REAL TIME DETECTION THE PERSON EMOTION STATE USING NEURAL NETWORK

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Emotions are complex and multifaceted experiences that play a key role in human life. They are intertwined with thoughts, actions and interactions with others, influence decisions and shape personality [1]. In essence, emotions are reactions to certain stimuli, both internal and external, which can be fleeting or long-lasting, subtle or intense [2, 3]. Emotions act as an important communication mechanism that allows us to express needs, feelings and attitudes.

In today's world, where technological progress is unstoppably gaining momentum, understanding and interacting with the emotional sphere of a person become not only important, but also an integral part of everyday life [4, 5]. Emotions guide decisions, influence actions and interaction with the surrounding world. However, emotional state assessment and recognition remain challenging tasks for researchers and developers [6].

It is in this context that neural network technologies prove to be an extremely powerful tool. They allow you to automate the processes of analysis and interpretation of emotions, making this process efficient and accurate. In particular, the use of neural networks to determine a person's emotional state in real time opens up new perspectives in various areas of life [7].

Therefore, as part of the work, the method of determining the emotional state of a person in real time by neural networks tools is proposed, which uses a convolutional neural network and allows detecting 7 basic emotional states of a person with an accuracy of more than 80% for each of the emotions. The scheme of the proposed method is shown in Figure 1.

