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THE RESEARCH OF DETECTIONAL METHOD ON CHINESE DATES JIANGTOU BASED ON CHROMINANCE COMPONENT AND IMAGE MORPHOLOGY

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ABSTRACT

The jiangtou color of Chinese datas full in ripe stage are similar to the normal ones and not be readily detected., so a new method is put forward based on chrominance compone and image morphology for detecting jiangtou. Obtain respective color space image of Chinese datas ; Cut out an image in the normal area and four images in the jiangtou area of respective color space image; Calculate gray average value and gray range and standard square deviation to screen Preliminarily parameters. The result is r and b in rgb color space; I2 in I1I2I3 color space; S in HIS color space and S in HSV color space. Use image morphology method to draw a complete jiangtou. Do experiments with 57 Chinese datas including 27crackled datas and 30 normal datas. The result show that S in HSV color space is superior to others and the correct recognition rate of jiangtou datas is 81.5% and the false positive rate is 3.3%， which can basically meet the accuracy requirement of Chinese red dates grading system.

Keywords: *Chinese Dates, Chrominance Compone, Jiangtou , Detection*

1. INTRODUCTION

Jiangtou refers to the effects of raining on Chinese dates in the growth or drying process. Its heads or local area can't reach proper drying. It contains much water and its color changes. It becomes rotten. Comparing to normal area, it is softer, easy to be crackled, resulting in bacteria attacking and rotten. It generates serious loss. Therefore it should be found timely and be deleted. Machine vision improves it greatly. The algorithms are: Ying Yibin et al proposes a new method, which describes color information in frequency sequence comprised by pixels; Ding Youchun et al extracts the bamboo's average chrominance features and texture features according to its position, which is considered as the sampling's property; Chai Ali, et al, extracts 9 chrominance parameters from each tomato's sick area, which uses gradual judgment, etc. Yu Xiaojuan, et al, extracts the chroma for module identification, definite the effective chroma area to distinguish normal and green potatoes, combining with second-order threshold method. Yuanting, et al makes use of recent infrared spectral image to solve the fruit information similar to background color. Determine the fruit position in differences among grey degree distribution. Realize the object effective identification. O Yangmin, et al, according to effects of sunshine on imaging, restrains the noise disturbance in average filter, so as to weaken such effects. They propose a co-occurrence matrix base on LAB chrominance distance to extract the chrominance and texture features[1-6].

The color of jiangtou area is similar to that of normal area, with strong dependence to fine source, so it is difficult to identify. Therefore this paper proposes a new method for detecting jiangtou base on chrominance component and image morphology. Firstly, statistic the grey average, standard variable, range of grey degree and detection efficiency of chrominance components to select proper one, Divide in image morphology method to get complete jiangtou.

2. MATERIAL AND METHOD

2.1. Material

Select jun-jujube grown by first agricultural division 10 league from Xinjiang production construction corps. The jun-jujube should be complete. There are 57, including jiangtou Chinese date and non-jiangtou Chinese date. Collect the

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sampling images in self-designing machine vision. 57 pictures are got.

2.2. Image Acquisition System

Image acquisition system of Chinese dates is shown as Figure 1.

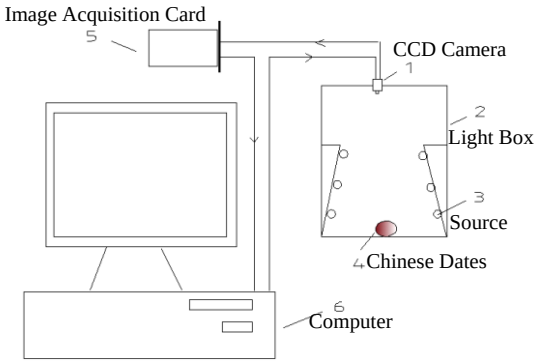

Figure 1: Image Acquisition System of Chinese Dates

The system consists of camera1, image acquisition system5, computer9, source3, light box2, etc. Take white HF fluorescent lamp as source, which symmetrically and finely distributes in the box. 75°angle exists between lamp bracket and light box. The walls of light box are ivory white. The bottom is covered by printing paper after frosting.

The image acquisition card uses OK—RGB10B chroma RGB component acquisition card, produced by Jiahuanzhongzi image technology ltd, which is installed in the computer base on PCI structure. Camera is OK—AC1300 high resolution color CCD, from Jiahuanzhongzi image technology ltd. The sight area is 672×519mm. Snapshot is 1/500s. Frame velocity is 15fps. The type of computer is Lenovo. CPU is PIV, with 256MB memory. The hardware capacity is 40G. Use MATLAB 7.0 under Vista system as detection software.

