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The Vehicle License Plate Location Based on Adaboost algorithm of Color Feature

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Abstract: Summarized Thethe Related Research Of The License Plate Location At Home And Abroad In Recent Years, This Article Proposed A License Plate Location Method Which Based On Adaboost Algorithm. At First, The Normal Images Were Converted Into HSV Image.According To The Characteristics Of The Color In HSV Image, The License Plate Image Binarization Processing Was Completed;Thedenoising Processing Was Completed By Morphology;Then Based On Adaboost Algorithm , Off-Line Trained Classifier Was Used To Detect License Plate Candidate Area, Finally The License Plate Localization Was Positioned.
Keywords: License Plate Location; Adaboost; Opencv

I. INTRODUCTION

License Plate Recognition Is A Kind Of Automatic Identification Technology By The Use Of Dynamic Video Or Still Images Of The Vehicle License Plate Number, Picture Color .A Complete License Plate Recognition System Generally Includes Five Main Parts: Acquiring Images, Preprocessing The Image, Preprocessing Image, Delimiting Character And Recognizing Character.Among Them, The License Plate Location Technology Is The Basis And Premise Of License Plate Recognition System, Is Also The Key To Improve The Whole License Plate Recognition System Recognition Rate.

License Plate Recognition Is Mainly Composed Of Four Modules: The Image Acquisition Module, The License Plate Locating Module, The Character Segmentation Module And The Character Recognition Module[1]. The Overall Architecture Of The License Plate Recognition System Is Shown In Figure 1-1.

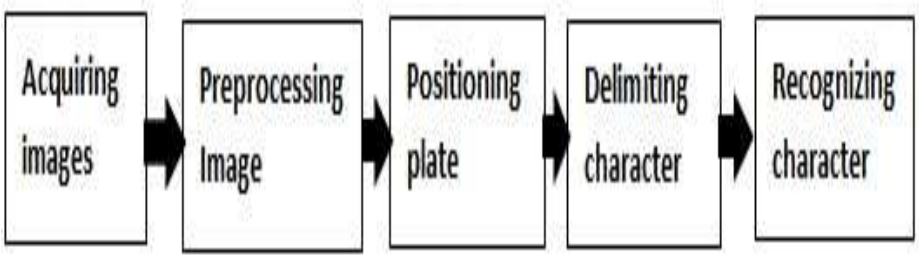

Figure1-1 Overall Architecture Of The License Plate Recognition System

II.

III. LICENSE PLATE LOCATION BASED ON ADABOOST ALGORITHMOF COLOR FEATURES

This Article Is Based On An Improved Adaboost Algorithm To Achieve A Kind Of License Plate Location System .This Whole System Consists Of Several Steps,As Is Shown In Figure 2-1.First,The Images Was Collected,Thenormal Images Were Converted Into HSV Image.According To The Characteristics Of The Color In HSV Image, The License Plate Image Binarization Processing Was Completed;Thedenoising Processing Was Completed By Morphology;Then Based On Adaboost Algorithm , Off-Line Trained Classifier Was Used To Detect License Plate Candidate Area, Finally The License Plate Localization Was Positioned[1].

