A tracking of the moving objects using normalized hue distribution in HSI color model

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ABSTRACT

In this paper, A tracking of the moving objects using normalized hue distribution in HSI color model was proposed. Moving objects are detected by using difference image method and integral projection method to background image and objects image only with hue area.

Hue information of the detected moving area are normalized by 24 levels from 0° to 360°. A distance in between normalized levels with a hue distribution chart of the normalized moving objects is used for the identity distinction feature parameters of the moving objects.

To examine proposed method in this paper, image of moving cars are obtained by setting up three cameras at different places every 1 km on outer motorway.

The simulation results of identity distinction show that it is possible to distinct the identity a distance in between normalization levels of a hue distribution chart without background.

KEYWORD
tracking, color, HSI, moving object

I. INTRODUCTION

An image observation method is be growing for development of the most recent video vision system. Before, the monitors of video cameras was watched by human in moving picture observation system, but unmanned observation system is activated by development of image processing technology today[1~5]. The application fields of moving observation system using video cameras are the intelligent traffic system, planet probe robot, coming in and out control system and so on. There are two ways for video observation system. One is the way that watches interesting places with overlapping of each views of multi-camera. The other is the way that watches each interesting place with each camera. That is, it is that equips one camera in one places[6~10].

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In this paper, a tracking of the moving objects using normalized hue distribution in HSI color model for the way that watches each interesting place with each camera for traffic information is proposed. Moving objects are detected by using difference image method and integral projection method to background image and objects image only with hue area.

Hue information of the detected moving area are normalized by 24 levels from 0° to 360°. A distance in between normalized levels with a hue distribution chart of the normalized moving objects is used for the identity distinction feature parameters of the moving objects.

To examine proposed method in this paper, image of moving cars are obtained by setting up three cameras at different places every 1 km on outer motorway.

II. HUE NORMALIZATION OF DIFFERENCE IMAGE

HSI(Hue, saturation, intensity) color coordination is consisted of hue, saturation, intensity[11,12].

The color of hue H is presented by angle of a circle. Red is placed on 0°, yellow is placed on 60°, green is placed on 120°, cyan is placed on 180°, blue is placed on 240°, magenta is placed on 300°.

The difference image method is the way that the moving objects are detected by difference of gray level between past image and present image. In this paper, RGB(red, green, blue) color coordination is transferred to HSI color coordination for extracting the feature parameter of moving objects, and the difference image is obtained by only hue H of HSI between past image and present image.

The difference image $DP_H(x,y)$ between past image and present image is showed in an equation 1.

$$DP_H(x,y) = \sum_{x=1}^{n} \sum_{y=1}^{m} I_{Hb}(x,y) - I_{Hf}(x,y) \quad (1)$$

$I_{Hb}(x,y)$ is a background image and $I_{Hf}(x,y)$ is present image that there is a moving object. The detecting of moving object is performed by integral projection method about difference image $DP_H(x,y)$.

The horizontal and vertical integral projection is showed in an equation 2. and an equation 3.

$$HA(y) = \sum_{x=1}^{n} \sum_{y=1}^{m} DP_H(x,y) \quad (2)$$

$$VA(x) = \sum_{x=1}^{m} \sum_{y=1}^{n} DP_H(x,y) \quad (3)$$

$HA(y)$ is a result of horizontal integral and $VA(x)$ is a result of vertical integral about $DP_H(x,y)$.

An area of moving object is obtained by equation (4) and equation (5)

$$DP_{Hb}(x,y) = 0, \quad |DP_H(x,y)| < T_b \quad (4)$$

$$DP_{Hb}(x,y) = 1, \quad |DP_H(x,y)| \geq T_b \quad (5)$$

$DP_{Hb}(x,y)$ is an area of binary moving object An area of moving object is obtained by T_b. If $T_H > DP_H(x,y)$, it is an area of moving object.

The hue H of $DP_H(x,y)$, $DP_{Hb}(x,y)=1$ is normalized to 24 levels in 0° ~ 360°. The angle range of each levels is 15° like an equation 6.

$$N_{L,L} = \sum_{x=1}^{m} \sum_{y=1}^{n} DP_{Hb}(x,y),$$
$$(L-1)\cdot 15 \leq MA_{H}(x,y) < L\cdot 15 \quad (6)$$

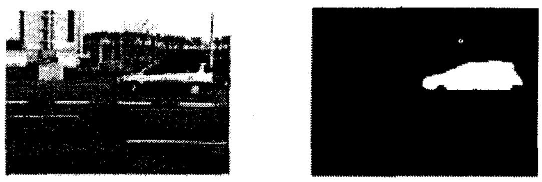
$N_{L,L}$ is normalized hue distribution. $MA_H(x,y)$ is hue of moving object. L is normalized level.

The Degree ranges and the representation values are showed in table 1. RV is representation values.

III. FEATURE PARAMETER

Three feature parameter δ_1, δ_2, δ_3 are extracted in $N_{L,L}$. The parameter δ_1, δ_2, δ_3 are the higher hue distribution normalized levels in $N_{L,L}$(Fig 2).

It is that shows the foreground image and an area of extracted moving object in Fig. 1.



