Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 8, 5336-5342

Part Of Face Recognition Depending On Color And Texture

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Abstract: -
Distinguishing the person and determining his identity is a very important matter when knowing part of his/her face. It is considered a great challenge because sometimes the cameras could not capture the entire face, but rather a part of it and this could be greatly useful in forensic science. This paper aims to identify and detect the identity of people that captured a part of the face by the cameras based on color and texture. In this work we relied mainly on extracting features of intersection the colors between the part of unknown person's image and the images of people into the database. Also, we depended on the texture feature by using Gray Level Gap Length Matrix (GLRLM) for the purpose of distinguishing and promising results were reached.

1. Introduction

As a result of the tremendous and rapid development that the world is witnessing in the field of Information Technology, especially in the techniques of surveillance devices that are used in several areas, including the airports, buildings and houses, which were used for the purpose of surveillance and crime detection. Therefore, since the 1960s, researchers have been interested in recognition the full face [1], such as distinguishing students' faces to take their attendance instead of manual registration depending on cloud computing (CC) [2] or distinguish the student who performs the exam automatically using Deep Neural Network (DNN) and Support Vector Machine (SVM) [3]. Another field evaluates the quality of a face image [4]; also Yang et al. 2017 used neural networks to recognize video faces [5]. Li et al. 2021 depended on the voice information to perform face recognition [6].

Surveillance cameras are considered the eye of electronic security, also good and effective tool for detecting hundreds of mysterious crimes, and even revealing the identity of the perpetrators, which was often the evidence for an integrated conviction, and it shortened a lot of efforts made by security men in detecting mysterious crimes.

Each of the surveillance cameras or phone photography directly contributed to assist the crimes such as murder, theft and kidnapping, which security men have long used in many crimes to find out the circumstances of the incident and the descriptions of the perpetrators.

It is known that when the criminals commit a crime, they wear masks that cover part or all of the face, which makes identifying their identity very difficult, so we faced a great challenge in this research when recognizing part of the face, by relying on the characteristics of color and texture.

2. Dataset

In order to obtain an image of unknown person that includes a part of his/her face and to obtain his/her full information, a huge database must be available that includes data and images of the suspicious people. Then the characteristics of the

unknown person's photo are checked with the photos of known people faces by using computer technologies, in order to get high accuracy and speed. The database used in this work consists of thirty images as shown in figure below, collected from various sites.

Figure 1 Represent the dataset.

We also have an image of an unknown person that includes part of his face and contains the forehead, eyes and part of the nose. This part of the image belongs to a person who is in the dataset, but it is shot in different place and time as shown in figure below:

Figure 2 Represent part of an unknown person

3. Methodology

In this work, we designed a system that recognizes the person by detecting part of the face. The proposed system includes three models:

3.1 Feature Extraction

Considered the color and texture are low-level visual features [7], we will rely on them in this work to recognize a part of an unknown person's face and to know how much successes detection these features would achieve.

- **Using skin color to distinguish part of face for an unknown person**

We also know that the main characteristic of distinguishing between people is the color of the skin [8], so we focused on the upper part of the face. On the basis of that, all the dataset images were cropped from the top of the face to the middle of the nose (meaning as far as the apparent distance from the unknown person) as in the figure 3.

Figure 3 represent the cut part of each face of the dataset.

When comparing the unknown face with the rest of the faces, the face should be deducted from the background, so we used the code below for segmenting the face from background and we achieved the result shown in figure 4.

```
I=imread('1f.jpg');
gR=I(:,:,1);
gG=I(:,:,2);
gB=I(:,:,3);
cform = makecform('srgb2lab');
J = applycform(I,cform);
L=graythresh(J(:,:,3));
t=im2bw(J(:,:,2),L);
for i=1:59
    for j=1:100
        if t(i,j)==1
            t1(i,j)=gR(i,j);
            t2(i,j)=gG(i,j);
            t3(i,j)=gB(i,j);
        else
            t1(i,j)=0;
            t2(i,j)=0;
            t3(i,j)=0;
        end
    end
end
new_t=cat(3,t1,t2,t3);
new_t=uint8(new_t);
end
```

(a) (b)

Figure 4 algorithms was applied to (a) one of the database images (b) test image

For the purpose of accessing the unknown person within the database, as soon as a part of his face is known. We relied on the skin color, so the algorithm mentioned in the [9] would be applied. Therefore, we relied on the intersection of colors between the part image of the unknown face and each face within the database.

