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INFORMATION IDENTIFICATION SYSTEM FOR IDENTIFYING PEOPLE BY PORTRAIT PHOTOS

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Manifold resources of human brain including 10-12 billion neurons are used for identification of peoples' faces (objects, signals, situations and events). It enables people to identify each other, read printed and handwritten texts with high speed, to drive cars in the street in complicated situations, process parts in assembly lines, decode aerocosmic photos. Choice of features for recognizing a human by his face is based on intuition. In automation of many task such as choice of the discriminating feature for recognition it is very difficult to use the factual information [1,2,3]. The human face is like a powerful signal device as much useful information can be obtained with it. For successful recognintion a number of issues should be solved:

1. Defining the anthropomentric points and automatic computation of the geometric features of the human face image presented for recognition;
2. Including the human face images in the base of the geometric features based on anthropometric points;
3. Defining the algorythm for the human face picture without scaling;
4. Identification process;
5. The process of the face recognizing and informing the system user about the results

There are two principal system types for the face recognizing. The first type system checks if the person facing the camera is a member of a limited group (*20-500* people). Generally, such systems are used in the control of access to buildings, computers etc. The second type system identifies a person by the photo search in a big data base or confirms its absence. Such a system should work with a data base that contains *1.000-1.000.000* images. It can work in autonomous mode [4].

In the organization of the identification system based on the face anthropometric points the method of formation of the image base date is of special importance. Currently there are various image base management control systems (IBMS). Some IBMS have been created by such firms like NEC, FACE, Krimnet, Image Pro Discovery etc. (IBMS names are given in accordance with the firms' names). Every system has its own limitations and advantages.

One of the principal recognition methods is defining the face geometric features (Figure 1). The heart of the method is to mark the key points on the face. Then distances (geometric features) between respective key points are determined. The key points on the human's face can be situated at various sites: e.g., at the eye margin, on the lip, on the ear lobe, on the nose etc. The practice of criminalistics has shown that about 30 special points should be selected in the image of a person. The points should be mostly stable against small changes (foreshortening, lighting, facial gesture, make-up, age changes) of the image [4].

In the course of preliminary experiments 19 special facial points which are shown in Fig. 1 were selected by us.

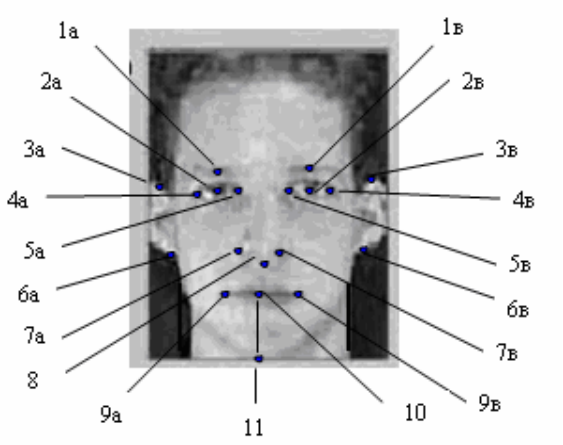

Fig. 1. Anthropometric points in the frontal projection of the human face.

In Fig.1 the identification points are marked as follows: the eyebrow centers (1a and 1b); pupils centers (2a and 2b); the upper marginal points of ears (3a and 3b); the right eye outside corner – 4a; the left eye outside corner – 4b; the right eye inner corner – 5a; the left eye inner corner – 5b; the lower points of the ears margins (6a and 6b); the distal outside nose points in the horizontal plane (7a and 7b); the nose tip (8) which is defined as the central point between the nose openings; the mouth corners (9a and 9b); the mouth center (10) – the point of intersection of the line between the upper and lower lips of the object and the vertical line dropped from the point defined as the nose tip of the object; the chin tip (11).