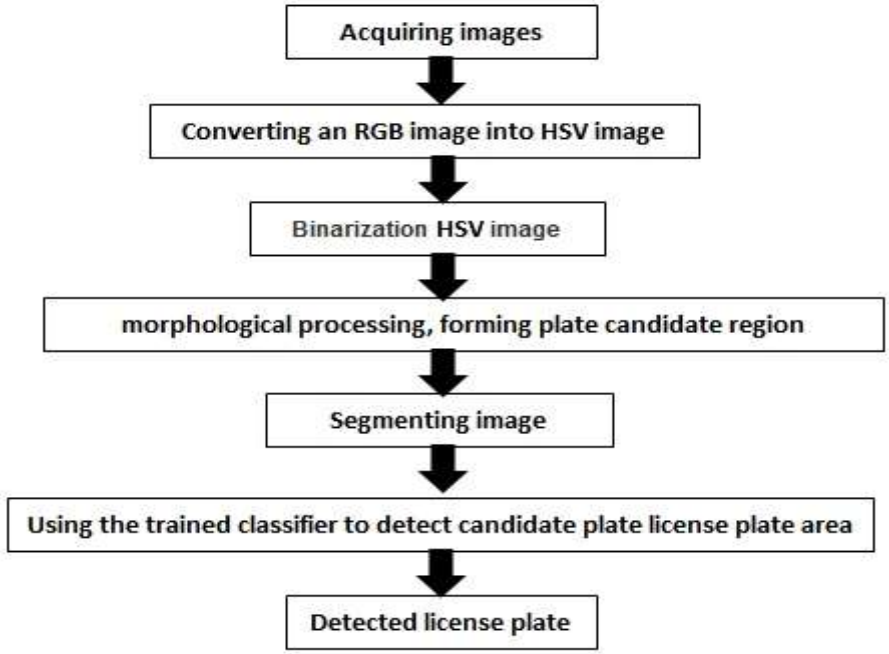

Figure 2-1 License Plate Locating Method Process

2.1 License Plate Color Analysis

According To License Plate Color Classification And The Nature Of The HSV Color Model, The Color Histogram Was Used To Statistical The Blue White Color Component Sizes In The HSV Color Model Accounts For The Proportion Of The Total Pixels Image, And The License Proportion Distribution Of Each Color Component Was Obtained Which As The Basis Of Color Feature Extraction[1]. HSV Image Of Each Color Group Is Shown In Figure 2-2:

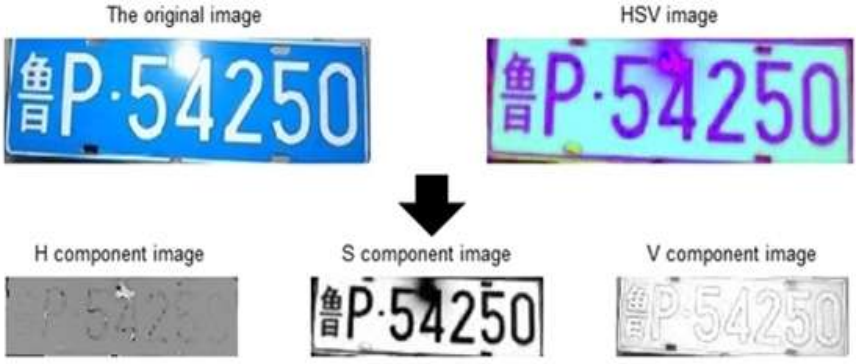

Figure 2-2 HSV Color Space In Various Color Group

Based On Color Feature Statistics, The Scope Of The Color Segmentation Threshold Was Determined .The Blue &White Plates Was Relatedwith H& Stwo Component, Color Segmentation Need To Identify The H, S Two Weight Threshold Range, The Results Is Shown In Table 3-1.

Table 3-1 Plate HSV Component Table

	H Component	S Component
License Plate	60<H<170	120<S<255

2.2 License Plate Color Pretreatment

2.2.1 Binarization

Once The Scope Of License Plate Color Segmentation Threshold Was Determined, The Unrelated Colorcan Be Filtered Out According To The Scope Of The Threshold Value[2].Binarization Is One Of All The Pixels On The Image Grey Value With Two Values Which Represented By 0 And 1, Namely Can Make The Image Clear Black And White Effect.Assuming That A Continuous Gray Image Is $f(x,y)$,The Binary Image Is $g(x,y)$,As Is Shown In Formula (2-1).

$$g(x,y)=\begin{cases}1, f(x,y)\geq T\\ 0, f(x,y)\leq T\end{cases} \quad (2\text{-}1)$$

Properly Selected Of T Can Correctly To Separate The Background From The Object, To Reduce The Image Information, Easy To Image The Extraction Of Useful Information.Binarization Process With The Threshold Value Whichmeetthe 60<H<170 And 120<S<255.The Result Is Shown In Figure 2-3:

Figure2-3 Binarization HSV Image

2.2.2 Mathematical Morphology Processing

In The Extraction Of Color Image, The Change Of The Background Environment Will Cause Some Similar To License Plate Hue, Saturation And Brightness Of Point Or Area,Which Can Lead To A Binary Image Into Some Kind Of Noise Or Interference.Here The Method Of Mathematical Morphology Processingcan Be Very Good To Solve The Problem Of Binary Image Noise Removal, Is Conducive To The Establishment Of The Interest Area And Position The Target After Calibration[2].

2.2.3 Erosion

Erosionis A Progress Of Eliminating The Boundary Point In Morphology, Which Make The Boundary Inward Contraction And Can Be Used To Eliminate The Noise In Image Binarization[3].For The A And B In Collection Z And B Was Used Toerosion A ,Which Expressed With $A\Theta B$,And Shownin Formula (2-2).

$$A\Theta B=\{z|(B)_z\subseteq A\} \quad (2\text{-}2)$$

As Shown In Figure 2-4 For The Color Image Of The Two Value Of The Corrosion Process.

