Motion trace in real-time processing

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Abstract

Recent years, researches about visual tracking are extensively studied. If we can visual tracking, we can apply the skills of automotive control and so on. For example, if obstacle avoidance of moving object instead of obstacle avoidance of the static object becomes possible, the control becomes possible as for a more complex situation. Facial recognition was researched in my laboratory, however, this research is weak of change in light, so that my main research improve that and to motion trace through head control of mobile robot.

1 Introduction

Recent years, the introduction of robot was bean considered in various fields. Various functions were bean required and the robot use was expanded. One of the functions requires environmental recognition and avoidance of an obstacle. In order to develop such robot, this laboratory, for some time, has mainly respond to the field of welfare and nursing. A mobile recognition robot has been researched and developed [1][2][3].

Researches about visual tracking are extensively studied. In this research, the following are conditions.
(1) Moving object is red circle marks.
(2) Moving object is near the CCD camera.

We used our laboratory robot. Image import from CCD camera, we compute feature point and center point to track moving object, and implement motion control of the head.

2 Experiment System

The robot which is being used in this research was manufactured by incorporated company DENKEN in 2000.The figure is shown in Fig.1.It consists of 2 drive 2 caster (2DC2W) systems.

The mobile robot is equipped on the right and left with the driving wheel, auxiliary caster rings at the front and back, a driving wheel on either side rotates by DC motor. Equipped with the rotary encoder of resolution 80 (Pulse Per Resolution) beside the driving wheel, and counting the number of pulses, the right-and-left independence can be achieved and a wheel can be controlled.

The difference in the rotation speed of a right-and-left driving wheel performs a steering function. The CCD camera (EVI-G20: Sony) is carried by the height of about 130 [mm] at 55 degrees of perpendicular directions at the head. The picture obtained from the camera is taken in by the memory on an image-processing board (FDM-PCI3: FOTORON).

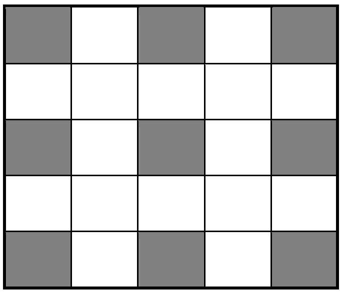
Fig. 1 View of The Mobile robot

3 Image Processing

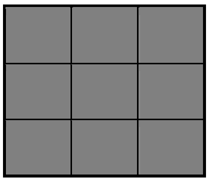
3.1 Pixel Skipping

When the size of image is 300 by 300 [pixel], it is difficult to implement in real time processing, when the size of picture is small, moving object will be not detected.

In order to make realize real time processing, image processing time must be shortened. Therefore, by setting the area of pixel which to be removed and to be taken the image is processing again by re-sizing and showing only the taken pixel area. In this research, re-sizing of image is 60 by 60. Fig. 2 shows that gray color is taken pixel area.