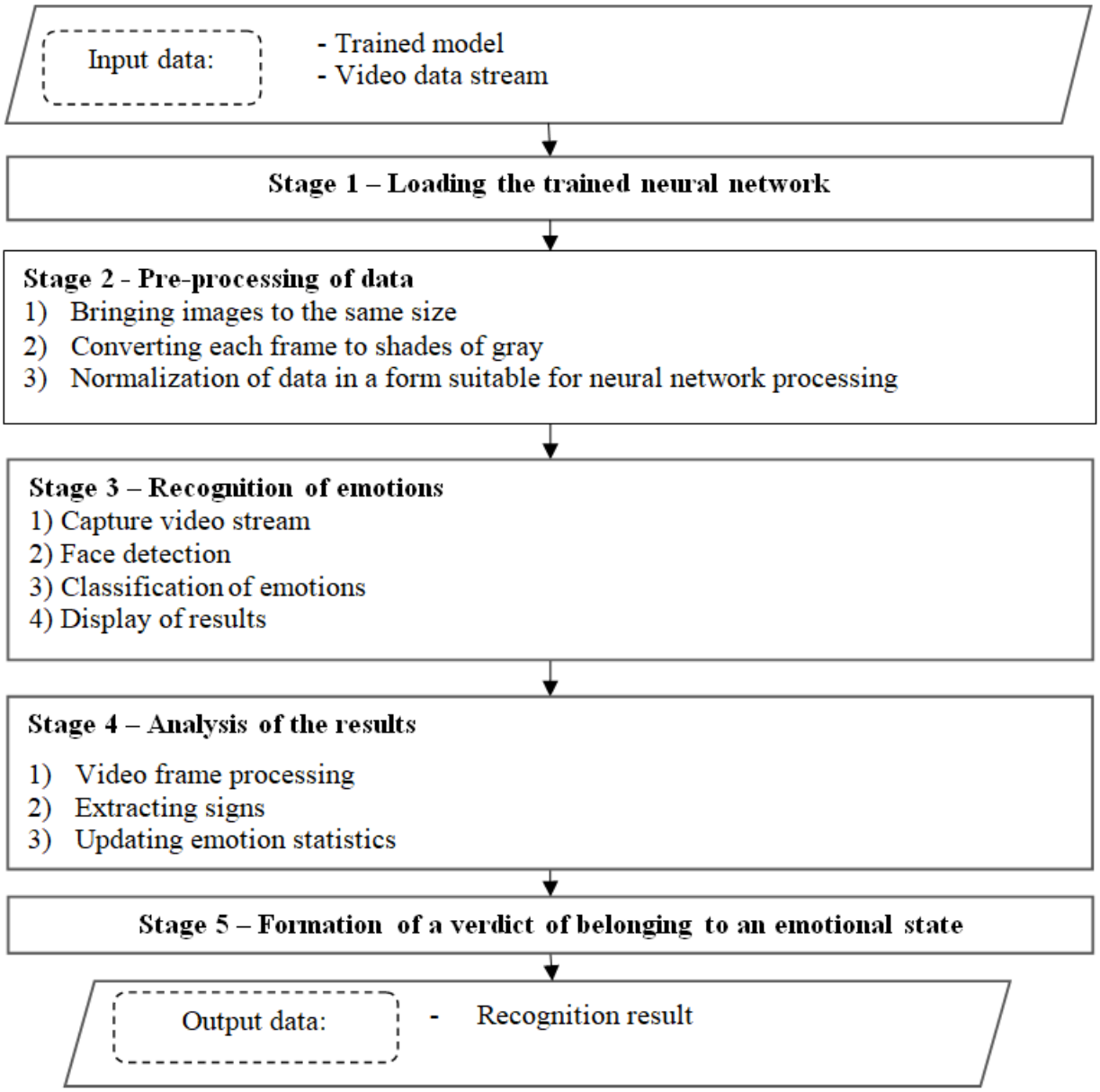

Figure 1. Stages of the method of determining a person's emotional state in real time

A trained model and a video data stream are given as input. At the first stage, the trained neural network, which is saved in HDF5 format, is loaded.

At the second stage, pre-processing of the data takes place, namely bringing the images to the same size, rendering each frame to a gray scale and normalizing the data. Image scaling is used to simplify data processing and analysis, which involves resizing frames to fixed dimensions, allowing images to be processed in the same way regardless of their original dimensions. Grayscale each frame makes the data single-channel, which simplifies further processing and reduces the amount of input data. Data normalization is performed to standardize the range of pixel values from 0 to 1, which helps avoid problems associated with excessively large pixel values and facilitates the model training process.

At the third stage, emotion recognition takes place, which includes capturing the video stream, detecting faces, classifying faces, and displaying the results. Capturing a video stream involves using a webcam to capture a sequence of image frames. Each

frame is a snapshot of the real world that will be analyzed to detect faces and identify emotions. Emotion detection begins by capturing a frame, using a computer vision algorithm to detect faces in it, which involves using face detection algorithms trained on a dataset. Classification of emotions begins with the input of images of faces to the trained model to determine their emotional state. In the next step, the model analyzes the image and assigns a corresponding emotional tag to each face. Displaying the results begins with the preparation of information about the emotional state of each face, which was classified by the model. These results are then displayed on a screen or other output device.

At the fourth stage, there is an analysis of the results, which includes processing the video frame, extracting features, and updating emotion statistics. Video frame processing involves capturing a new frame from a video stream and preprocessing that frame for further analysis. Feature extraction involves using computer vision algorithms to detect faces and determine their features. Updating emotion statistics includes counting the number of different emotions detected in each frame and updating the overall emotion statistics for the entire video stream. At the fifth stage, a verdict on the emotional state is formed.

The output is a recognition result that includes information about a person's emotional state, represented as emotional tags corresponding to emotions such as joy, sadness, anger, disgust, fear, surprise, and standard.

The proposed method allows you to achieve an accuracy of more than 80% for each emotion, the chart of metric values for each emotion is shown in Figure 2.