At the beginning we apply the procedure for calculating the three matrices colors (red, green and blue) for each pixel of the entire visible part of each face. Next step, for each pixel must obtain a matrix of unique values (this means uniform color values for each image). As shown in Figure 5 the uniform colors of one image of the database, where the procedure was applied and we got matrices consists of 189 colors of derivatives of the Red color, 202 colors of derivatives of Green color and 206 colors of derivatives of Blue color. Let $I_i(x,y)$ represent all pixels of three matrices (Red, Green, Blue) for each image within dataset as the following equation

$$I_i(x,y) = \{\forall Pi(I_R(x,y), I_G(x,y), I_B(x,y))\};$$

Where P_i denote the number of the color elements in the dataset $I_i(x,y)$.

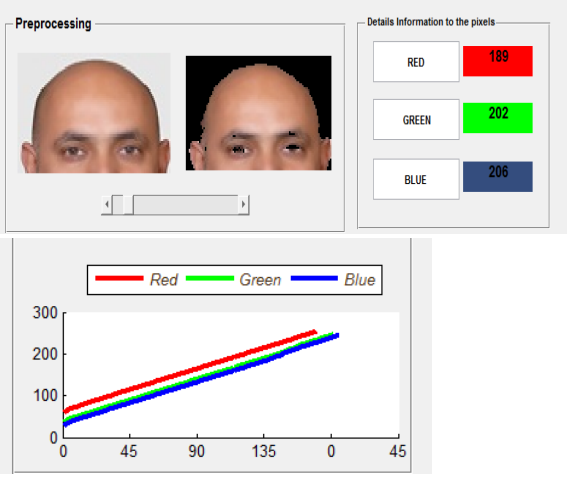

Figure 5 represent the result of one face within the database.

Also, we applied the procedure on the skin of unknown person, and we obtained the data shown in Figure 6 consists of three matrices I(x,y), which include (227 colors of Red derivatives color, 222 colors of Green derivatives color and 226 colors of Blue derivatives color).

$$I(x,y) = \{\forall P(I_R(x,y), I_G(x,y), I_B(x,y))\};$$

Where P denote the number of the color elements in the unknown image I(x,y).

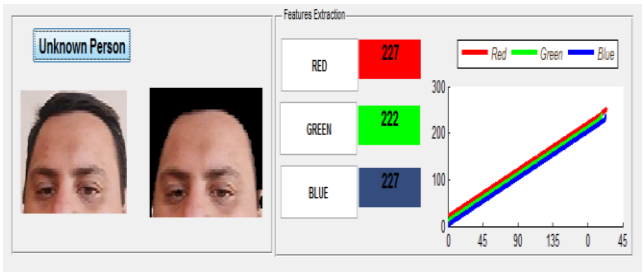

Figure 6 represent the result of test person.

Then, we could apply the procedure that represent cross colors between the unknown person's image and all images of people in the database by applying the equation below, which is mentioned in detail in [8]. Hence, figure 7 demonstrate the results:

