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USING THE NEURAL NETWORK TECHNOLOGY IN SOLVING THE TASKS OF PERSONAL IDENTIFICATION

Abstract. This article is devoted to the practical application of the apparatus of artificial neural systems for the development of the computer system of video surveillance and authentication personality. The purpose of the analysis is to improve the efficiency of the automated recognition of individuals for the identity authentication by integrating features of the face change parameters over time.

Keywords: biometrics, neural networks, authentication, video surveillance system, a fuzzy knowledge base.

Systems of automatic recognition of objects of different classes on digital images are vital for wide range of practical solutions in the field of computer vision, robotics, video surveillance and access control systems, different interfaces of human-computer interaction, etc. A key example which reflects the basic principles of these technologies is the system of auto detect of people's faces in the electronic video images. It is necessary to combat terrorism and crime, for total control of movement of migrants, to identify the person at the banking operations in electronic networks and for a number of related tasks, where identification is very important.

Face recognition problem was considered early on computer vision stage. A number of scientific and industrial companies for over 40 years actively develop the system of automatic recognition of human faces: Smith & Wesson (ASID system – Automated Suspect Identification System); ImageWare (FaceID system); Imagis, Epic Solutions, Spillman, Miros (Trueface system); Vissage Technology (Vissage Gallery System); Visionics (FaceIt system) [1].

The use of artificial neural networks to solve the problems of image identification is widely used in solving various practical problems [2, 3, 4]. For example, artificial neural networks device is used to detect ECG signals [5], human signature [6], and identification of smartphone user palm [7]. The use of mathematical device of artificial neural networks in systems of identity authentication is also widely used. For example, in [8] the task of authenticating users of smartphone based on 14 gestures is considered. Models of behavior of users are classified by a neural network with radial-basis functions. In [9] the problem of the smartphone user authentication based on a behavioral model is also considered. The authors of the research [10] study the issues of human age based on the evaluation of fingerprints. In researches [11, 12] the problem of authentication, based on the analysis of a person's face using a neural network approach are considered. Analysis of geometrical facial features to determine the gender of the person with the help of neural networks with back-propagation is carried out in [11], the authors [12] use convolutional neural networks for face recognition.

Over the past few years a number of scientists [13-15] proposed a plenty of methods for the facial identification, implementing a variety of scientific approaches. Among the first facial recognition implementations, using methods based on learning, the system of Teuvo Kohonen from Helsinki University of Technology [16] is well known. He demonstrated that recognition of aligned and normalized image can be performed using a simple neural network. Used network performed a description of a person, approximating the eigenvectors of the autocorrelation image matrix. These eigenvectors are

called “own faces” (eigenface). However, Kohonen system has not found practical application because it based on precise alignment and normalization.

In the following years, there have been numerous attempts to implement individual recognition schemes using different neural networks methods. In their studies, Michael Kirby and Lawrence Sirovich from Brown University [17] introduced the algebraic operation, which simplified the calculation of "own faces". Moreover, they showed that for accurate coding of aligned and normalized images it is necessary to have no more than 100 own faces. Matthew Turk and Alex Pentland from Massachusetts Institute of Technology [18] demonstrated that the residual error that occurs at encoding with the help of own faces, can be used for the detection of faces in the disordered natural image and determination of the exact location and size of face. Then they showed that the combination of the method of detection and localization of faces with the method of own faces recognition provides a reliable face recognition in real-time, with minimal restrictions on the recognition.

The proposed technologies of face recognition enable to perform automatic search and identification of image files and video stream. However, nowadays, wide range of tasks in this area, such as how to teach a computer to effectively carry out detection procedure for different evaluation criteria, how to decode and store digital images of faces with the least memory volume, how to choose effective assessment criteria of faces similarity, how to perform complex image processing, etc. remains unresolved [19]. The main requirements that apply to the algorithms of this class are: high recognition quality, work in a real time mode, the stability of the work in relation to external factors [20].