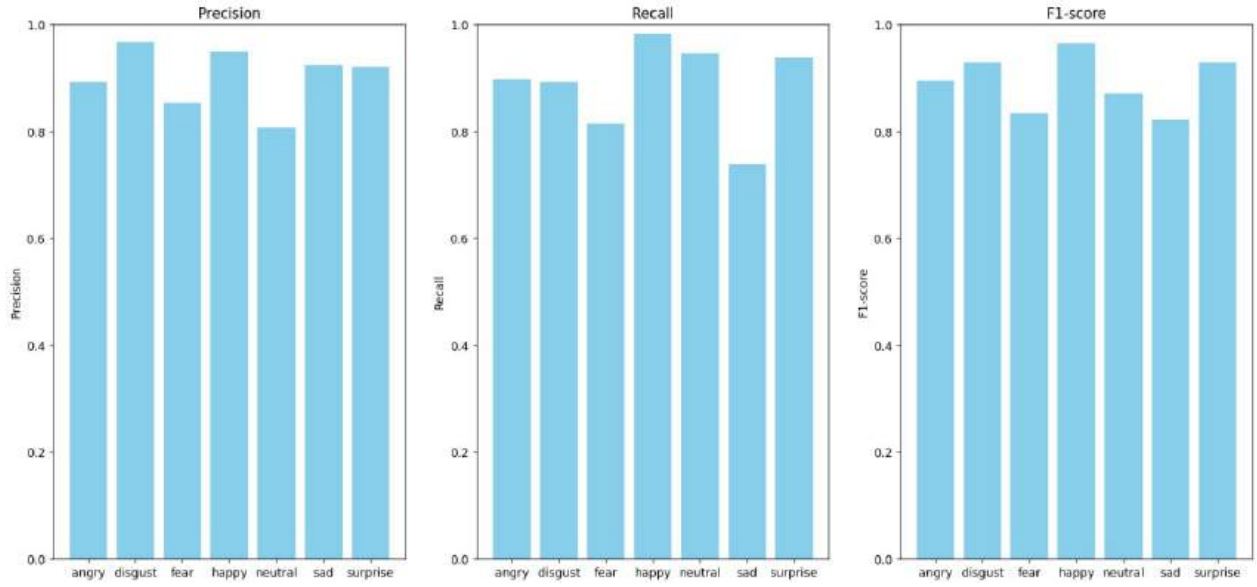

Figure 2. The value of metrics for emotions

As can be seen from Figure 2, the lowest Precision indicator is 0.8 for the neutral emotion, and the highest for the disgust emotion. The confusion matrix for this study is shown in Figure 3.

