

Recognition of People by Photographs

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Abstract – The technique of the person search in base of images on its photograph is considered. On the basis of the chosen identification points of the face, distances between them are calculated. Identification attributes of the face are defined on specially chosen way which differs from earlier available attributes.

Keywords: recognition, identification, anthropometrical characteristics, special points, biometric technologies, database

I. Introduction

Unlike other alive essences, human sight is allocated by qualitative ability fast recognition of familiar objects, things, people and many others. It can recognize them even under their images.

As we notice, identification of the person by the person is carried out almost instantly to different attributes, such as a smell, a voice, clothes and etc. But the face image is more reliable attribute at recognition of the person.

The problem of formalization of process of recognition of human faces was examined at a dawn of development of images recognition systems and till now remains actual. But last decades the amount of scientific researches and publications has increased in several times, which are testifies an increasing urgency of the given problem. It explains first of all with increasing opportunities of computer technical equipment and reduction in price of their operation. But on the other hand the enhanced attention to biometric technologies is dictated also by existence of an extensive circle of commercial and social problems where automatic identification of the person is an integral part of their successful application. So for example, identification of the person under the image of itself face can be applied in monitoring systems of identification cards (the passport, driving license) information safety (access to computers, databases, etc.) Supervision and investigations of criminal events, and also in bank sphere (cash machine, systems of the removed management of the invoice) [1, 2].

At present time there is a significant amount of works, devoted to researches of recognition of people on photographs and also some recommendations to developers of systems of identification of the person by photo [3,4,5,6,7,8,9,10,11,12,13]. Thus the digital image of the person face is meaning the term of "photograph", face without elements of clothes, ornaments, solar glasses, etc. which can close or distort some parts of the face.

It is obvious that people essentially different from each other such features as the arrangement of eyes, eyebrows, nose, ears, mouth and etc. Therefore is not surprising that historically the first approach to the decision of a problem of automatic identification of the person under the image by face has been based on allocation and comparison of

some anthropometrical characteristics of the face. This method for a long time is used in practical criminalities, however gauging and comparisons were carried out manually. It is especially effective in case of when the person does not have other photos, except for a photo in the document (controlling by document). The basic problem of the given approach is choice and definition of set of characteristic points of a human face on which identification will be carried out. However, thus, some requirements shown to portraits should be considered:

- Identification points should not be closed by a hair dress, a beard, a mask and etc;
- Process of recognition should not depend on scale of the image;
- System of identification points should provide relative stability of process of recognition at minor alteration of a foreshortening of shooting easy turn of a head, an inclination, change of a facial expression and etc.);
- The quantity of characteristic points should be minimal for maintenance of high accuracy of recognition.

In the literature there is a numerous quantity of works of the various aspects of this problem devoted to the decision [3,5,6,7,8,9,10,11,12,13].

In the given work the technique of search of the person in a database of images on the set digital portrait which is based on specially developed geometrical characteristics of the face is considered.

II. Allocation of special points

As shows criminalities an expert it is necessary to allocate about 30 special points on the image of the person. These points should be as much as possible steady against little changes (a foreshortening, illumination, a mimicry, cosmetics, age changes, etc.) images.

During preliminary experiments 19 special points of the face which are shown on fig. 1 have been selected.

As follows from fig.1 identification points are designated as follows: the center of an eyebrow (1a and 1b); the center of a pupil (2a and 2b); the top extreme points of ears (3a and 3b); the right corner of the right eye - 4a; the left corner of the left eye - 4b; the left corner of the right eye - 5a; the right corner of the left eye-5b; the bottom points of the ending (lobe of the ear) ears (6a and 6b); extreme points of a nose across (7a and 7b); a tip of a nose (8) which is defined as the central point between nose apertures; corners of a mouth (9a and 9b); the center of a mouth (10) - as a point of crossing of a line dividing the top and bottom lips of object, and a perpendicular lowered from a point defining tip of a nose of object; a tip of a chin (11).

Let's allocate following distances (fig. 2):

- 1) Centre to centre retinas of eyes (2a, 2b);
- 2) Between internal corners of eyes (5a, 5b);
- 3) Between the center of a retina of an eye and the center of an eyebrow [(1a, 2a), (1b, 2b)];
- 4) Between the center of a retina of an eye and the middle of a line short circuit of lips [(2a, 10), (2b, 10)];
- 5) Between the center of a retina of an eye and the bottom point of a nose [(2a, 8), (2b, 8)];
- 6) The maximal width of a nose (7a, 7b);
- 7) Between the center of a retina of an eye and a chin [(2a, 11), (2b, 11)];
- 8) Between the middle of a line circuit of lips and a chin (10, 11);
- 9) Between a tip of a nose and a chin (8, 11);
- 10) Width of a mouth (9a, 9b);
- 11) Width of the face at a level of a line of eyes;
- 12) Width of the face at a level of the bottom point of a nose;
- 13) Width of the face at a level of a line short circuit of lips;
- 14) Between an external corner of an eye and the top point an ear [(3a, 4a), (3b, 4b)];
- 15) Between the top points of ears (3a, 3b);
- 16) Between the bottom points of ears (6a, 6b);
- 17) Between top and bottom points an ear [(3a, 6a), (3b, 6b)].

Distances (1), (2), (4), (5), (6), (7), (8), and (11) we shall consider as the cores, as influence on them of such factors as a hair dress, a make-up, ornaments and insignificant so on.

Available in this area works [4], [5], [6], [7] for definition of attributes, i.e. parities of distances, were used either every possible parities or some chosen parities of available distances. However us the offered variant of calculation of attributes differs from earlier already used attributes a little. We shall explain an essence of this difference.

