УДК 004.75

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METHODS FOR RECOGNIZING A PERSON'S EMOTIONAL STATE IN VIDEO ANALYTICS SYSTEMS

The paper deals with the methods of analysis human’s emotional state are examined on the basis of analysis of video-images. Experimental results are compared and analyzed. These results are got at the use of different methods, as Support Vector Machine, Active Appearance Models and Convolutional neural networks

Keywords: Support Vector Machine, Active Appearance Models, Active models of appearance (Representation model), Convolutional neural networks.

Fig.: 2. Tabl.: 1. Bibl.: 5.

Target setting. In connection with the steady increase in the volume of various negative emotional states, it is becoming increasingly important to improve the diagnosis, clarify the features of affective states, determine their pathophysiological substrates. In today's world, automated video flow analysis systems, including tracking human behavior, are used in various areas: security by analyzing the trajectories of people , support activities for operational and investigative activities, psychological and medical diagnosis.

Actual scientific researches and issues analysis. The relevance of this topic, the presence of a large number of unresolved issues led to the formulation of the purpose and hypothesis of this study, the choice of methodological tools and methodological basis for the analysis of experimental data.

Uninvestigated parts of general matters defining. A lot of work has been in for the research of new methods for recognizing a person's emotional state in video analytics systems. However, it is impossible to find a clear leader among the considered programs in terms of recognition accuracy. So many factors must be considered when choosing a particular method to use. But this paper focuses on Support Vector Machine, Active Appearance Models and Convolutional neural networks.

The research objective. To perform its own demonstration development of an algorithm for detecting abnormal human behavior, which can then be used for its intended purpose. Also, a comparison of the results of machine learning algorithms Support Vector Machine (SVM), Active Appearance Models (AAM) on an experimental data set with normalized key points and distances between them, as well as the Convolutional neural networks (CNN) method on monochrome images.

Subject of the paper. Development and comparison of methods and software that allow to recognize and analyze emotional states of a person.

The statement of basic materials. In this paper, we will develop and compare the results of the machine learning algorithm SVM, ANN on the experimental data set with normalized key points and distances between them, as well as the CNN method on monochrome images for emotional states of a person.

In this regard, the study is to implement and compare the most popular machine learning methods for classification problems: the method of reference vectors (SVM), active models of appearance (AAM), convolutional neural network (CNN).

Experiment. The training of AAM and SVM methods was carried out on two data sets: normalized key points and distances between key points.

The next studied algorithm of emotion recognition is a convolutional neural network, which is studied on monochrome images, its training is carried out on a relatively small sample of data, which consists of images that consistently change over time from weakly to "brightly" expressed emotions.

Preparation of an experimental sample for training was gotten from the Extended Cohn-Kanade Database (CK +) which was used to teach machine learning algorithms, consisting of 11,061 photographs, with a quality of 640 × 490 pixels, in * .png format. 623 structures with emotions are marked in the CK + database. The sample is divided into 8 classes of emotions: 1 - anger, 2 - contempt, 3 - disgust, 4 - fear, 5 - happiness, 6 - sadness, 7 - surprise, 8 - normal state. The source database is redesigned to minimize recognition errors. For SVM and AAM methods, an image with the most "expressed" emotion was selected for each class of emotions and a person, and a mirror image was performed for each image to increase the sample size.

The uneven distribution of images by class is due to the limited sample size for each class in the source database CK +, classes 5, 7, 8 have a larger amount of data in the source database than classes 1, 2, 3, 4, 6. Example images, used in the database are shown in Fig. 1

Fig. 1. Example of images from the database, classes are located from left to right (far left image corresponds to 1 class, far right 8 class) (The Extended Cohn-Kanade Database)

The calculations of normalized coordinates key point ***i*** - x_i' and y_i' was performed according to the formulas:

$$x_i' = \frac{x_i}{width};\ y_i' = \frac{y_i}{height} \quad (1)$$

Where: x_i- horizontal coordinate of point ***i***, y_i – vertical coordinate of point ***i***.

The calculation of distances between key points was performed according to the

formula:

$$d_i = \sqrt{(x_c - x_i') + (y_c - y_i')} \quad (2)$$

Where: d_i- distance between two points, $(x_c - x_i')$ - horizontal change in point ***i***, $(y_c - y_i')$ - vertical change in point ***i***.

To learn the CNN method, you need to convert all images from the database to monochrome.

Fig. 2. Example of monochrome images from a normalized base,

Training of SVM, AAM algorithms was carried out by means of the built-in methods of machine learning in OpenCV library while CNN algorithms training was done in the caffe library.

Thus, analyzing the data obtained from each test case, I concluded that the methods of SVM and AAM showed very similar results in the accuracy of the classification of emotions. But the AAM method showed greater recognition accuracy than the SVM method on the distance data by 7.70%, and on the key points by 1.02%.

Table 1

Summary table of test results

Method	Data	Recognition accuracy, %
SVM	Key points	53,48
	Distances	55,50
AAM	Key points	54,50
	Distances	63,20
CNN	Monochrome images	88,11

As you can see, the accuracy of the classification increases if you use for training data based on the distance between key points.

For the SVM method, the accuracy increased by 2.02%, and for the AAM method, the accuracy increased by 8.70%.

Conclusions. The main purpose of this paper was development and comparison of the most popular machine learning methods for the classification of emotions and the methods of AAM and SVM on the data set from the distances between key points show a more accurate classification result than those same methods on a data set from normalized key points.

Nevertheless, active appearance models demonstrate a more accurate recognition rate than the SVM method. Both methods have an acceptable level of

detection. The CNN method on a set of monochrome images showed the best result of all the studied methods. The process of preparation of the experimental base for training, experimental testing of the used methods was described and conclusions were made based on the obtained results.

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