Online training of specialists in the energy industry

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Abstract. We considered the psychological and pedagogical problems arising from online learning, especially in a pandemic. Since in these conditions the lecturer's emotional impact on the audience is depleted, the task is to use the achievements of information technologies to find ways to "bring" the audience closer to the lecturer. A computer program has been developed that uses the image recognition function so that in the online learning process the lecturer receives information about the emotional state of the audience directly during classes. The developed program can be used for the practical implementation of the proposed approach.

Key words: Online learning, pandemic conditions, image recognition function, computer program 2A2RAS.

1. Introduction

In recent years, the principles of education in the world community have changed significantly. This was especially noticeable during the Covid-19 pandemic [1-5].

Distance learning has long been practiced in the education system. However, it is far from the same as online learning. During online learning, a student can listen lectures in live broadcast, use interactive tests, exchange files with a teacher, communicates with classmates and teachers in chats, etc. Such learning allows you to fully immerse yourself in the educational environment.

At the same time, the emotional component is lost to a large extent during online learning. However there are specific fields of industry in which specialists should have certain psychological features, for example, operators of nuclear reactor. These features include psychological stability, the rate of reactions and intuition. Thus methodists and educators should look for different ways to bring lecturer and student closer together so that they can better feel each other's emotional reactions. This is a difficult task, and so far no results are visible in this direction.

Recently, pattern recognition methods have become widespread [6]. These methods have been especially successfully applied in medicine. Scientists at the National Human Genome Research Institute (USA) have used facial recognition software to diagnose rare genetic diseases in Africans, Asians and Hispanics. Using face analysis technology, scientists in 96.6% of cases made the correct diagnosis for difficult to identify diseases and different ethnic groups [7]. Since, as mentioned above, with the help of modern methods of pattern recognition, it is possible to analyze the specific features of a person, which makes it possible to assess the internal state of a person, it becomes possible to use this approach to improve the nature of interaction between the teacher and students in online learning.
We solved this problem by using the results of works [8, 9] in which methods for regulating the emotional state of students in the learning process have been developed. These works examine the specific emotions of students, their classification, and methods of correcting them.

The solution to the problem is to use face analysis technologies to determine the emotional state of the audience during the lecture and so that the lecturer constantly receives this information. This approach may well be practically implemented with the further improvement of online learning. One of such additional technologies is described below.

2. Online learning today
Nowadays most of the universities are providing online courses for their students within and off campuses. Online learning has become a logical continuation of distance learning. And the word "online" only indicates the way of acquiring knowledge and communication between the teacher and the student.

Online learning has the capacity to break down barriers that have restricted individuals from an equitable education in the past [10]. However, there is a need for new pedagogical approaches and methodological development. In connection with the spread of COVID-19 pandemic and a self-isolation regime the online learning has become more relevant than ever. All educational institutions have urgently switched to online education. However the online classes are often problematic because there are many problems that need the face to face interaction between teacher and students [11].

We consider the most spread cloud-based online tools for example Video conferencing platforms, Zoom, Microsoft Teams, WebEx Blackboard and Google Hangouts. There are pros and cons in each application, depending on our needs. People try to define factors influencing different aspects of educational environment in e-learning. Authors of [12, 13] conducted semi-structured interviews with e-teachers and e-students to determine the main factors influencing educational level in e-learning environment.

Many online tools have become household names because this technology has been adopted since the outbreak of COVID-19. Using the example of some of widely used platforms for conducting online classes, we see its advantages and disadvantages (see table 1).

The challenge is to be able to obtain the desired quantitative results using the selected technology.

Further investigations will be conducted for choosing the corresponding technology which can be used to complement existing qualitative methods. Taking into account the last achievements in Zoom and similar technologies we can hope on the fast progress in the mentioned directions contributions in the future [14]. Of course, tutors who use Teams for teaching should provide intensive training for colleagues [15]. Tutors need to avoid duplication and set clear parameters for methods of communication. They should make it clear that a certain channel will use a chat as the preferred tool for communicating.

3. Using pattern recognition systems
Face recognition has attracted more and more attention from computer vision researchers in recent years. The face recognition systems are widely used individual frames. This approach gives rise principal difficulties, the main of which is in the following question: "which frames to use for recognition" and "how best to combine information received from different frames ". In general, the scheme of algorithms for recognizing people by face is as follows: 1) detection of the specific face area in the input image; 2) preprocessing of the face image and its geometric identification; 3) construction of a compact description vector [16].

