



PROBLEMS OF CREATING A ROBOT EYE ANALYZER SYSTEM FOR HUMAN FACE RECOGNITION AND IDENTIFICATION

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Abstract

In this paper, sufficient scientific research on identifying the similarities of two images has been conducted, and information on the availability of sufficient algorithms and software products in this area has been provided. The recognition algorithm consists of comparing two images and determining their similarity. The authors have developed a comprehensive analysis of existing algorithms for the recognition process, taking into account their capabilities and shortcomings. A new criterion, algorithm and software are developed for the recognition process, as well as the examples showing its performance and high level of accuracy has been proved.

Keywords: Coefficient, correlation identification, face images, features, methods, statistics.

Introduction

This article provides methods for the correlation coefficient for identifying the image of a face and a person from a database based on symbols. The practical result of solving the problem of recognizing the desired image from the database based on the symbols of the face image, as well as creating algorithms and software using the correlation coefficient method is presented. It should be noted that throughout our research, we focus on further improving them using existing methods and algorithms [1, 2].

We need to create an algorithm to identify the searched person from database (DB). The process becomes more complicated, if a criterion that determines the differences

between two or more images, its algorithm, and software product would be created (see Figure 1).

Method 1



Method 2

Figure1. The main window for checking the algorithm of character recognition of two images

Software in C++ is developed to test the algorithm of two-character recognition, the images were converted to a 297x112-dimensional matrix, and database (DB) is created.

The following two methods for creating a recognition criterion are considered in detail and images are compared:

- **In the first method**, two identical images and one different image was obtained. Then, the question of finding the degree of probability that the process of comparison between them and their similarity are checked. The created scale, algorithm and software reached 100% accuracy. As a result, two images showed similarity, i.e., the first and second were 100% - percent similar to each other, and the third image was different from them.
- **In the second method**, experiments on checking that the algorithm is 100% accurate for 3 same images have been carried out. These 3 images were found to be 100% similar.

In order to verify the complete operation of the algorithm, let us consider another issue: several types of trains have been obtained and the probability of separating them from each other have to be checked. The criteria and algorithm of the process of comparing trains (see Figure 2) are mainly given in the following stages:

1. Images are converted into tabular or matrix forms.
2. The column and row of the matrix are aligned (2000x2000) so that the pixel size is the same.
3. In figure 2, there are 12 types of trains, which means 12 matrices or 12 tables. As a result of our experiments, it has been confirmed that the comparison of a row of matrices with a much smaller one takes up less computer memory. So we created a criterion, algorithm and software to find the percentage of probability of mutual similarity between two images comparing pixels with each other [1, 2, 3].

The main window of the program (see Figure 2) contains the main buttons, which are used to perform certain functions:

1. Using the "**Open**" button, you can select any image in the search or conditionally, open the image in the main window and search for it. When there is a new image that is been searched or suspected, it is passed through the steps of placing it in the computer's memory, that is, it encodes the image into digital numbers, creating a covariance matrix for these images.
2. Using the "**Save**" button, you can save the newly opened image in the database.
3. Using the "**Find**" button on the right side of the program window or in the database, allows you to open the pictures of the suspects one by one, based on a specific condition.
4. Using the "**Print**" button, compare the similarity of the image opened with "**Open**" and the image opened with "**Find**" and determine the probability of differences between them.



Figure 2. Overview of the program window.



In order to determine if our program has the highest capacity, we put a single dot in one of the images while testing them on the basis of experiments, and it was found that the created algorithm and software also have the ability to detect single dot differences. Improving this process, we focused on the picture on the right side of the program in figure 2 above, putting 6 yellow dots on them to find these 6 dots and recognize the difference in images and tested the capabilities of our program. If the similarity of the trains in figure 2 is 100%, the image is entered into a separate control database "suspect"; if the similarity is not confirmed, it is automatically reloaded to the database and the comparison with the next image is performed.

As a result of the algorithm software improvements, this criterion is intended to solve the problem of recognizing the face of criminal from the database (DB). The research on this issue shows that if there are certain marks on the face of a searched person (scar, spot, etc.), it simplifies the process and compares it on the basis of that pixel area that enables to find it with 100% accuracy. Sources have shown that the human facial structure is formed at the age of 20-25 and has the property of stagnation, for example, it is said that strong marks on the human eyes, lips, nose, ear supras, etc. remains unchanged for the end of the life. The identification of individual features that characterize the individuality of a person's facial structure is very important.