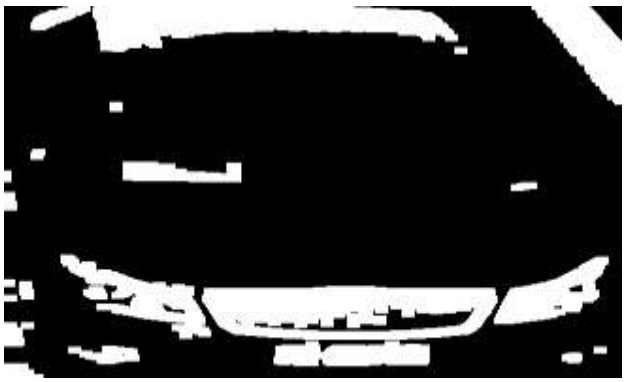

Figure2-4 Erosion Treatment Of Binary Image

2.2.4 Dilation

In Morphology ,Dilationand Corrosion Are On The Contrary, Which Can Expand Binary Image Pixel Boundary Point .Making All The Background Point Merge Into The Object, Which Is The Process Of The Boundary To External Expansion[4]. A And B Were The Member Of The Z Collection, A Was Dilated By B ,Which Expressed As $A \oplus B$,And Defined As

$$A\Theta B=\{z\left|(\hat{B})_z \cap A \neq \varnothing\right.\} \quad (2\text{-}3)$$

When Selecting The High Resolution Image Acquisition,The License Plate Image In The Image Is Larger,Which Can Operate Noise Processingthrough The Secondary Corrosion And Expansion, As Is Shown In The Formula (2-4), And Will Not Lead To Corrosion Of The Target Are Treated When In Noise Removal[5]; While The Smaller Image Resolution, Has To Adopt A Corrosion And Expansion Operation, Namely The Formula (2-5).

$$P = ((C\Theta T) \oplus T) \quad (2\text{-}4)$$

$$P = ((((C\Theta T)\Theta T) \oplus T) \oplus T) \quad (2\text{-}5)$$

According To The Above Color Segmentation And Morphological Operation, Can Complete The Extraction Of License Plate Candidate Area Can Be Completed, As Is Shown In Figure 2-5.

Figure2-5 Dilationtreatment Of Binary Image

IV. LICENSE PLATE LOCALIZATION BASED ON ADABOOSTALGORITHM

3.1 Traditional Adaboostalgorithm Principle

In The Framework Of Probabilistic Approximation (PAC), A Concept, If There Is A Learning Algorithm Of Polynomial Can Be Learned, And The Accuracy Is Very High, Then Called The Concept Can Be Learned Strongly; A Concept, If There Is A Learning Algorithm Of Polynomial Can Be Learned ,And The Accuracy Is Better Than Random Guesses Slightly, Then Called This Concept Is Too Weak To Learn.

For Adaboost Algorithm, By Raising Those In The Previous Round Of Sample Weight Of The Classifier Error Classification And Reducing The Sample Weight Of The Correct Classification To Change The Right Value And The Probability Distribution Of Training Data.

3.2 Improvedadaboost Algorithm

While Traditional Adaboost Algorithm By Weight Update Rules Can Be Better Trained Classifier,However, There Is A Degradation. Difficult Samples Has High Weight,In Each Classification Iterative Algorithm Difficult Sample Is Assigned High Weight,Then It Causedegradation[1]. A Direct Result Of The Consequences Of Degradation Are Those Generated Relatively Good Classification In The Subsequent Learning Process, As The Weight Distribution Will Be Offset Gradually Destroyed Or Discarded, And Ultimately The

Whole System Performance.

In This Paper, The Traditional Adaboost Algorithm Was Improved,The Particular Way Is In The Process Of Training In Each Iteration, Define A New Threshold, According To The Samples Are Whether Classified Correctly And Whether The Current Weight Greater Than HW_m ,These Two Aspects Update The Weights.Redesigned Classifier Is As Follows:

The Known Concentration Have N Training Samples $(x_1,y_1),(x_2,y_2),...,(x_N,y_N)$,Among Them There Are a Negative Samples And b Positive Samples ,Supposing That w_{mi} Indicates The i Th Sample Error Weights Of The m Thcycle.To Initialize The Weights: $y_i=0$, $w_{mi}=\frac{1}{2a}$;While $y_i=1$, $w_{mi}=\frac{1}{2N}$ .The Specific Training Process Is As Follows:

(1) Normalize The Weight

$$w_{m,i} \leftarrow \frac{w_{m,i}}{\sum_{j=1}^{N} w_{m,i}} \quad (3\text{-}1)$$

(2)For Feature f_j , The Training Threshold θ_j And Inequality Sign Direction p_j ,Make The Function

$$\varepsilon_j = \sum_{j=1}^{N} w_{m,i} \left| G_m(x_i) - y_i \right| \quad (3\text{-}2)$$

Minimize As Much As Possible;

(3) Choosing A Minimum Error Rate Classifier h_t ;