Let us consider the following distances (Fig. 2):

1) between the centers of the eyes retina (2a, 2b);
2) between the eyes inner corners (5a, 5b);
3) between the eye retina center and the eyebrow center [(1a , 2a), (1в , 2в];
4) between the eye retina center and the middle of the line between the lips [(2a , 10), (2в, 10)];
5) between the eye retina center and the lower point of the nose [(2a ,8), (2в ,8)];
6) the maximal width of the nose (7a, 7в);
7) between the eye retina center and chin [(2a , 11), (2в , 11)];
8) between the line separating the lips and chin (10, 11);
9) between the nose tip and chin (8, 11);
10) mouth width (9a, 9в);
11) the face width at the eyes line level;
12) the face width at the lower point of the nose;
13) the face width at the level of the line separating the lips;
14) between the outside eye corner and the upper point of the ear [(3a, 4a), (3в, 4в)];
15) between the upper ears points (3a, 3в);
16) between the lower ears points (6a, 6в);
17) between the upper and lower points of the ears [(3a, 6a), (3в, 6в)].

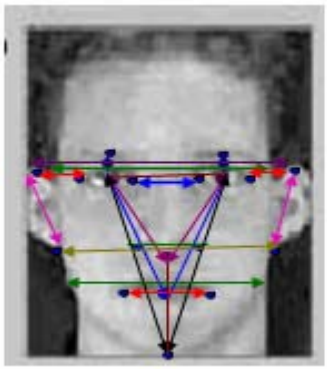

Fig. 2. Distances between the anthropometric points.

The distances (1), (2), (4), (5), (6), (7), (8), (11) we will consider as the principal ones as the effects of such factors as hairdo, facial make up, decorations, etc., are insignificant.

Using features for identification units in the form of ratios make those independent in terms of scale on the distance from which the shot of a person is made. In this case to use real sizes of head is quite impossible and as for the features it is not important at all what the distance of a person from the camera objective was.

Additionally for the practice sake the distances (1)-(17) were divided into two groups:

- the distances that are measured in the horizontal direction –(1), (2), (6), (10), (11), (12), (13), (14), (15), (16);
- the distances that are measured in the horizontal direction.

Certainly, the features formed on the basis of ratios between the distances of the first group will be quite stable to the person's head turn about the vertical axis of the photo and the features formed on the basis of distances of the second group will be quite stable to the head movements about the horizontal axis (bows). We believe that the same stability of features can be achieved for combined turn and bow movements of the human hair. The limits of the human head turn and bow will be certainly determined by the possibility of the special points selection and defining the respective distances.

Experiments showed quite good results (about 1-1.5% deviations) concerning stability of features in groups with turns of head till 25^o and bows till 15^o. The left and right turns were not discriminated.

Let us proceed to the description of IBMS "Recognition" developed by the authors of the paper for the person identification

The IBMS "Recognition" differs from other available systems in defined features. First the data base was created for the IBSM "Recognition". Photos of 300 persons were included in it; the images were different in size. Apart from that the following data were included in it: name, surname, patronymic, birth date, eye color, height

The data base was created on the basis of the person images and data obtained from the personnel department of the organization. Apart from the general information 19 features were used defining the geometric characteristics of the face. The number of the features can be increased. When the data base is updated the special points (Fig. 1) are determined for the person manually for the two groups, the distances (1)-(17) are determined automatically and kept.

Then the features for respective groups are calculated and are kept in the data base as well. These data are determined and calculated once only at the moment of the data base formation. Some data of the person (sex, race, age, region, special tokens etc.) available in the data base can serve as key for search. Then the identification task is reduced to finding a few images in the data base (from one to ten) which are most like the presented image. The presented image is compared with the images available in the data base by calculating the Euclid distance between the two points in 16-numerical space.

The features defining the geometrical characteristics of the face are considered as principal ones. The face features of any person included in the data base are different from those of other people. The estimates corresponding to those features are determined in compliance with the anthropometric points of the human face. The vertical and horizontal characteristics are read on the basis of the points marked by us and automatically included in the data base. Thus the needed information on 300 people is kept in the data base.

The "Recognition" IBMS system can be used in the systems for information security (access to computers, data bases etc.), observing and investigating criminal events, and in banking as well. The search in the data bases by the portrait photos of a person, automatic control of ID are especially important for police of most countries due to growth of terrorist acts and other criminal cases paralleled with the growth of general populace mobility.

References

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