2.3. Artificial Detection Method

Conforming to GTLB001, the jiangtou is classified as jiangtou Chinese date and non-jiangtou Chinese date. The mildew one is not jiangtou Chinese date, shown as Figure 2.


(a) Good Chinese Dates (b) Jiangtou Chinese Dates

(C) mildew Chinese dates

Figure 2: Image of Jiangtou Chinese Dates and the Normal One and Mildew One

Put the experimental Chinese dates on the desk flatly. Conduct artificial detection under natural source, and the result is 27 jiangtou Chinese dates and 30 normal Chinese dates[7-11].

3. JIANGTOU DETECTION

3.1. Initial Selection

To different chrominance components, the difference of grey degree between normal area and jiangtou area is different. To be more convenience to extract, select the one with big difference. The formula to transform grey figure from RGB one is:

$$Y = 0.299 \times R + O.587 \times G + 0.114 \times B \quad (1)$$

The grey mean difference reflects the difference situation among samplings. The standard variable reflects the discrete degree in the sampling class. The smaller the value is, the more difficult the intersection is. Therefore, select them as the selection criteria. Their formulas are:

$$\bar{H} = \frac{1}{N}\sum_{i=1}^{N} H_i \quad (2)$$

$$\sigma_H = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(H_i - \bar{H}\right)^2} \quad (3)$$

N is total value of object pixel, Hi is the hue value of ith pixel

Due to smaller jiangtou, its grey range is narrow. To correctly grasp its features, intercept 4 typical area to conduct grey statistic. Consider its grey average as the one of jiangtou area. The method is as follows:

- Get the chrominance images of a Chinese date. Intercept a image on normal area, and 4 images on jiangtou area.
- Statistic the grey average and standard variable of normal area and jiangtou area

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- Continue conducting statistic on grey averages and standard variables of all jiangtou Chinese dates
- Calculate the average of grey mean and standard variance of normal area and jiangtou area of Chinese dates
- Compare the differences among the averages. Select the biggest one as the initial candidate on components.

Get 27 typical jiangtou Chinese dates as the samplings. Take 1 date in figure 2 as example to indicate. Intercept a image in normal area and 4 images in jiangtou area, shown as Figure 3.

(a) (b) (c) (d) (e)

(a) normal area (b) normal area 1
(c) normal area 2 (d) normal area 4
(e) normal area 5

Figure 3: Image Screenshots in RGB Image

Imagine $\overline{H}_1$ as the grey mean of normal area, σ_{H1} as the its grey standard variable; imagine $\overline{H}_{20}$ as the grey mean of jiangtou area, σ_{H20} as the its grey standard variable; imagine $\overline{H}_2$ as the grey mean of jiangtou area, σ_{H2} as the its grey standard variable; H is $\left|\overline{H}_1 - \overline{H}_2\right|$. $\overline{gr}$ is the range of grey in jiangtou area. Summarize the 5 RGB images. The result is shown as TABLE 1.

TABLE 1: Gray Statistical Results of one Jiangtou Chinese Date in RGB Components

Statistic Area	Grey	R	G	B
normal	$\overline{H}_1$	70	51	49
area	σ_{H1}	0.008	0.008	0.008
jiangtou	$\overline{H}_{20}$	85	55	44
Area 1	σ_{H20}	0.066	0.066	0.066
jiangtou	$\overline{H}_{20}$	83	83	43
Area 2	σ_{H20}	0.052	0.052	0.052
jiangtou	$\overline{H}_{20}$	84	54	44
Area 3	σ_{H20}	0.032	0.032	0.032
jiangtou	$\overline{H}_{20}$	84	55	47
Area 4	σ_{H20}	0.032	0.067	0.067
jiangtou	$\overline{H}_{20}$	84	54	44
area mean	σ_{H2}	0.054	0.054	0.054
jiangtou grey range	$\overline{gr}$	2	2	4
grey difference	H	14	3	5

Use the same way to statistic the grey mean and standard variable, separately solving the grey means and standard variables in normal area and jiangtou area. We no longer explain to reduce the content. The result is shown as TABLE 2.