The main goal in the formation of this article (the creation of principle for the process of human face recognition and to study its analysis) is focused on:

- Identification of the ways to form the space of informative signs in recognition.
- Development of methods and algorithms for the formation of information sets.
- Development of application software based on the proposed methods and algorithms.

Identification analysis based on facial expressions - information about the person's face structure based on informative and robust features was first systematized by the French criminologist A. Bertilon in the late 19th century and used to register perpetrators. A. Bertilon noted that **"The general structure of the face, some parts are different, head, eyesight, ear supras, facial size and the sum of their measurements are specific to one person and not repeated in another person."**

Based on the classification of measurements worked by A. Bertilon, German criminologists R.A. Reiss, Russian scientists N.S. Bokarius, S.M. Potapov, I.N. Yakimov developed methods for the application of certain systems of facial expressions on the basis of appearance, features in expertize identification, and some of them developed the rapid search of facial features.



The scientific foundation for identification on the basis of facial features is formed according to the achievements of a number of disciplines (anatomy, physiology, forensic medicine, etc.) and is widely developed in investigative, operational and expert activities are known from sources.

The process of comparing images consists of the following steps:

1. The facial mode of desired object is formed in the form of a matrix and the statistical status of appearance confirmation of the individual is determined.
2. The primary features of the face, which are based on the appearance, are selected. In these features, each image formed in the object is transferred to the column and row view, as well as to the process of numerical fragmentation of the image symptoms divided into classes.
3. The identification criterion stage is defined for classifying and recognizing the pixels and symbols of image sorted in the object.
4. A reference to the database is formed and a comparison process is performed on the basis of criteria in the order of images sequence.
5. On the basis of the main features and signs present in the appearance of a person's face, an object similar to 100% is selected from the database.

For the comparison process between the two matrices, we use the following criteria residual variance and coefficient correlation methods [1].

We use the coefficient correlation method (CCM) to find the image we need for objects, classify them, and find the basic formula:

$$R_{x_j / l} = \frac{\overline{H_{x_j} \cdot H_{x_l}}}{\sqrt{H_{x_j} \cdot H_{x_l}}} \quad (1)$$

Here,

$$\begin{aligned} \overline{H_{x_j} \cdot H_{x_l}} &= \sum_{i=1}^m x_{ij} \cdot x_{il} - (1/m) \left(\sum_{i=1}^m x_{ij} \right) \cdot \left(\sum_{i=1}^m x_{il} \right) \\ H_{x_j} &= \sum_{i=1}^m x_{ij}^2 - (1/m) \left(\sum_{i=1}^m x_{ij} \right)^2; \quad H_{x_l} = \sum_{i=1}^m x_{il}^2 - (1/m) \left(\sum_{i=1}^m x_{il} \right)^2 \end{aligned}$$

In the above formula (1), the degree of correlation link similarity probability is a determining criteria and it is related as follows:



Using the CCU result (1), we construct a correlation matrix $R_{ij} = X_{ij}$ and perform an analysis on this matrix. The coefficient correlation value is the first image model given to us if the following condition is done $R_{x_{i,j}} > T(\alpha, m)$ $\alpha = 95\%$ the $R_{x_{i,j}}$ similarity between them is more than 95%.

1. When the multi-coefficient correlation $R_{x_{i,j}} = 1$ is equal to the high value of $S_{ost}^{-2} = 0$, the similarity of compared two images is 100%, an adequate result is obtained.
2. If the second condition $R_{x_{i,j}} \leq T(\alpha, m)$ is formed, it is concluded that the second image is not similar to the first image, then the third image starts from step 1, and the process is repeated until you find a similar image.

Conclusion

1. In criminology, when comparing two simple images, that is, two fingerprints, metric methods have been used so far. In some cases, these methods have become obsolete, and these methods are becoming a history.
2. During the inspection of the program, it became clear that it turned out that the opportunity to save time in the process of comparing the image by line is huge.
3. Based on the given parameters the use of statistical methods should be considered in recognition the face image on the basis of signs and pixels. Experiments have shown that the residual variance and correlation coefficient methods usually serve as a criterion for recognizing the wanted person from the reference images stored in database.
4. The biometric systems, image recognition algorithms are used to describe the photos using the integrated algorithm and neuron networks together. The created criterion provides a very high speed for storing images in the database and processing. This method simplifies the task of uploading two- and three-dimensional images from the database to database management system.
5. The created criteria and its software are included in image database (human face image) have to be paid more attention to condition of clarity, so that the human face part searched in the database will be 100% recognizable out of more than 200,000 objects.



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