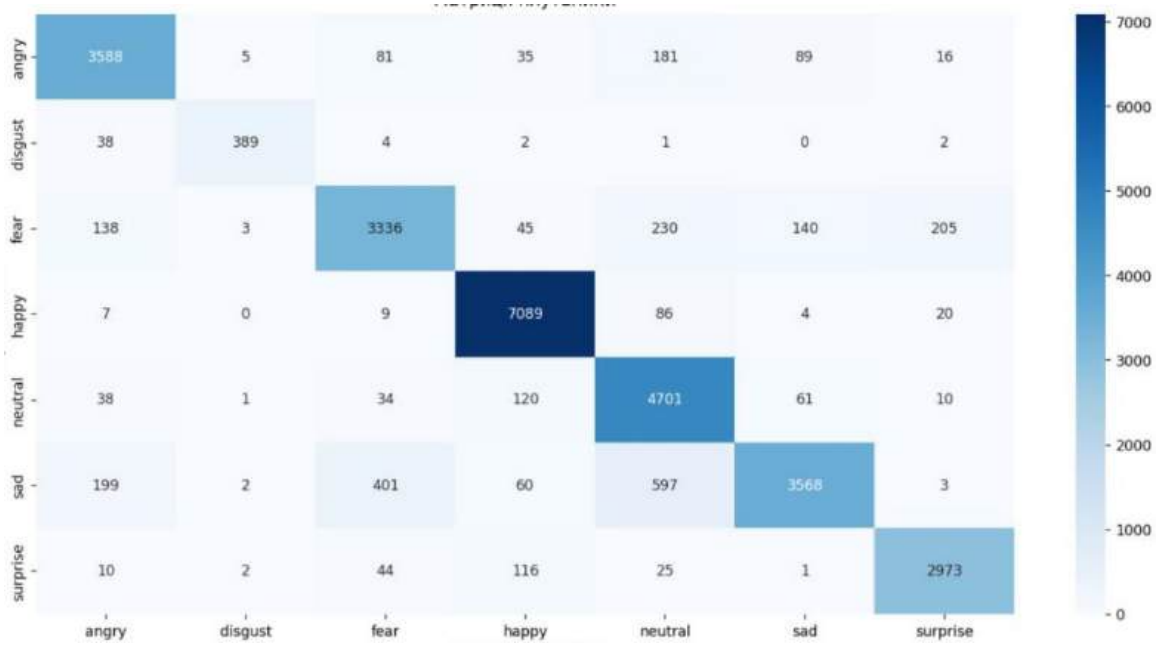

Figure 3. The confusion matrix

The given confusion matrix shows which samples are confused with other emotions to what extent. However, these results are natural, since there are emotions that are similar in their manifestations. As part of the conducted research, application software was also created, which demonstrates the validity of the developed method (Figure 4).

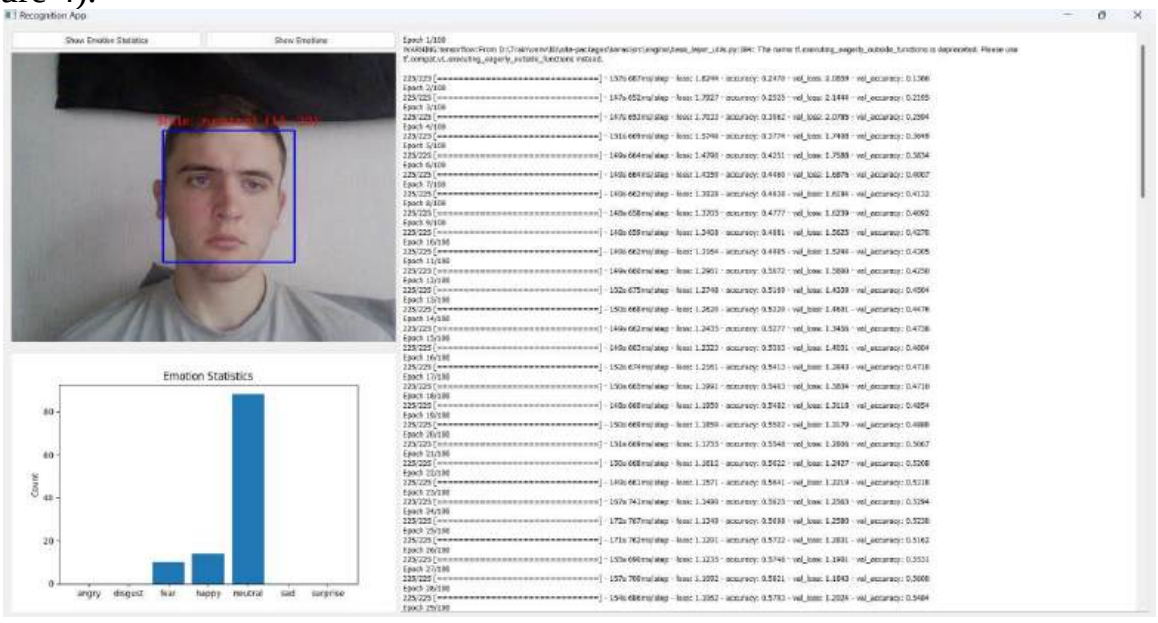

Figure 4. Developed software product

Therefore, a method for determining a person's emotional state in real time by means of neural networks was created, which uses the convolutional architecture of a neural network and allows identifying emotional states with an accuracy of more than 80%.

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МОДЕЛЮВАННЯ РОЗПОВСЮДЖЕННЯ ЗВУКОВИХ ХВИЛЬ У ЗВУЖЕНІЇ ЧВЕРТЬХВИЛЬОВІЙ ТРУБІ TQWT

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Анотація

Моделювання та візуалізація хвиль у середовищі із звуковідбиваючими елементами є ключовим аспектом комп’ютерних наук та обчислювальної математики. У роботі створено алгоритмічну основу для моделювання звукових