Let there is a set of distances $S(s_i \in S, i = 1, n)$. Elements p_i set of attributes $P(p_i \in P, i = 1, n - 1)$ which is defined as follows:

$$p_i = \frac{s_i}{s_{i+1}}, i=1, n-1 \quad (1)$$

Set P we shall consider as basic set of attributes. We shall prove that any set of attributes constructed on the basis of elements parities of set S can be received from elements P, by final number of arithmetic operations. We shall enter following designations:

$$p_{kj} = \frac{s_k}{s_j}, \text{ } \forall \text{ } k, j = 1, n; k \neq j, |k-j| \neq 1, k < j \quad (2)$$

Lemma. If p_i ($i=1, n-1$), are known, then

$$p_{kj} = \prod_{l=k}^j p_l \quad (3)$$

Really, if disclose product so we will receive

$$\prod_{l=k}^{j-1} p_l = \frac{s_k}{s_{k+1}} \cdot \frac{s_{k+1}}{s_{k+2}} \dots \frac{s_{j-2}}{s_{j-1}} \cdot \frac{s_{j-1}}{s_j} = \frac{s_k}{s_j} = p_{kj} \quad (4)$$

The essence of proved consists in that the basic set already contains the information on other parities of distances and therefore, there is no necessity of their use as attributes. In other words for identification it is possible to consider consideration of basic set sufficient. It is necessary to note that, in case of when attributes are calculated by division of all distances into distance between pupils the received set too is basic set.

Introduction of attributes in the form of the relation for identification units makes it scale not dependent on distance from which the photo of the person is made. In this case, use of real sizes of the sizes of a head and its sites not probably to define, and for an attribute absolutely unimportantly, on what distance there was a person during shooting from an objective.

In addition for practical purposes distances (1) - (17) have been divided on two groups:

- Distances measured in conformity to a horizontal direction ((1), (2), (6), (10), (11), (12), (13), (14), (15), (16));

- The distances measured in conformity to a vertical direction.

Undoubtedly, the attributes made on the basis of parities between distances entering in first group will be steady enough to turn of a head of the person on a vertical axis on photos, and attributes made on the basis of distances of the second group will be steady enough to an inclination of a head of the person downwards or upwards on a horizontal axis. We consider that the same stability of attributes will be kept in case of simultaneous turn and an inclination of a head of the person. Limits of turn and an inclination of a head of the person in a photo, certainly, will be certain by opportunities of allocation of special points and definitions of corresponding distances.

Experiments have shown good enough results (about 1-1,5 % of deviations) on stability of attributes in groups at turn of a head of the person up to 25 degrees and an inclination - up to 15 degrees. A deviation of a head to the left or to the right it was not considered.

III. The organization of identification system of person on the base of anthropometrical points of face

At the organization of identification system on the basis of anthropometrical points of face a special role plays ways of formation of databases of images. Without listing of known ways of the organization of base and carrying out in it of search and also comparisons of data stored it, we shall pass to the description of a database of images of the system of person identification developed by authors on the basis of the above-stated acceptances and reasoning.

The database is formed on the basis of data of a staff department and the image of the person. At the moment of updating a database for the given person special points (fig.1) are defined manually and simultaneously in two groups, distances (1) - (17) are automatically defined and stored. Further attributes P are calculated, for corresponding groups and too are stored in base. These

data are defined and calculated only once during the moment of formation of a database.

The certain data of the person (a floor, race, age, region, special signs, etc.) which are available in a database, can serve as a key of search.

The task of identification is reduced to a finding from a database of several images (from one up to ten) the most similar on set.

The set image is compared to images available in a database by calculation Euclid distances between two points in 16 - measured space. Using the above-stated keys of search it is possible to reduce number of checked images considerably.

Let is designating parameters of some person image as follows:

$$P_i^* (i = 1, n - 1)$$

Parameters of the image of i - th person in a database we shall designate so:

$$P_i^j (i = 1, n - 1 j = 1, N)$$

Euclidian distance is calculated as follows:

$$S_j(P_i^*, P_i^j) = \sqrt{\sum_{i=1}^{n-1} (P_i^* - P_i^j)^2} \quad (5)$$

$(i = 1, n - 1 j = 1, N)$

IV. Conclusions

The system "Recognition" developed by the offered method can be applied in monitoring systems of identification cards (the passport, a driving license), information safety (access to computers, databases, etc.), supervision and investigations of criminal events, and also in bank sphere.

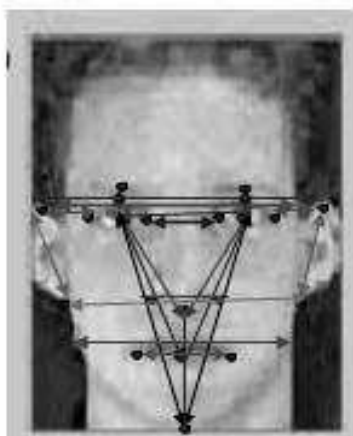


Fig.1. Anthropometrical points on a face-to-face projection of the face of the person

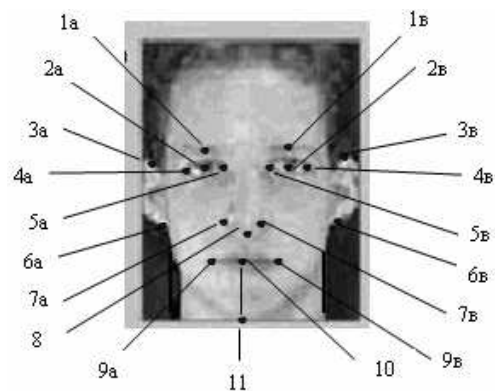


Fig.2. Distances between anthropometrical points.

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