The small mean difference is bad for character extraction. To reduce work content, select the 10 chrominance with bigger differences as the indexes. They are r and b in rgb color space; I2 in I1I2I3 color space; S in HIS color space and S in HSV color space. Conduct statistic on all the samplings. The result is shown as TABLE 3.

TABLE 2: Gray Statistical Results of one Jiangtou Chinese date in Chrominance Components

Number	Chrominance Space	Chrominance Component	$\overline{H}_1$	$\overline{H}_2$	H	Optimal Component
1	*RGB*	*R*	70	84	14	*R*
2		*G*	51	54	3	
3		*B*	49	44	5	
4	*rgb*	*r*	105	117	12	*r*
5		*g*	77	76	1	
6		*b*	73	62	11	*b*
7	*CMY*	*C*	185	173	12	*C*
8		*M*	204	202	2	
9		*Y*	206	212	6	
10	*lab*	*l*	168	172	4	
11		*a*	54	60	6	
12		*b*	58	72	14	b
13	*I1I2I3*	*I1*	56	61	5	
14		*I2*	21	40	19	I2
15		*I3*	0	0	0	
16	*YCbCr*	*Y*	65	71	6	
17		*Cb*	124	117	7	
18		*Cr*	136	144	8	
19	*YIQ*	*Y*	56	61	5	

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20		*I*	11	20	9	
21		*Q*	3	3	0	
22	*HSV*	*H*	55	11	44	H
23		*S*	77	120	43	S
24		*V*	70	84	14	V
25	*HSI*	*H*	249	246	3	
26		*S*	37	67	30	S
27		*I*	57	61	4	
27		*I*	57	61	4	

TABLE 3: Gray Statistical Results of Jiangtou Chinese Dates in Chrominance Components

Number	Chrominance Space	Chrominance Component	$\overline{H}_1$	$\overline{H}_2$	H	$\overline{gr}$
1	RGB	R	70	84	14	2
2	rgb	r	105	117	12	5
3		b	73	62	11	4
4	CMY	C	185	173	12	5
5	Lab	b	58	72	14	6
6	I1I2I3	I2	21	40	19	4
7	HSV	H	55	11	44	0
8		S	77	120	43	5
9		V	70	84	14	2
10	HSI	S	37	67	30	16

The TABLE 3 shows, the grey range is small and the discrete degree is weak. The grey mean difference of H component in HSV space is 44, biggest, then S component in such space, S component in HIS space, I2 component, b component in LAB space, R component in RGB space, C component in CMY space and r, b component in rgb space. Consider these 10 components as initial candidate parameters[12-14].

3.2. Second Selection

Imagine b1 and b2 as b component in rgb and b component in Lab, S1 and S2 as S component in HSV, S component in HIS. The chrominance components from such is shown as Figure 4.

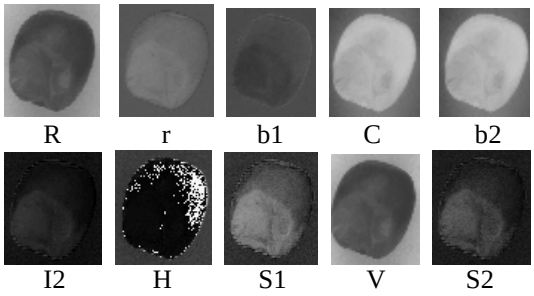

Figure 4: Initial Screening Chrominance Components Image

Figure 4 shows that there is much discrete situation in H components, which is bad for feature extraction. Delete it. Until now, the result is to delete H component and save the other 9 components.

3.3. Third Selection

According to mean range and grey mean difference between normal area and jiangtou area, select the jiangtou features in adaptive threshold. Set f(i,j) as grey value at pixel (i,j)of original chrominance image, g(i,j) as grey value at pixel (i,j) of detection image, "1"as the pixel value of jiangtou area, "0"as the pixel value of normal area and k is the regulation content of grey threshold. The algorithm is:

$$g(i,j)=\begin{cases} 0, & f(i,j)<\overline{H_2}-k \\ 1, & \overline{H_2}-k\le f(i,j)\le \overline{H_2}+k \\ 0, & f(i,j)>\overline{H_2}+k \end{cases} \quad (4)$$

K has an effect on accuracy. If k is too small, the completion will be bad. Otherwise, although jiangtou is complete, the algorithm will be too complex, affecting the detection efficiency. Separately pretest the jiangton in the primary image. Lots of results show, when k is 1/2 $\overline{gr}$, the algorithm can get the jiangtou image correctly. The result is shown as Figure 5.