All facial recognition technologies are based on choosing facial parts by help of computer program and obtaining video image. Then the computer program compares the obtain data with previously investigated face pictures from the existed database. These systems carry out analyzing facial features; reveal their positioning and distancing between sets of geometric coordinates. Every person’s ‘face-print’ has unique nature, and it is a complex task to identify geometric properties of a captured face image. However, recently developed algorithms and created programs largely solve the problem.
Table 1. Comparative overview of some of widely used platforms for conducting online classes.

| Advantages and disadvantages online tools | Zoom | Microsoft Teams | Google Hangouts |
|------------------------------------------|------|-----------------|-----------------|
| 1 Stable connection and access from all devices | +   | +    | +   |
| 2 Time limit | 40 minutes | Unlimited | Unlimited |
| 3 Security problems | +   | -    | -   |
| 4 Number of listeners | Host up to 100 people (free plan) | 250 | Free version supports up to 10 members |
| 5 Supported platforms | Mac, Windows, Linux, Android, iOS, Web | Mac, Windows, Linux, Web | Android, IOS, Chrome, Web |
| 6 Screen sharing options | Controlled by Host | Host (can be more than one) | Host |
| 7 File transfer\&volume for an account | 1 Gb | Microsoft 365, 10 Gb per license | Google Drive, 15 Gb free |
| 8 The ability to draw on a special online board during demonstration | +   | +    | +   |
| 9 Integration with other tools | Facebook, YouTube; demonstration of any application with iPhone/iPad | Microsoft 365 | Google Service |
| 10 Broadcast recording | +   | +    | on some paid plans |
| 11 Video quality | 720p | 720p | 720p |
| 12 Access to any content of the working group | +   | +    | +   |
| 13 Breakout Rooms | +   | -    | -   |

Nowadays the corresponding ‘facial detection’ technologies already work. The programs allow fixing facial expressions in order to infer people’s moods, emotions and affective states [17].

It is necessary to create technologies which can be applied to the specific conditions of education process. There are also statistical methods through which facial recognition technologies quantify and frame a student’s face. These works are based on the ‘emotion learning analytics’ that has tried to use facial detection in the learning higher education. Scientists already use a facial detection of ‘academic emotions’ of students (contentment, anxiety, and frustration, satisfaction with the learning content) [18] for improving the learning results.

3.1. New approach in order to improve the system of online learning in pandemic conditions

This paper implements the idea of using image recognition technologies to improve online learning by providing the teacher in the course of classes with continuous information about the emotional state of
To solve this problem, a computer program has been developed in a simplified version in comparison with the existing one, which allows you to apply the method of image recognition in the online education system. For the application of the developed program, a technical solution is proposed, which is illustrated in Fig. 2.

3.2. Computer program and technical realization (2 Axis Automatic Recognition and Aiming System - 2A²RAS)

2A²RAS is a system of algorithms for describing the interaction of a computer program with a person. It is an automatic recognition system. Let us consider how the face hover program works.

The face is critical to a person's identity. This is a feature that best distinguishes a person. Face recognition – interesting and a complex problem, and affects important applications in many areas, including education. The program is designed to track faces in a picture. The algorithm is shown in Fig. 1.

![Algorithm of the 2A²RAS program](image)

The work of the program includes the following stages.

1. A video image is received from a camcorder connected to a computer. The program written in C# is running on a computer. 2. The video image is split into frames and each frame is processed using the open computer vision library Emgu CV. It is a cross-platform library that can be used to practically explore really interesting features from image capturing to character recognition [19-21]. In this article, we focused on the OpenCV wrapper Emgu CV, whose methods can be embedded in a C# program. 3. Using a file containing a set of special functions corresponding to certain parts of the picture (in the case of a person's face, this can be a nose, mouth, lips, eyebrows, etc.), the program converts the picture to black and white, reducing its volume to almost 3 times and breaks the picture into small sections. 4. “Haar Cascades” technology [22] is applied to each area (for example, to find the eyes). If the result coincides by the required percentage with the compared original image, then this part of the picture is determined as the one that the program was looking for. The so-called Haar signs for finding and highlighting objects allow you to find out the position of the face relative to the
camera. The whole system consists of several controlled servo motors, to which the command is sent to turn the video camera so that the recognized face is in the center of the picture. Displays the confidence score for each emotional component. Determining the path to the image in the database and returning the result of emotional perception in the form of a table.

Thus, by sequentially searching for different parts of the face, it is possible to determine the characteristic features of the face and track changes corresponding to different emotions. The mentioned functions are used in the form of matrices to check the picture pixel by pixel.

3.3. Description of technical scheme

![Diagram of the technical scheme](image)

**Figure 2.** Technical scheme of the developed technology for the online educational process.

The figure shows main parts of the proposed 2A²RAS system: a computer with installed Webcam, micro controller, External power supply, Servo motors. Coordinates determined using “Haar Cascades” technology the program sends via the local USB port to the micro controller in format: \{X: x coordinate Y: y coordinate\}. Further, a program written in C++, running on micro controller manipulates the received data, taking out from them the desired coordinates and sends these coordinates to 2 Servo motors, which are connected with micro controller.

**Conclusion**

The use of online learning in the modern educational process, which has become predominant in the context of the pandemic, has led to the emergence of new psychological and pedagogical problems. An important problem is finding ways for improving emotional and psychological contact between the lecturer and students. We have developed a computer program and a scheme for the technical implementation of the approach based on the theory of pattern recognition to provide the lecturer with continuous information about the emotional state of the audience during the lecture.

The developed program and technical implementation of the approach for assessing the emotional state of students in the process of online learning is a simplified version of similar programs used in medical diagnostics. The proposed approach is technically easy to implement, which will improve to a certain extent the interaction of the teacher and students in conditions of online learning.

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