(a) Original Image



(b) Skipping Image

Fig. 2 Pixel Skipping

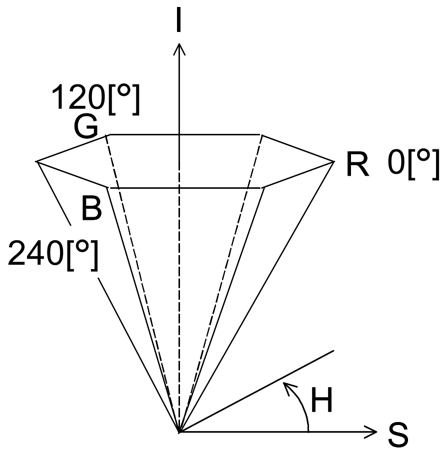


Fig. 3 Coordinates About RGB & HSI

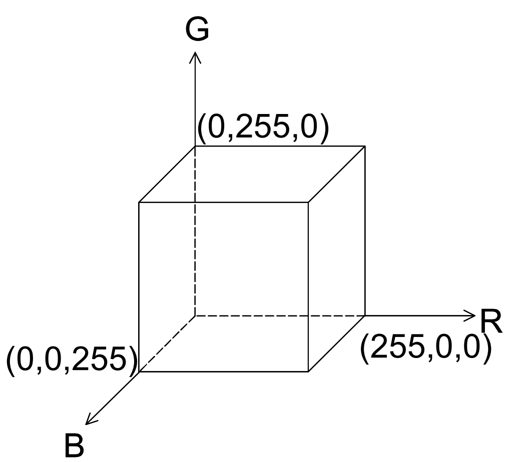
3.2 Conversion From RGB To HSI

The image is taken in from a CCD camera; it is a picture expressed with a total of 24 bits of 8 bits each of RGB. Then, in order to treat the feature from a picture independently as much as possible, the following equation performs HSI conversion of the hue, saturation and intensity. Each of R, G and B is standardized to take values between 0 and 1, with a maximum total intensity of 1. Following equations are Hue, Saturation and Intensity.

$$I = \max(R, G, B) \quad (1)$$

$$S = 255 \times \frac{I - \min(R,G,B)}{I} \quad (2)$$

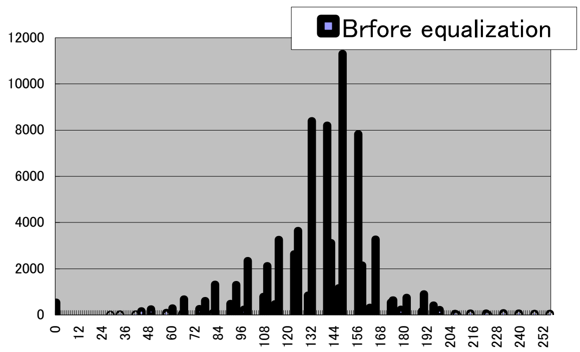
$$H = \begin{cases} 60 \times \dfrac{G-B}{I-\min(R,G,B)} & (\max(R,G,B) = R) \\ 60 \times \dfrac{B-R}{I-\min(R,G,B)} + 120 & (\max(R,G,B) = G) \\ 60 \times \dfrac{R-G}{I-\min(R,G,B)} + 240 & (\max(R,G,B) = B) \end{cases} \quad (3)$$



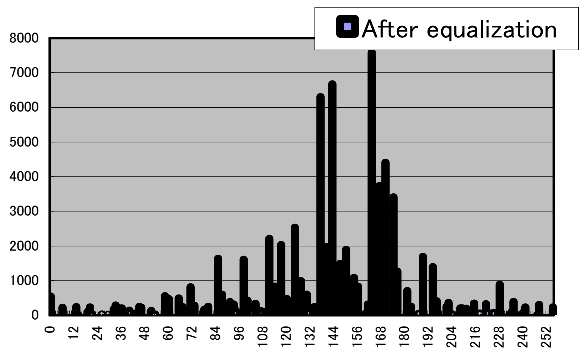
However, if HSI value is not threshold area, the camera will not recognize the object.

3.3 Equalization Processing

When the light is strong or weak, visual tracking can not be performed by using color information. Then, converse from RGB to HSI. We improve to be constant curve of cumulative frequency of I(intensity). Equalization processing is shown in Fig.4.