(a) foreground image (b) extracted moving object

Fig. 1. foreground image and an area of extracted moving object

Table 1. Degree ranges and representation values of the normalized levels

Level	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}
Range	0 ~15	15 ~30	30 ~45	45 ~60	60 ~75	75 ~90	90 ~105	105 ~120	120 ~135	135 ~150	150 ~165	165 ~180
RV	1	2	3	4	5	6	7	8	9	10	11	12
Level	L_{13}	L_{14}	L_{15}	L_{16}	L_{17}	L_{18}	L_{19}	L_{20}	L_{21}	L_{22}	L_{23}	L_{24}
Range	180 ~195	195 ~210	210 ~225	225 ~240	240 ~255	255 ~270	270 ~285	285 ~300	300 ~315	315 ~330	330 ~345	345 ~360
RV	13	14	15	16	17	18	19	20	21	22	23	24

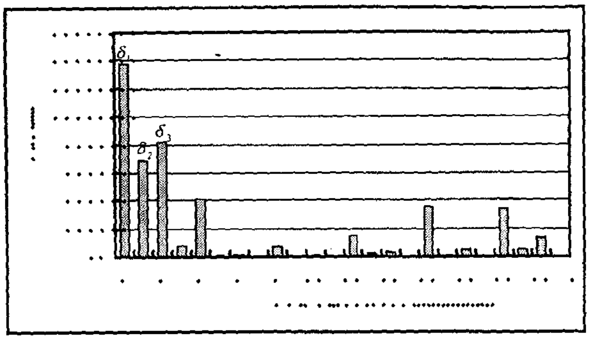


Fig. 2. Hue distribution of moving object in Fig. 2.

The higher three levels are selected as the feature parameter δ in Fig. 2.

The feature parameter λ is obtained with parameter δ. λ_1 is distance between δ_1 and δ_2. λ_2 is distance between δ_2 and δ_3. λ_3 is distance between δ_3 and δ_1.

The parameter λ is obtained by equation 7

$$\lambda_j = \delta_j - \delta_{j+1} \qquad (7)$$
$$\lambda_j = 21 - \delta_j + \delta_{j-2}, \quad j=3$$

j is number of feature parameter δ.

Ⅳ. EXPERIMENT

To examine proposed method, image of moving cars were obtained by setting up three cameras at different places every 1 km on outer motorway. The obtained RGB image was transferred to HSI image.

The background image is showed in Fig. 3.

Fig. 3. Background images

(a) 1st frame (b) 3rd frame (c) 5th frame

Fig. 4. images of car M_1 at places P_1

The images of driving car M_1 are showed in Fig. 4.

The normalized levels and representation values of moving objects in Fig. 4 are showed in Fig. 5.

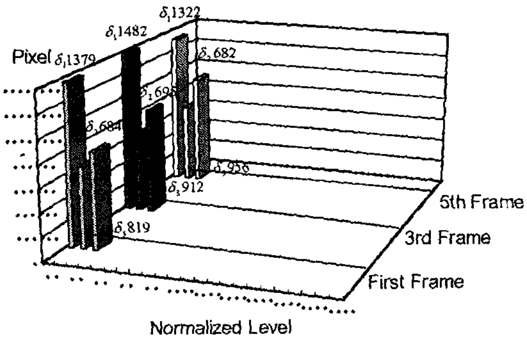


Fig. 5. Normalized levels and representation values of moving objects in Fig. 4

The representation values of δ at 1st frame, 3rd frame and 5th frame are 1, 2, 3. That is δ_1 is 1, δ_2 is 2 and δ_3 is 3. Therefore, λ_1, λ_2 and λ_3 are 1, 1, 22.

The images of car M_2 at three places P_1, P_2, P_3 are showed in Fig. 6.

(a) place P_1 (b) place P_2 (c) place P_3

Fig. 6. images of car M_2 at places P_1, P_2, P_3

The normalized levels and representation values of moving objects in Fig. 6 are showed in Fig. 7.

The values of feature parameter δ and λ are same at place P_1 and P_3. But The values of feature parameter δ and λ changed at place P_2.

That is, in place P_1 and P_3, δ_1 is 1, δ_2 is 2 and δ_3 is 3 and λ_1 is 1, λ_2 is 1 and λ_3 is 22. In place P_2, δ_1 is 1, δ_2 is 3 and δ_3 is 5 and λ_1 is 2, λ_2 is 2 and λ_3 is 20. The change of parameter is caused by change of intensity, place and noise.

Though these causes, the range of change was maintained within 2 level.

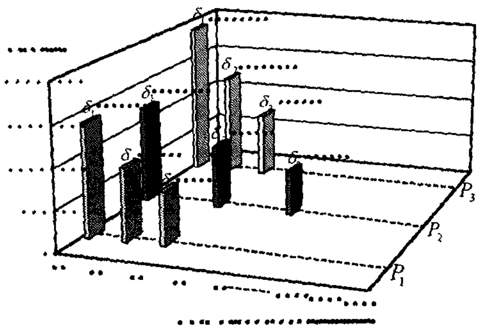


Fig. 7. Normalized levels and representation values of moving objects in Fig. 7

Table 2. Distance λ among representation values of parameter δ about M_2

Para.	P_1	P_2	P_3
λ_1	1	2	1
λ_2	1	2	1
λ_3	22	20	22

V. RESULT

A tracking of the moving objects using normalized hue distribution in HSI color model was proposed. Moving objects were detected by using difference image method and integral projection method to background image and objects image only with hue area.

Hue information of the detected moving area were normalized to 24 levels. A distance in between normalized levels with a hue distribution chart of the normalized moving objects was used for the identity distinction feature parameters of the moving objects.

To examine proposed method in this paper, image of moving cars are obtained by setting up three cameras at different places every 1 km on outer motorway.

The simulation results was showed that it was possible to track moving object by normalized hue distribution.

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