Figure 5 shows R component, C component and V component have big boundary noise. There is big intersection between background of b component in Lab space and jiangtou area. It is mainly resulted from the algorithm, which is difficult to clear. Therefore delete them. The third selection result is: r, b component in rgb space, I2 component in I1I2I3 space, S component in HSV space and S component in HIS space[15].

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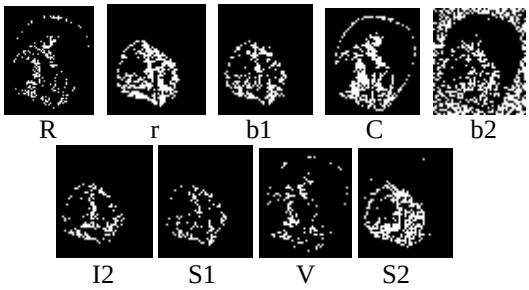

Figure 5: The Pretesting Results Images on Candidate Color Components

3.4. Jiangtou Feature Extraction

Figure 5 shows, most jiangtou areas are discrete, which relates to the number of samplings and jiangtou features. The larger the number of samples is, the more typical jiangtou is. Therefore the result is more accurate and more complete. k has to be regulated. Lots of experiments show, in different chrominance spaces, k is different. To r and I2 component, k is 7. To b component, k is 5. To s component in HSV space and S component in HIS space, k is 16. After such regulation, most of jiangtou area is continuous. The noise is filtered in 3×3 filtering calculator. The result is shown as Figure 6 a-e.

Figure 6 shows, the object images have cavities. Therefore use the mathematical morphology methods to fill in the cavity. The procedures are shown as follows:

construct structure element B. this paper select 'disk'. The parameter value depends on the size of cavity. It is available to all jiangtou Chinese dates. Lots of experiments show, set disk as 15.

Separately conduct expansion operations on figure 6 a-e. the formula is

$$Z = G + B \tag{5}$$

G is original image and Z is image after expanding.

Conduct rot operation on the image, the formula is:

$$Z = G - B \tag{6}$$

After such processing, the result is shown as Figure 6 f-j.

The Figure 6 shows, every component can get the complete division of jiangtou. However, the accuracy depends on the sampling number, typical jiangtou and fine source. So firstly save all the candidate components. Finally determine optimal chrominance components by real detection results.

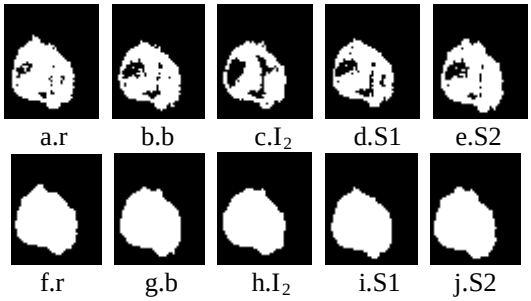

Figure 6: The Pretesting Results Images on Candidate Color Components

4. CONCLUSION AND ANALYSIS

4.1. Experimental Result

This paper uses the method above to test jiangtou Chinese dates in 57 images, of which 27 jiangtou images and 30 normal images. Separately conduct statistic on corrective ratio, error ratio and detection time. The result is shown asTABLE 4.

TABLE 4: The Testing Result on Jiangtou of Chinese Dates

Experimental Chinese Date	Chrominance Component	Crackled	Normal	Corrective Ratio /%	Error Ratio /%	Time /ms
27 Jiangtou Dates and 30 Normal Dates	r	23	4	85.2	14.8	169
	b	21	6	77.8	22.2	42
	I_2	22	5	81.5	19.5	31
	SI	20	5	81.5	19.5	67
	S2	23	4	85.2	14.8	64
	r	16	14	46.7	53.3	169
	b	4	26	86.7	13.3	42
	I_2	12	18	60.0	40.0	31
	S1	1	29	96.7	3.3	67
	S2	7	23	76.7	23.3	64

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4.2. Analysis

The table above shows, b component has low corrective ratio and high error ratio; the corrective ratio of r, S2 component is 85.3%, but their error ratios are too high. the corrective ratio of I2 component is 81.5%,but its error ratio is big. Although the corrective ratio of s1 component is also only 81.5%, its error ratio is very small. So select S1, S component in HSV space, as optimal chrominance component[16].