$$P = I_{test}(x,y) \bigcap I_i(x,y)$$

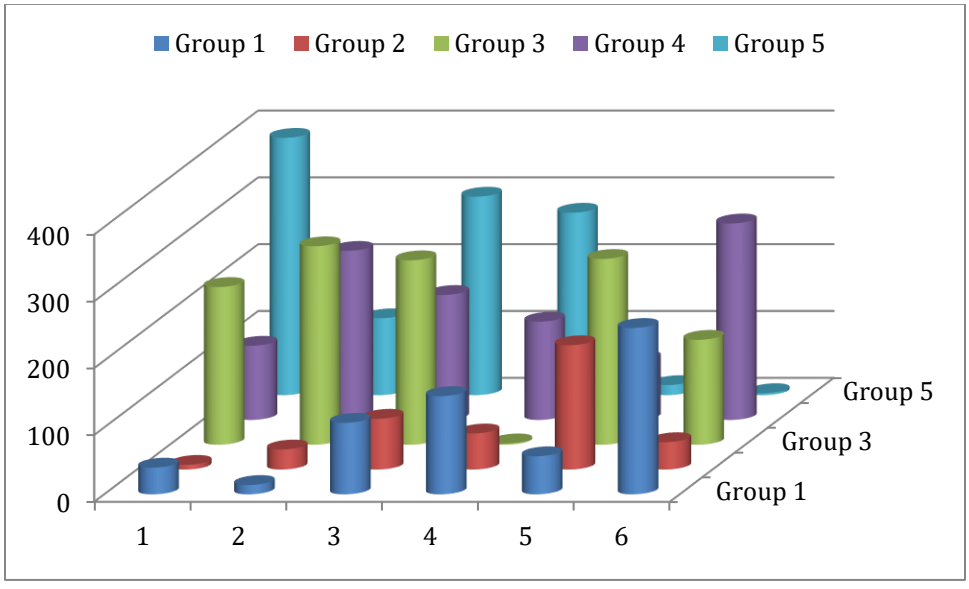

Figure 7 represent the results of the first feature.

We also note from the above figure that it represents the number of intersecting colors between the skin of the unknown person and the skin of each person in the database. It is normal to notice joint colors, because each image includes a huge amount of pixels that contain color values. When looking at figure 7 we note that the highest value was achieved in the first image of the fifth column, where the number of joint colors was (385), which indicates to the

correct person. We performed several experiments for a total of 100 images and it was successful for only 57.

- **Using skin texture to recognize part of face of an unknown person**

The texture of the skin is one of the important characteristics, which may be more powerful than color feature in the classification operation. So the adjective of texture will be adopted to identify the unknown person. The approved method is GLRLM, which have been mentioned in detail in [10], we would apply the method on four directions (0º, 45º, 90º, and 135º). Hence, the variables would be calculated are (Short Runs Emphasis (SRE), Long Runs Emphasis (LRE), Gray Level Non-uniformity (GLN), Run Percentage (RP), Run Length Non-uniformity (RLN), Low Gray Level Run Emphasis (LGRE), High Gray Level Run Emphasis (HGRE)) for each image in the database. The results of the database images and the test image as demonstrate in the Table 1 and Table 2 respectively.

Table 1: Results of Texture Feature to the database images using (GLRLM)

No	SRE	LRE	GLN	RP	RLN	LGRE	HGRE
1	0.0007	0.0233	4.0200	0.0016	0.7339	0.1213	0.7339
2	0.0007	0.0306	3.7440	0.0015	0.7487	0.1255	0.7487
3	0.0006	0.0133	3.1096	0.0016	0.8252	0.1200	0.8252
4	0.0006	0.0226	2.9359	0.0015	0.5945	0.0961	0.5945
5	0.0006	0.0485	2.0283	0.0011	0.6026	0.1014	0.6026
6	0.0006	0.0222	2.7155	0.0014	0.6099	0.0955	0.6099
7	0.0006	0.0123	3.2693	0.0017	0.7496	0.0799	0.7496
8	0.0006	0.0119	2.9449	0.0016	0.7515	0.0695	0.7515
9	0.0006	0.0165	3.2531	0.0016	0.7142	0.0820	0.7142
10	0.0006	0.0147	3.3126	0.0016	0.6735	0.0752	0.6735
11	0.0006	0.0215	2.9057	0.0015	0.6873	0.1165	0.6873
12	0.0006	0.0065	4.7966	0.0021	0.9192	0.0849	0.9192
13	0.0006	0.0188	3.2643	0.0015	0.6705	0.1216	0.6705
14	0.0006	0.0106	4.2972	0.0019	0.8311	0.1012	0.8311
15	0.0006	0.0178	2.9860	0.0016	0.6343	0.0867	0.6343
16	0.0006	0.0142	2.7934	0.0016	0.8335	0.1344	0.8335
17	0.0006	0.0176	3.4586	0.0016	0.7467	0.0948	0.7467
18	0.0007	0.0332	3.5646	0.0015	0.5765	0.0853	0.5765
19	0.0007	0.0213	3.7034	0.0016	0.6139	0.1029	0.6139
20	0.0006	0.0136	3.6602	0.0017	0.6961	0.0983	0.6961
21	0.0006	0.0625	2.3670	0.0011	0.6613	0.1534	0.6613
22	0.0006	0.0103	3.5816	0.0018	0.7483	0.1022	0.7483
23	0.0006	0.0187	2.7572	0.0015	0.7133	0.1197	0.7133
24	0.0006	0.0177	2.9355	0.0015	0.6521	0.1030	0.6521
25	0.0006	0.0242	2.8840	0.0015	0.6203	0.1104	0.6203
26	0.0006	0.0119	3.8550	0.0018	0.7440	0.0914	0.7440
27	0.0006	0.0098	3.8018	0.0018	0.8003	0.0879	0.8003
28	0.0006	0.0130	3.5460	0.0017	0.7283	0.0918	0.7283

