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HUMAN RECOGNITION BY FACE IMAGE BY NEURAL NETWORK METHODS

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In the modern world, biometric methods are used to identify a person. Biometrics is a set of methods and devices for identifying a person, which are based on his unique physiological or behavioral characteristics.

Currently, there is an enduring interest in the problem of face recognition. Face recognition can be conditionally divided into 2 tasks: identification and verification. The task of identification is to compare the captured face with all face images stored in the database. The purpose of verification is to compare the person's face in the candidate's photo with the face in the reference photo stored in the database[1].

Face detection

The task of detecting a face in an image is the first step in the process of solving the problem of face recognition.

Existing algorithms for face detection can be divided into four categories:

Recognition using templates specified by the developer;

the empirical method;

the method of characteristic invariant features;

· method of detection by external features, learning systems.

An empirical approach based on knowledge based top-down methods involves the creation of an algorithm that implements a set of rules that a photographic fragment must meet in order to be considered a human face. This set of rules is an attempt to formalize empirical knowledge about how a face looks in an image and how a person is guided to make a decision: he sees a face or not a face.

The main stages of the algorithms of this group of methods are:

• detection of clear signs of a face in images: mouth, nose, eyes;

• detection of the border, shape, color, texture, brightness of the face;

• combining all found features, then their verification[2].

The method of detecting faces in complex scenes involves finding the correct geometric arrangement of facial features. For these purposes, a Gaussian filter is used with many different orientations and scales. Then, a search is made for the correspondence of the found features and their mutual position by random enumeration.

The essence of the feature grouping method is to use the second derivative

of the Gaussian filter in order to find areas of interest in the image. Then, using a threshold filter, the edges are grouped around each such area. After that, a Bayesian network estimation is applied to combine the identified features - thus, a selection of facial features is made.

Research process

The research process was an iterative set of experiments.

Each experiment consisted of 4 phases:

• Reflection.

• Implementation.

• Launch.

• Analysis of results.

In the first phase, the theoretical material was studied (reading scientific articles, descriptions of algorithms), thought over, as a result of which some idea was born later. In the second phase, this idea was implemented in code. Then the search for errors in the code was carried out through testing. Upon completion of testing, the program for collecting statistics was launched. The statistics collection program launched the recognition module for pairs of photos from the test sample[3]. Each photo was compared with each 1 time, but not with itself. After that, the overall statistics were recorded in a separate Excel file, where each line is a separate experiment. Having several experimental results, it was possible to choose the best one and, based on this, choose a further direction for research. The lower the ratio of the average among “own” photos to the average among “strangers”, the better. The file with detailed statistics was sorted in ascending order of distance. The ideal result was considered if the maximum distance for comparing photos of the same person is less than the minimum distance for comparing photos of different people (and the greater the difference, the better). Over the course of the entire study, more than 20 studies were conducted, of which 14 were the most significant and were documented (Appendix 1). The last experiment showed the best results and was chosen as the final one. The ratio of averages with the result of rounding was 0.276; the maximum distance for "own" photos was 23.77425, and the minimum for "strangers" was 34.00935. Based on the results of the final version, a percentage metric was created (Figure 1). First of all, this was done for comparison with the "reference" commercial recognition system developed by VisionLabs, which returns the result of the comparison as a percentage of confidence. For comparison, a new expanded sample of photographs "MUCT" was used. Photographs of 10 people were taken from there, 3 photographs of each. The comparison strategy is the same: "each with each" (Table 1).