The main reason for identification accuracy is its similar color and instable source, which results in error. Both the number of samples and typical degree of jiangtou area will have effect on correct extraction[17-18].

5. CONCLUSION AND DISCUSSION.

This paper select among the candidate components base on chrominance components. S component in HSV space is the best. This paper studies the jiangtou division in image morphology method, proposes the identification algorithm base on chrominance component and image morphology. The result is: the corrective ratio of jiangtou identification is 81.5%. The error ratio of normal ones is 3.3%. This algorithm is insensible to date types, shapes and fruit stalk. But it is sensible to source. Such method has some theoretic significane and practical value for other indexes detection.

REFRENCES:

[1] Cai Jianrong. Quantitative Description of Tea Color Using Computer Vision[J]. *Journal of agricultural machinery*, 2000,31(4):67-70.

[2] Cheng Fang Ying Yibin. Inspection of Mildewed Rice Seeds Based on Color Feature[J]. *Journal of agricultural machinery*, 2004,35(4):102-105.

[3] Ding You-chun, Xiong Li-rong, Chen Hong, et al. The Research of Testing Model about Duck Egg Color[J]. *Journal of Agricultural Mechanization Research*, 2005,(2):176-178.

[4] Liu Guomin1, Zou Meng, Liu Muhua, et al. A Study on Computer Vision Technique for Inspecting Color and Pigmentation ratio ofNavelOrange[J]. *Act aAgriculturae Universitatis Jiangxiensis*, 2008,30(3):551-554.

[5] Liu Guo-min1, Zou Meng, Liu Muhua, et al. Pilot Studies on Computer Vision Technique for Testing Exterior Quality of NavelOrange[J]. *Journal of Agricultural Science and Technology*, 2008, 10(4): 100-104.

[6] Liu Jianying, Wang Qiaohua, Xiong Lirong1, et al. Research on the Model for Fresh Level of Duck Eggs[J]. *Journal of Huazhong Agricultural University*, 2002,21(6):567-569.

[7] Wang Jian, Du Shiping. Identification investigation of Tea Based on HSI Color Space and Figure[J]. *Journal of Tea Science*, 2008，28(6):420-424.

[8] Wang Yuliang, Liu Xianxi, Su Qingtang, et al. Maize seeds varieties identification based on multi-object feature extraction and optimized neural network[J].*Transactions of the CSAE*, 2010, 26(6): 199-204.

[9] Zhu Weihua, Cao Qixin. Defect segmentation of tomatoes using fuzzy color clustering method[J]. *Transactions of the CSAE*, 2003,19(3):133-136

[10] Liu J, et al. Corn Whiteness Measurement and Classification Using Machine Vision[J]. *Transaction of the ASAE*, 2000,43 (3):757-763.

[11] Shatadal P, Tan J. Identifying damaged soybeans by color image analysis[J]. *Applied engineering in Agriculture*, 2003, 19(1): 65-69.

[12] Ahmad I S, Reid J F. Evaluation of colour representations for maize images[J]. *Journal of Agricultural Engineering Research*, 1996, 3:185-196.

[13] Ying Yibin,Xu Huirong,Xu Zhenggang. Non-Destruetive Maturity Evaluation of Citrus By Hue Frequeney Sequenee Method[J]. *Journal of Biomathematies*，2006,21(2):306-312.

[14] Ding Youchun Chen Hong. Bayes-Based Color Detection and Classification Method of Bamboo Slices[J]. *Journal of Huazhong Agricultural University*, 2009,28(6):767-770.

[15] Chai Ali， Li Baoju， Shi Yanxia， et al. Recognition of Tomato Foliage Disease Based on Computer Vision Technology[J]. *Acta Horticulturae Sinica*, 2010,37(9):1424-1429.

[16] Yu Xiaojuan, Liao Guiping, Li Jinwei, et al. Greened potatoes detection based on hue threshold ivision[J]. *Transactions of the CSAE*, 2009,25(Supp.2):314-319.

[17] Yuan Ting Zhang Junxiong Li Wei Ren Yongxin. Feature Acquisition of Cucumber Fruit in instructured Environment Using Machine Vision[J]. *Journal of agricultural machinery*, 2009,40(8):170-174.

[18] Ou Yangmin，Wang Renhuang，Chen Futing. The Extraction of Texture Based on the Co-occurrence Matrix of LAB Color-Difference[J]. *Journal of Guangdong University of Technology*, 2011,28(4):48-50.