29	0.0006	0.0280	3.0303	0.0014	0.6263	0.1262	0.6263
30	0.0007	0.0563	2.9160	0.0012	0.6191	0.1413	0.6191

Table 2: Result of Texture Feature to the test image using (GLRLM)

SRE	LRE	GLN	RP	RLN	LGRE	HGRE
0.0006	0.0578	2.0095	0.0011	0.5569	0.1173	0.5569

3.2 Classification

In order to recognize the unknown person image based on texture features, we have depended on the Euclidean distance equation. The results as shown in figure 8.

$$D(q,p)=\sqrt{\sum_{i=1}^{n}(q_i-p_i)^2};$$

Where q_i, p_i indicates to the values of two features for images, and n is the vector size.

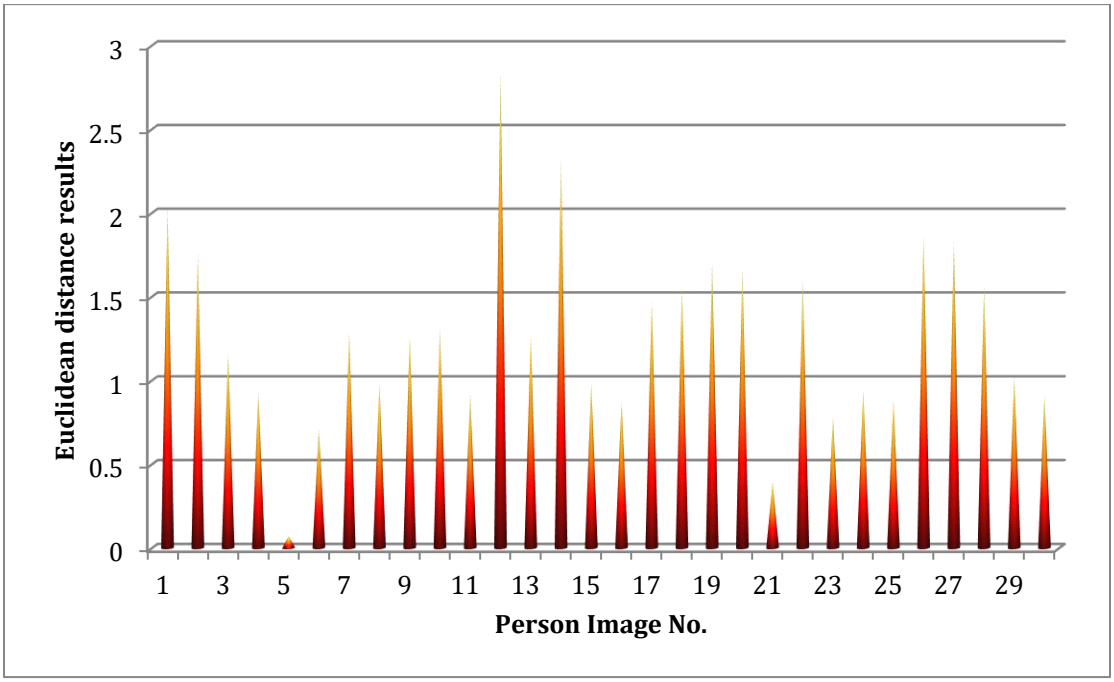

Figure 8 represent the results of Euclidean distance

When we applied the equation of the Euclidean distance between the tested image with the database images, we got the image number 5 is achieved the least distance and this means that it belongs to the person in the first cell of the fifth column and this is the correct person.

We applied the method on 100 images in different locations of the same people in the database and achieved a result of 85% of detection.

4. Conclusion

The idea of the paper is a new challenge, and the aim is to detect the identity of the person by accessing a part of his face when it picked by cameras. Therefore, this will assist the security authorities to get to the crime. In our paper, we relied on the characteristics of color and texture of the face, and we obtained promising results in the use of texture qualities, but the color of the face gave low results. Hence, we recommend in the future work to rely on the shape of the face and the lines it carries.

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