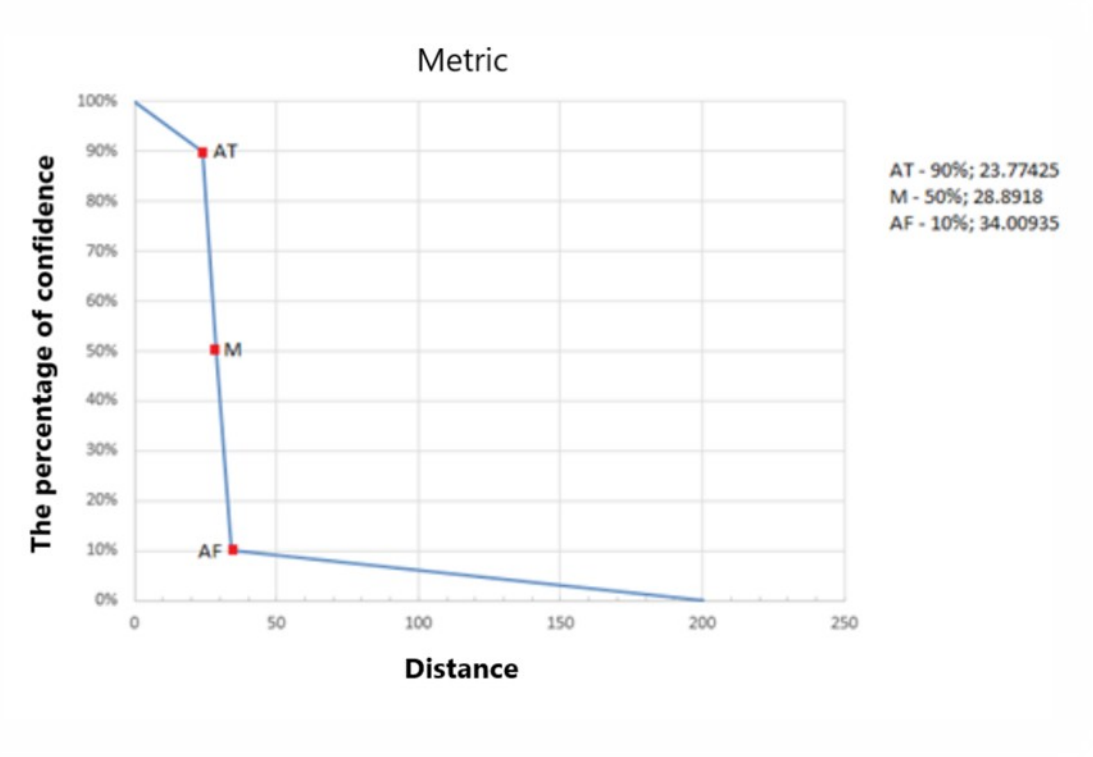

Figure 1. Conversion of distance to percentage

Table 1. The results of the work of recognizers on an expanded sample

	Their		Aliens	
	The average	Σ	The average	σ
Own development	79.897354%	26.323261%	9.564245%	9.374744%
VisionLabs	99.0138%	3.1629694%	6.1211834%	15.611576%

To identify the percentage of erroneous definitions, it was assumed that if the distance when comparing 2 images is greater than 28.8918 (the arithmetic mean of the maximum distance for "own" photos is 23.77425 and the minimum for "strangers" is 34.00935), then there are different people in the images, if less than or equal, then the images are the same person[4]. Since VisionLabs returns the percentage of confidence, where 100% is exactly the same person, 0% is exactly different, 50% was considered to be the middle (Table 3.2). An expanded sample was used.

Table 2. The number of errors in recognition on an expanded sample (435 comparisons)

	False positive	False negative	Total

Own development	6/435	4/435	10/435 (~2.3%)
VisionLabs	20/435	0/435	20/435 (~4.6%)

Since the percentage of errors is less than that of VisionLabs, it was decided to introduce this development into the enterprise access system[5].

Conclusion

Promising areas of research in this area to achieve the intended goal are noted. The description and results of preliminary experiments on the creation of an access control system based on the analysis of the image of a person's face are given. The research process was an iterative set of experiments.

Each experiment consisted of 4 phases:

· Reflection.
· Implementation.
· Launch.
· Analysis of the results.

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