1S-07

PERSONAL IDENTIFICATION WITH COLOR DISTINCTIVENESS DESCRIPTOR

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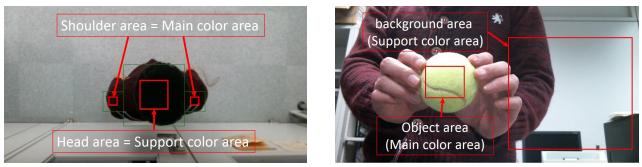
1. INTRODUCTION

Person identification is one of the most important subjects in computer vision. There are many personal features[1] that can be used for person identification, such as eyes, mouth, nose or facial feature points. Some researchers used other features, such as ear, hair, arms, hands, legs, gait analysis[2][3] for the job. On the other hand, the development of biotechnology enables us to get some special personal information, such as fingerprint, retinal image or blood vessel image. These kinds of personal information can also be used for personal identification[4]. However, since the acquirement of fingerprint, retinal image and blood vessel image requires special and expensive equipment, and nowadays people are unwilling to let their face captured without acknowledgment or prior permission, it is desired to carry out personal identification without using bio-metrical information or facial images.

In this paper, we assume that the people do not change their hair style and the clothes, and propose a person identification method that only uses a bird eye view image where people only show their heads and shoulders, so avoid using any face-related personal information.

2. CDF: COLOR DISTINCTIVENESS FEATURE

This section describes a novel descriptor named as *CDF: Color Distinctiveness Feature*. *CDF* is calculated based on Bayes rule from two color areas: one is main area, the other is support area (see Fig.1).



(a)For person detection (b)For object detection

Fig. 1. Main and support color area.

By performing distance transformation in color space starting from main area and support area colors, all pixels filled up in the learning stage. A color r can be described by probability density functions (PDF) $s(r|C_m)$ and $s(r|C_s)$. Let $S(C_m)$ and $S(C_s)$ be the priori probabilities of the main color and the support color, respectively, the color distinctiveness $S(C_m|r)$ can be calculated with equation (1).

$$S(C_m|r) = \frac{S(C_m)s(r|C_m)}{S(C_m)s(r|C_m) + S(C_s)s(r|C_s)} \quad (1)$$

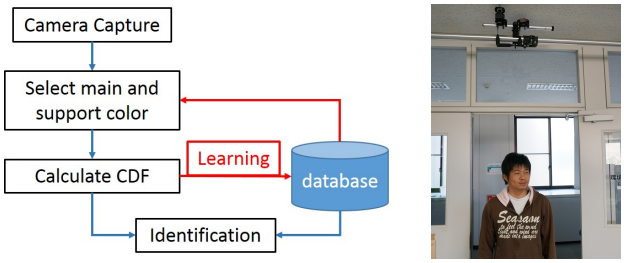
By assuming $S(C_m) = S(C_s) = 0.5$, we can get equation (2).

$$S(C_m|r) = \frac{s(r|C_m)}{s(r|C_m) + s(r|C_s)} \quad (2)$$

The value of the color distinctiveness $S(C_m|r)$ is between 0 and 1. We use the color distinctiveness as a feature to express color information of a person or an object. As show in Fig.1(a), shoulders are main areas and head is support area. The color distinctiveness of same person in different input images has value near to 1, and the one of different person has value near to 0. We can use the value of $S(C_m|r)$ to identify the person.

3. PERSONAL IDENTIFICATION WITH CDF

The flow char of personal identification is shown in Fig.2(a). Experiment environment showed as Fig.2(b).



(a)Flow chart of our method (b)Experiment environment

Fig. 2. Flow chart and experiment environment

We capture a bird's-eye view image. In the learning stage, when a person passes through an aisle and appears in the camera image, we calculate the person's color distinctiveness feature (CDF) and store its CDF_l into the database. In identification stage, when a person passes through the aisle again, we calculate the person's CDF, and compare CDF_i with all

person's CDF_l in the database. According to the sequence of recording, we assign an id n to each CDF_l when it is stored into the database. The max number of features in the database is N. CDF_i and CDF_l are continuous probability distributions in the same color domain X. In this paper, the similarity of CDF_i with all person's CDF_l can calculate by using Bhattacharyya distance measures.

$$D(CDF_i, CDF_l) = -In(\sum_{x \epsilon X} \sqrt{CDF_i(x) CDF_l(x)}) \quad (3)$$

After the calculation of similarity of every CDF pair, the ID with the highest similarity will be regarded as the matching result.

$$ID = \underset{n \epsilon \{1,2,\ldots,N\}}{\arg\max} \; D_n(CDF_i, CDF_l) \quad (4)$$

4. EXPERIMENTS

We implemented this CDF on a Bird's-eye views system. In this system, we used a PC with Intel Core i7 4770 CPU and 8GB memory, running Windows 7 OS and the camera is a Logicool c615 webcamera.

For person identification we have 4 people involved in our experiments(Fig.3). CDF of everyone was stored and calculated with each other person. The results of person identification experiments by using Bhattacharyya distance evaluation are showed in table.1(left). The results by using Hamming distance evaluation are showed in table.1(right). The results of the highest evaluation are marked with red color.

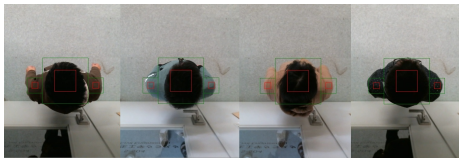


Fig. 3. Person images of Bird's-eye views for identification.

Table 1. Results of person identification. Left is Bhattacharyya distance, right is Hamming distance

P-B	1	2	3	4	P-H	1	2	3	4
1	99.97	99.52	99.79	99.94	1	0.84	0.00	0.00	0.00
2	99.47	99.96	99.72	99.50	2	0.00	0.30	0.00	0.00
3	99.90	99.82	99.99	99.81	3	0.09	0.00	0.76	0.00
4	99.94	99.70	99.81	100.00	4	0.00	0.00	0.00	0.98

The CDF is not only use for person identification, it also can be used for object identification. So we implemented this CDF as an object identification system. We did experiments for 4 objects shown in Fig.4. The Table.2(left) showed results by using Bhattachryya distance evaluation and the Hamming distance evaluation results are showed in Table.2(right). The results of the highest evaluation are marked with red color.

Fig. 4. Object images for identification.

Table 2. Results of object identification. Left is Bhattacharyya distance, right is Hamming distance

O-B	1	2	3	4	O-H	1	2	3	4
1	99.00	98.14	98.38	97.52	1	0.87	0.79	0.81	0.78
2	98.30	99.34	97.79	98.74	2	0.31	0.76	0.37	0.29
3	98.23	98.00	99.13	96.70	3	0.31	0.36	0.78	0.33
4	97.53	98.41	96.66	99.41	4	0.55	0.57	0.56	0.88

5. CONCLUSION

We have proposed a novel descriptor named as *CDF*. By using our method, person identification can be avoid using any face-related personal information. Through the experiments, we confirmed our method is not only used for person identification, it also can be used for object identification.

6. REFERENCES

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