obvious in low-frequency sub-graph, thus we can extract color characteristics. We consider the high frequency wavelet coefficients of calculation of statistical characteristics as texture features. These eigenvalues are average, mean square deviation, energy and inertia. We take texture features as the basis so as to definite the image regions. As for the window whose coverage region is A in the subband, the formula of the average, mean square deviation, energy and inertia in this region are as follows.

$$\mu_{\theta} = \frac{1}{W \times H} \sum_{i=1}^W \sum_{j=1}^H I_1^{\theta}(\mu + i, v + j)$$

### THE HSV COLOR FEATURES OF LICENSE PLATES

We transform the cars image color of the background image wavelet low frequency spatially and then decompose it, namely transform space RGB(Red, Green, Blue) to space HSV(Hue, Saturation, Value), and extract color feature in the transformed color space. The method of transforming color space RGB to color space HSV is as follows:

$$\sigma_{\theta} = \sqrt{\frac{1}{W \times H} \sum_{i=1}^W \sum_{j=1}^H [I_1^{\theta}(\mu + i, v + j) - \mu]^2}$$

The basic idea of color extraction is: in the color space HSV, extract the color car image with component H and S and identify color region with component V subsidiarily, at the same time, characteristic the white region feature and black region feature with component Z. Calculating the first and second moment of every component color's histogram so as to represent the distribution of the color in the image, and then extract the color feature.

Let P be the i-th color component of the i-th picture element in the picture, the first second and third component of the color in the region can be represented as: In this way, we can calculate and construct a color feature component in nine dimensional. And the specific form of this proper vector is as follows:

$$E_{\theta} = \sum_{i=1}^W \sum_{j=1}^H [I_1^{\theta}(\mu + i, v + j)]^2$$

### THE WAVELET TRANSFORMED LICENSE PLATE LOCATION:

Calculate the lapse rate of every high frequency component chart decomposed by wavelet resolution. The reason why we calculate the lapse rate not the horizontal gradient is that the most obvious changes of the region car plate character is changes in lapse rate. Summing all the lapse rate and we can get intruding car plate region. The formula of summation of lapse rate is the picture that we sum the lapse rate of the three high frequency subgraph in alternative region, and then we use the summation feature of high frequency component lapse rate to resolve the region opponent of car license and car light in detail. Firstly let the lineage of picture be m, column number be n, and use a small rectangular whose lineage is m and column number is 6 to search the whole picture from left to right,

and write down the density value of every small rectangular region. (Density value is the total number of searched white pixels or picture elements in the small rectangular area). Secondly, calculating the density value in the whole picture as the threshold value. (The threshold value is the total number of white pixels or picture elements in whole picture). First of all, we characteristic the region whose threshold value is less than density value as 1, the region whose threshold value is more than density value as 0, and then scan these marks. The region marked 1 is obvious and region marked 0 is screening. As the result, we expand the region marked 1 to the left or to the right, and we can locate the left and right bound of car license.

### SEARCHING FOR ALTERNATIVE CAR LICENSE REGION

The location of the car plate is by the side of the picture center. According to the situation, we put forward a license plate region searching method from the center to around.

Identify the height and width of license plate

Let the width of projected window be  $W$  and  $H$ , which should be the same or bigger than the license plate.

Let the sliding step of line be  $1 < w < W$ , row be  $1 < h < H$ , so we can identify the speed and precision.

The datum point of the projected window starts from the center of image.

Command line arguments increases  $h$ , and line parameters increases  $w$

Command line arguments decreases  $2h$ , line parameters decreases  $2w$ ,

Command line arguments decreases  $3h$ , line parameters decreases  $3w$

Command line arguments decreases  $4h$ , line parameters decreases  $4w$

And so on.

In this way we can scan the data, so we can insure the definitely passing license plate region in the scanning region, and improve the searching efficiency. As shown in the chart.

$$G_{\theta} = \sum_{i=1}^W \sum_{j=1}^H (i-j)^2 I_1^{\theta}(\mu+i, \nu+j)$$

### SUBSEQUENT TREATMENT OF THE LICENSE PLATE REGION

Next, an important work we should do is that the correction for grade after the location, whose quality will affect the subsequent identify of license plate character. Firstly, we identify the angle of inclination, and then take projection on the direction of the angle, so we can get the sole, and then identify the boundary of the plate character. The node shift of the plate is within plus or minus 15 degrees. According to this, we can get the angle of the plate through calculation. The method is as follows.