During the implementation of Feret scientific program three different algorithms operating on the basis of the NN have demonstrated the highest level of recognition accuracy for large databases (1200 people) in the most difficult conditions for the recognition. The algorithm developed at the University of Southern California [21]; University of Maryland [22] and an algorithm created in Media Laboratory at the Massachusetts Institute of Technology.

For frontal images, the recognition accuracy is 95%. For images taken by different devices and at different lighting, the accuracy typically decreases to 80%. For images taken a year apart, the recognition accuracy is about 50%, which, in our opinion, highlights the need of continuous supplement of the database with update images and the search for more efficient algorithms.

In March, 2015, Google's researchers have published scientific work [23], considering the new system of artificial intelligence called FaceNet, which recognizes people's faces with high accuracy, showing the result of almost 96% on a standard set of data “Labeled Information Faces in the Wild” [24], which includes more than 13 000 images of persons taken from the Internet. Google system does not only recognize faces, but also enables to pick up a collection of other people who are like the given photograph. High result is explained by a new method of training a neural network: there were used triplets of photos, which were presented the faces of the same or different people; that are equally aligned and made under the same conditions. However, despite the current success, the problem of face recognition taking into account the aging factor, or the influence of other changes remains unsolved.

Based on the analysis of scientific publications presented above, the group of methods, acting on the basis of training or self-study is a promising scientific direction in the field of identity authentication, in particular face recognition. It is known that the trained neural network is capable of accurate reproduction of the input signal and its approximation. Automatic capability of the NN to interpolation enables to determine the missing signals, due to the influence of external factors, or the coordinates of the location of the lines, and extrapolation may allow predicting the effects of aging or changes in appearance for several reasons. NN successfully restores distorted information and are widely used in various branches of science and technology, especially robotics and machine vision systems. Thus, the use of the scientific device may allow solving a number of problems related to the human identification without use of additional hardware and time-consuming algorithms with many patterns for each of the objects.

The aim of the analysis is to develop the computer system of individual identification which is based on trained neural network and test of the NN effectiveness under the influence of external factors. To achieve these goals the following tasks should be solved: to consider the possibility of intelligent biometric system of person authentication on the example of face recognition, using the mathematical apparatus of artificial neural networks, to analyze the traditional approaches in the field of face recognition and identify their characteristics, to propose the structure of the neural network of face recognition system and to conduct a simulation to verify the effectiveness of the trained neural network.

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ТҰЛҒАНЫҢ АУТЕНТИФИКАЦИЯСЫ АЯСЫНДАҒЫ ЕСЕПТЕРДІ ШЕШУДЕГІ НЕЙРОЖЕЛІЛІК ТЕХНОЛОГИЯЛАРДЫ ҚОЛДАНУ

Аннотация. Мақала бейнебақылау және тұлға аутентификациясы компьютерлік жүйелерін құру үшін жасанды нейрондық желілер аппаратын практикалық қолданудың талдауына бағытталған. Талдау уақыттың өтуімен бет-әлпет параметрлерінің өзгеріс ерекшеліктерін есепке алу арқылы тұлға аутентификациясы мақсатында бет бейнесін тану тиімділігін арттыру үшін жүргізілді.

Түйін сөздер: биометрия, нейрондық желі, аутентификация, бейнебақылау жүйесі, айқын емес білім қоры.

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ИСПОЛЬЗОВАНИЕ НЕЙРОСЕТЕВЫХ ТЕХНОЛОГИЙ ПРИ РЕШЕНИИ ЗАДАЧ В ОБЛАСТИ АУТЕНТИФИКАЦИИ ЛИЧНОСТИ

Аннотация. Статья посвящена вопросам анализа практического применения аппарата искуственных нейронных систем для разработки компьютерной системы видеонаблюдения и аутентификации личности. Целью анализа является повышение эффективности автоматизированного распознавания лиц для аутентификации личности путем учета особенностей изменения параметров лица с течением времени.

Ключевые слова: биометрия, искусственные нейроные сети, аутентификация, система видеонаблюдения, нечеткая база знаний.

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