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Remote Recognition of Human Emotions Using Deep Machine Learning of Artificial Neural Networks

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Abstract

Currently, there is a need in society to use digital and cybernetic methods of remote diagnostics of a person's mental state. Using a digital or cyberphysical system in the process of remote recognition of the patient's mental state, it is possible to increase the effectiveness of recognizing the actual psycho-emotional state of the patient, both in the consulting mode and in dynamic observation. For remote assessment of the mental state, methods are widely used based on recognition of facial activity, which is reflexively associated with the display of the psycho-emotional state. In this paper, the authors propose a new approach to creating such a methodology. This work was supported by the RFBR grant 18-07-00987.

Keywords: monitoring of the psychophysical state; artificial intelligence; neural networks

1. Introduction

Currently, there is a high negative stigmatization of mental health issues in any society. This is due to patients ' distrust of the human factor-the doctor, who, in the opinion of patients, can make mistakes and make a biased conclusion. Therefore, there is a need in society to use digital and cyberphysical methods of remote diagnostics of a person's mental state [1, 2]. Cyberphysical or digital systems include information technology systems that integrate computing resources into physical entities of any kind, including biological and man-made objects [3]. Using a digital or cyberphysical system in the process of remote recognition of the patient's mental state, it is possible not only to overcome negative stigmatization, but also to increase the effectiveness of recognizing the actual psycho-emotional state of the patient both in counseling mode and in dynamic observation [4, 5, 6]. Currently, methods based on the recognition of facial activity, which is reflexively associated with the display of psycho-emotional state, are widely used for remote assessment of mental state [7, 8, 9]. The main problems associated with the recognition of human facial expressions are the classification of emotions and the choice of computer vision method [10, 11, 12, 13]. It can be noted that in the known publications we have not found descriptions of methods that fully meet the requirements of accurate remote recognition of emotions. In this paper, we will consider a new approach to creating such a methodology [14, 15, 16, 17, 18, 19, 20].

2. Methods

The aim of our study is to create a methodology for remote recognition of emotions using the technology of deep machine learning of artificial neural networks.

Accordingly, we identified the following research objectives:

- Develop a new methodological approach to creating a model for remote recognition of emotions
- Integrate a new methodology into a machine learning system based on the use of artificial intelligence technologies

3. Results

A method has been developed in which individual dynamic monitoring of facial expressions, movements and speech is used to recognize the psycho-emotional state. At the same time, to determine facial expressions, motor and speech activity, a person is presented with test material that affects its receptor field. According to the data obtained, the psycho-emotional state of a person is determined in accordance with the coding system of facial movements. The resulting facial image is classified by the artificial intelligence system (artificial neural network) as an affective component of emotional disturbance.

Classification is carried out in several stages. First, the severity and duration of emotional disturbances determines a simple emotion, mood, affect. Then, by the nature of emotional disturbances, a reduced mood, an increased mood, an unstable emotional sphere, and a qualitative distortion of emotions are determined. The next step in the motor component of affective disorders is determined by increased and decreased motor activity. Affective disturbances, characterized by fast and slow speech, are determined by the ideator component. The obtained data is stored as a database of the spectrum of emotions of an individual person. When the data is generated, remote monitoring is carried out for a given time using artificial intelligence methods. At the same time, data on the reduction of facial muscles, motor and speech activity are constantly compared with the generated database of the spectrum of human emotions. Based on the results, recommendations are made about the need to refer the patient to the correction of the psychophysiological state.

To determine facial expressions, motor and speech activity, a person is presented with test material to influence his receptor field. Then, according to the obtained data, the psychoemotional state of a person is determined in accordance with the facial movement coding system. The resulting facial image is classified by the artificial intelligence system as an affective component of the violation of emotions. Such a solution allows for timely correction of the psycho-emotional state at the workplace or in a place of constant presence.

The image can be fixed both in the visible part of the spectrum and in other parts of the spectrum, for example, when registering different wavelengths - ultrasound, infrasound, infrared, terahertz. This allows you to recognize even weak contractions of facial micro-facial expressions and determine emotions with mild emotional expression, as well as if a person tries to hide and restrain his emotions.

Recognition of the psychoemotional state by facial expressions, motor and speech activity of a person, contains several stages.

At the first stage, a stimulus material is presented to display a particular emotion on the face. This material affects separately, or simultaneously, or in various combinations on the visual, auditory, olfactory, tactile, auditory, and proproiceptive human analyzers. He is able to cause a certain emotional reaction on the video image, audio recording, exposure to odors, effects on the skin different in shape and temperature of objects (needles, feathers, ice, hot water, etc.) effects on humans special devices, which change with different speed and body position in space. This approach personifies a person's emotions and increases the accuracy of recognition compared to the method of averaging the emotions of many people.

At the second stage, upon presentation of the stimulus material, at least one variable temporary component of the facial muscle contraction of the human face is measured. This allows the recognition of a minimal micromimic reaction.

At the third stage, upon presentation of stimulus material, at least one emotion expressed on a person's face formed by contraction of facial muscles the speed of speech, which is transmitted to the artificial intelligence system to form a database of normal and pathological human emotions, are measured. This provides individualization and accuracy of recognition of emotions.

When the measured facial expression formed by the contraction of facial muscles coincides with the facial expression stored upon presentation of stimulus material, the emotion of a person is recognized as a person in a certain psycho-emotional state. In this case, the time spent by a person in this state, as well as the motor and ideator components of the affective state, are determined. This allows you to timely determine the negative emotional state of a person.

To monitor and recognize emotions, make decisions and evaluate the effectiveness of psychocorrection, an artificial neural network is used, including on mivar, robust and other mathematical principles of work. Such a system allows, without human intervention, to remotely control the process of recognition and correction of the psycho-emotional state.

4. Discussion

Implementation of the proposed methodology is as follows. A camera is installed that can recognize facial muscle contractions. The camera is positioned so that it can constantly monitor the patient's face. After turning on the camera, a person is presented with a test task for an independent image on his face of certain emotions and a test effect on his receptor field that can cause emotional experiences.

The test task is as follows. In front of the camera, a person is offered to remember or relive an emotion from a list of possible human emotions. At the same time, the artificial intelligence system fixes the contractions of the facial muscles that form the facial expression with a particular emotional experience of a person. Data is entered into the database as a test sample of the emotions of this person.

Test effects on the receptor field are as follows. In front of the camera, a person is presented with a set of irritants in the form of video information, sound, tactile, olfactory, proprioceptive, capable of causing an emotional experience of a person from the list of possible emotions. At the same time, the artificial intelligence system remembers the contractions of facial muscles and facial expressions for a particular evoked emotion. Information is stored in the database as a test sample of the emotions of this person.

Further, when a person begins his activities, the camera monitors his facial expressions for a given time (hours, days, months). At the same time, the facial expression formed by the contraction of facial muscles is constantly compared with test samples and the current emotional state is recognized. After a predetermined time, the artificial intelligence system provides data on the amount of time a person is in a particular emotional state. If the predominant finding of a person in a negative emotional state is revealed, then a recommendation is made to conduct psychocorrection.

4. Conclusion

The methodology proposed by the authors in this work for assessing the psycho-emotional state of a person seems very useful in assessing the functional readiness of persons in responsible and dangerous professions. In addition, this approach will make a significant contribution to the remote monitoring of patients with mental illnesses, which is especially important in the context of epidemics and forced quarantines.

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