1. Start from the license plate in the horizontal direction, and take 3 degree as the step length, and then project it along the counter clockwise and the clockwise.
2. Statistic the black picture element at every line after the projection. And then pick out the changes gradient of the 3 adjacent rows of black pixels from the result of statistics. Keep the greatest difference of the result.

### THE ANALYSIS OF EMULATIONAL EXPERIMENT RESULT

The car plate picture we adopt is mainly taken by digital camera at random under natural condition, whose size is 640\*480. The car plate region accounts for 3%-10% in the whole car plate picture. Also there are some pictures--the car plate pictures of headstock or tailstock of a car, which are snapped by a camera. We simulate and verify the license plate picture of the license plate location arithmetic in this thesis in all kinds of lighting conditions and backgrounds. The results are shown in the figure.

We identify the following evaluation parameters in order to judge the experiment.

The correct detection rate: the proportion of correctly detected car plates' number and the total number of car plates in detecting set.

The false detection rate: the proportion of false car plate and total number of car plates in detecting set, including the condition that a car does not have car plate and we detect the car plate.

The missing detection rate: the proportion of car plates we are not detected and the total number of car plates in detecting set.

The experiment data is as follows:

$$T = (\mu_{LH}, \sigma_{LH}, E_{LH}, G_{LH}, \mu_{HL}, \sigma_{HL}, E_{HL}, G_{HL}, \mu_{HH}, \sigma_{HH}, E_{HH}, G_{HH})^T$$

The analysis of the experiment results

1. The texture and color feature have different location effect under diverse weight assemble, so is the speed. The bigger proportion which color feature accounts for weight, the less time. The best weight of color feature is 0.6, and the bigger weight will make the recognition rate decreased.
2. The accuracy rate of this method in the thesis is better than the other three calculation I have tested, however, the

location speed is in inferiority.

3. This method uses comprehensive feature to locate license plate, which overcomes the disadvantage and limitation of single feature location, at the same time, it is less effected by the texture and lighting condition of a car, and so on. Experiment has testified that the method in this thesis is very good to deal with the car license location. At the same time, it provides the theoretical and significance application of value to wavelet texture analysis technology, extraction of feature and matching technology.

### CONCLUSION

In this thesis, we mainly introduced the color license plate location algorithm based on wavelet texture analysis. Firstly, we take a two dimensional wavelet decomposition to the picture, calculating the wavelet texture feature of the picture in the projected window, then transform the low frequency to the RGB color component and HSV chromatic value at the same time, extracting the color feature and get the comprehensive feature vector. Secondly, we use the wavelet changes to locate the license plate region. Finally, we post-process the car plate. This method uses comprehensive feature to locate license plate, which overcomes the disadvantage and limitation of single feature location, so it can avoid the mixing randomized texture noise in cars picture. The experiment has testified that the car picture can have good texture feature extraction effect in complex lighting condition and texture. So it improves the accuracy rate of license plate in large extent.

### REFERENCES

- [1]Gao Q,Wang X N,Xie G F.License Plate Recognition Based OnPrior Knowledge[A].Proceedings of the IEEE International Con-ference on Automation and Logistics[C].**2007**:2964-2968.
- [2]Keerthi S S,Lin C J.Asymptotic behaviors of support vector machines with Gaussian kernel[J].*Neural Computation*.15July **2003**:1667-1689.
- [3]Chen Z X,Liu C Y.A Novel Algorithm of License Plates AutomaticLocation Based on Texture Feature[A].IEEE International Conference on Automation and Logistics[C].**2009**,5-7Aug.2009:1360-1363.
- [4]KaushikDeb,Kang-Hyun Jo.HSI Color based Vehicle LicensePlate Detection[A].International Conference on Control,Auto-mation and Systems[C].**2008**,14-17:687-691.