(a) Original Image

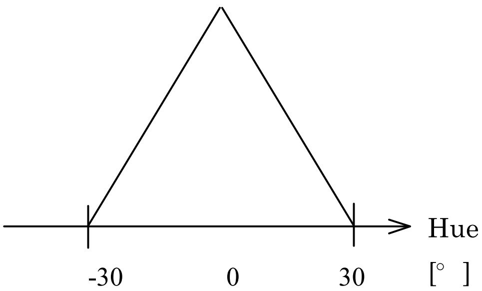


(b) Equalization

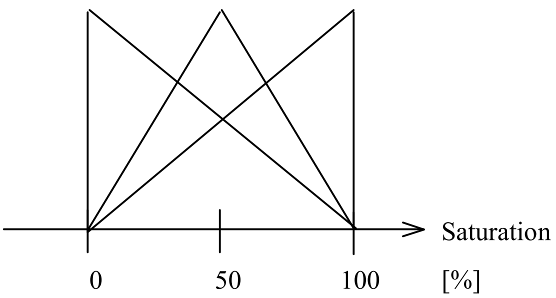
Fig. 4 Equalization Processing

3.4 Fuzzy Control

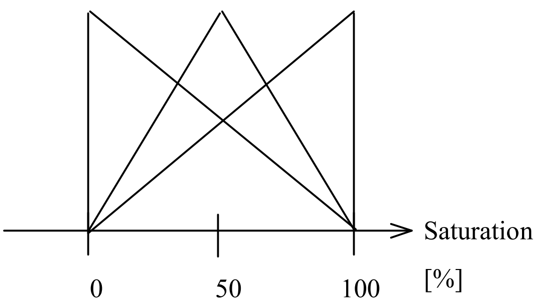
To perform the visual tracking, there is threshold processing. In many cases, human decided threshold. However, there are some problems. For example, difference object of same saturation, threshold cannot be detected. In this research, to prevent this problem, we perform fuzzy control of saturation. Input and output fuzzy set is shown in Fig. 5. Result is shown in Fig. 6. The green point is center of circle.



(a) Input Hue



(b) Input Saturation



(c) Output Saturation

Fig. 5 Fuzzy Set

(a) Original Image

(b) Human decided Threshold

(c) Fuzzy Control Of Threshold

Fig. 6 Fuzzy Control

3.5 Labeling Technique

The label represents number. The number, which represents value from 0 to 255, is boundary value. The processed image is labeled separate boundary value. Labeling-propagation processing by using raster scanning is shown in Fig. 7. Fig. 7 shows that the label represents by using alphabet value. As a result, characteristics of the moving object are calculated.

	A				1	
	1				1	
	1				1	
	1				1	
	1	1	1	1	1	
		1	1	1		

(a) Labeling Start

	A				A	
	A				A	
	A				A	
	A				A	
	A	A	A	A	A	
		B	B	B		

(b) Labeling End

Fig. 7 labeling-propagation processing by using raster scanning

4 Motion Detect Experiment

Motion detect experiment was actual conducted in the environment. Tracking moving object motion trace using red circle mark is carried out. After the red circle mark is detected, the head of the robot will move following the direction of the red circle mark movement. As the first step of processing is pixel skipping, second step is conversion from RGB to HSI, equalization and third step is labeling. The green point of the image (c) is shown in Fig. 8 is center of circle.

(a) Original Image

(b) Skipping Image

(c) Result Image

Fig. 8 Motion Detect Process

Since the image (c) is shown in Fig. 8, center of the circle is calculated. Therefore, head of the robot rotate to center of the circle. However, moving object is difficult to detect in strong light. When moving object and other object are similar saturation, other object is detected, too.

5 Conclusions

In this research, we are able to improve threshold in light. However, moving object is difficult to detect in strong light. When moving object and other object are similar saturation, other object is detected, too. Therefore, we would like to improve than this research in strong light and weak light, and we would like to consider about occlusion.

References

[1]Syuiti Otsu, Masanori Sugisaka " Research on the environmental recognition in a mobile robot ", Oita University Graduate School Master Paper , 2003.

[2]Syohei Kuriyama, Masanori Sugisaka " Development of the mobile robot run system using dead reckoning and vision information ", Oita University Graduate School Master Paper , 2003.

[3]Toshio Maeyama , Masanori Sugisaka " The obstacle avoidance run in the mobile robot using the CCD camera ", Oita University Graduate School Master Paper , 2002.

[4]
http://www.cse.unr.edu/~looney/cs674/ch6html.htm
Chapter 6. Processing Color Images.