(4) Update The Threshold

$$HW_m = \frac{\sum_{j=1}^{N} w_{m,i}}{N} \quad (3\text{-}3)$$

(5) Update The Sample Weight

$$w_{m+1,i} = \begin{cases} \dfrac{w_{m,i}\beta_m}{Z_m}, G_i(x_i) = y_i \\ \dfrac{w_{m,i}\beta_m^{-1}}{Z_m}, G_i(x_i) = y_i \ \& \ w_{m,i} \le HW_m \\ \dfrac{w_{m,i}}{Z_m}, G_i(x_i) = y_i \ \& \ w_{m,i} \ge HW_m \end{cases} \quad (3\text{-}4)$$

In The Formula, $\beta_m = \frac{\varepsilon_m}{1-\varepsilon_m}$, Z_m Is The Normalization Factor For $\sum_{j=1}^{N} w_{m,i} = 1$, HW_m Is Updated Weight. Finally, The Strong Classifier Is：

$$G(x) = \begin{cases} 1, \sum_{m=1}^{m} \alpha_m G_m(x) \ge 0.5 \sum_{m=1}^{m} \alpha_m \\ 0, other \end{cases} \quad (3\text{-}5)$$

In The Formula $\alpha_m = \ln \frac{1}{\beta_m}$ 。

Known From The Analysis Of The Above, Only When The Sample Is Wrong Classified, And Combined With The Current Weight Is Less Than The Update Threshold, At This Time Of The Sample Weight Will Increase. On The Other Hand, Its Weight Will Be Reduced, Thus To Some Extent Alleviate The Degradation Phenomenon In License Plate Locating Damage.

3.3 License Plate Localization Based Onadaboost Algorithm

When Detect The Target Based On Statistical Learning Method , First Of All, A Large Number Of Samples Are Needed, And Then Make Positive And Negative Samples Library, Use Machine Learning Algorithm To Train A Classifier As A Detection Model Of The Target, And At Last , The Classifier Is Used In The Image Search So As To Detect The Target[6].

Positive Samples Mainly Comes From The Internet Search, This Experiment USES The Different Provinces Of License Plate Images Under Different Light Conditions, And Unified Set To 150 * 50 Pixels. The Training Samples Are Shown In Figure 3-1 :

Figure3-1 Positive Sample Of License Plate

Negative Samples Were Randomly Selected From The Images Which Do Not Contain The Target Image. Negative Samples Is Shown In Figure 3-2.

Figure3-2 Negative Sample Of License Plate

3.4 License Plate Locating Experiment Based On Adaboostalgorithm

Based On The Above Algorithm, This Paper Use QT5.7.0 + Opencv3.0 Implements License Plate Locating Experiment[1].Through The Training Of The Positive And Negative Samples, Eventually Get The License Plate Classifier, Through Color Image Binarization And Morphology Denoising, And Then Search In The

Candidate Area , Finally Get The Target Detection Result. According To The Method Described In This Article, A Large Number Of Camera Car Images Was Tested, The Experimental Results Were Satisfactory[7].

The Operating System Is Microsoft Windows 7,The Development Tools Is QT5.7.0+Opencv3.0,The Application Software Is The License Plate Localization Based On Adaboost Algorithm Program, The Program Interface Is Shown In Figure 3-3.

Figure3-3 Program Interface

As Seen From The Table 3-1, The Recognition Rate The Use Of The Improved Adaboost Algorithm For License Plate Location, Compared With The Traditional Adaboost Algorithm, Is Higher.

Table 3-1 Experimental Comparison Of Two Different Algorithms

The Brightness		Sunny Day	Cloudy Day	Night
Number Of Images		109	120	50
Traditional Adaboost Algorithm	The Number Of Accurate Positioning	99	105	44
	Accurate Probability	90.8%	87.5%	88.0%
Improved Adaboost Algorithm	The Number Of Accurate Positioning	101	109	45
	Accurate Probability	92.6%	90.8%	90.0%

V. CONCLUSION

Based On The Summary License Plate Positioning Of The Related Research At Home And Abroad In Recent Years, Was Proposed Based On License Plate Color Features Based On Adaboost Algorithm Of License Plate Locating Method. Change Method In License Plate Locating, The First Images Into HSV Image, According To The Characteristics Of The Color In HSV Image Of License Plate Image Binarization Processing, Morphological Processing And Denoising. Then Use Offline Training Classifier Based On Improved Adaboost Algorithm To Detect License Plate Candidate Area, And On QT5.7.0 + Opencv3.0 Platform To Write The Program License Plate Recognition, Finally Complete The License Plate Locating. And Compared With Traditional Adaboost Algorithm, Through Adaboost Algorithm Based On Improved Classifier, Can Be More Accurately Identify The License Plate Area Under Different Illumination Conditions.

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