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HUMAN ACTION ANALYSIS IN AUTOMATED ONLINE PROCTORING SYSTEMS

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ANNOTATION. Despite the development of computer vision, the functionality of modern Automated Online Proctoring Systems (OPS) is still quite primitive. This paper presents the additional functionality and requirements for OPS, including human pose analysis functionality, which will allow evaluation of physical activity and monitoring of hygiene requirements during the working process.

Introduction. The availability of devices and the access to the Internet are increasingly developing the field of distance learning and particularly Automated Online Proctoring Systems. However, despite the development of image processing and machine learning, the functionality of modern Proctoring Systems is still at a primitive level. As part of the image processing functionality, they focus entirely on tracking students' faces and do not monitor human poses. Physical activity assessment is needed not only as a part of the learning process, but also to keep students healthy, in accordance with regulations, since they spend the entire learning process in front of computers or other devices when studying remotely. In existing implementations, this process falls entirely on the shoulders of the teacher or even the students themselves, who work through the lesson materials or tests on their own. Lack of such functionality slows down the learning process and is potentially harmful to the students' health in a longer term.

The purpose of the work. The purpose of this paper is to rethink the basic requirements and functionality of Automated Online Proctoring System in the light of current realities, so that more attention can be given to physical activity analysis and the health of the student.

The main part of the work. Distance learning and Automated Online Proctoring Systems are not a new thing, but they have taken a huge leap forward with the COVID-19 epidemic [1]. In the last couple of years, dozens of software products have been developed to help teachers assess remotely the quality of student work (Figure 1).

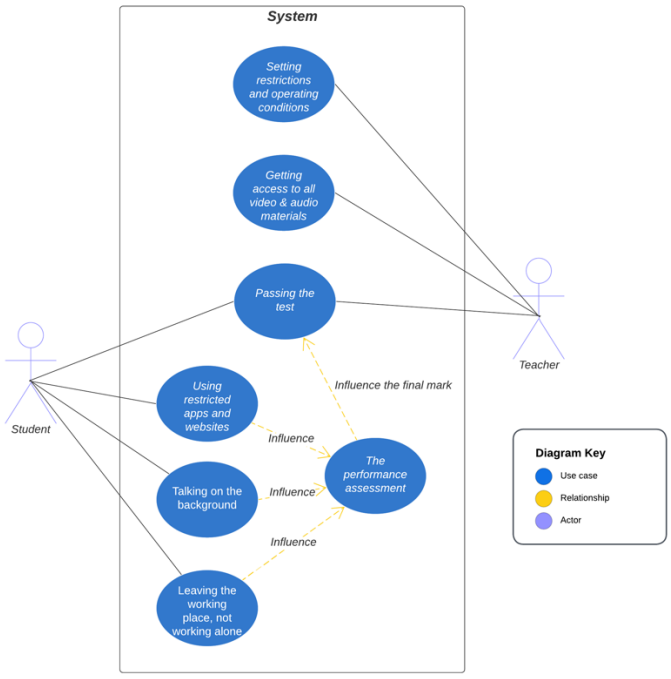

Figure 1 – The Use case diagram of Automated Online Proctoring System

The analysis of existing OPS [2] systems highlighted the following sources of information on student performance:

- computer working place analysis: active window, unverified devices, sites restriction, etc.;
- audio analysis: background noise;

- student's face analysis: checking the student's documents, monitoring the direction in which the student looks, checking that the student is in front of the computer and that no third person is present.

After the test the teacher get access to videos (in some programs it is video of the whole process of working on the assignment, in others only the “suspicious” parts), audio and screen shots that are then attached to the assessment of the student's behaviour and performance.

During the analysis of existing software products, the tracking of "suspicious" student activities was tested. The testing process of video processing was as follows: there were three "exams" and in each exam four "suspicious" actions were performed twice (changing the direction of looking, absence of the student at the desk, presence of third person at the desk, chaotic movements and waving of hands). In total there were 24 test situations per software product.

Table 1 – Comparative characteristics of several Automated OPS

Name/Characteristics	True cheating detections	Integration	Price
Quilgo	25%	Google Forms	50 tests free, up to 35$/month
AI Proctor	30%	A wrapper for other applications	$6 per exam, free trial.
ProctorEdu	25%	No	starts at $6 per exam

As a result, the systems performed well in tracking unwanted switching between desktop windows in all test cases, and an acceptable in audio noise analysis (about 80% responses were detected correctly, there were a few False positives, which is not a critical in scope of OPS). The most problematic part in all the software solutions was the computer vision part: all software products gave a True positive result of only 25-30% cases and False negative in others, which is unacceptable. According to the developers' claim and based on the fact that the teacher receives full video or video clips at the output these systems should process a video stream. But test results show that video sequences are not processed completely, but rather are being sampled at an arbitrary moment in time.

In overall, the analysis of existing software solutions revealed the following common problems:

- a lack of transparency in the handling of customer personal data, which is not in line with the General Data Protection Regulation (GDPR);
- unpredictable performance of the image recognition modules;
- total absence of control over the hygiene requirements for computer usage, which can lead to health problems of students.

Based on the obtained results, it is proposed to introduce additional functionality and requirements for Automated Online Proctoring Systems, which would include mandatory monitoring of student's physical activity (Figure 2).

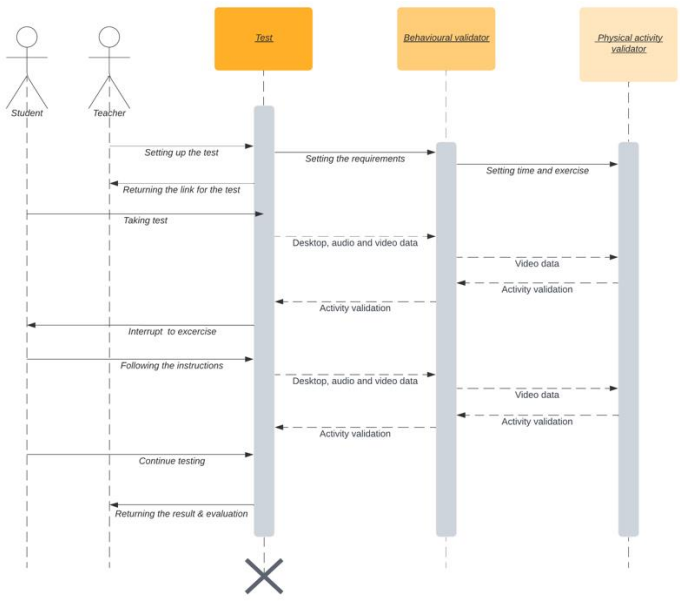

Figure 2 – The Sequence diagram of proposed Automated Online Proctoring System

It is proposed to use "State Sanitary Rules and Norms of Working with Visual Display Terminals of Electronic Calculating Machines DSanPIN 3.3.2.007-98", and more specifically, "Addendum 7" to it, which contains detailed instructions with exercises as a base.

To demonstrate the proposed functionality, an architecture with specified requirements for Automated OPS has been developed (Figure 3). Regarding the usage of the developed system, it is proposed to try introducing it as an add-on for an existing solution such as Google Forms. This will make it easier to work with for both the teacher and the student, as it will eliminate the need to install additional software on the desktop and switch between different software products.

InternVideo-T [3] is proposed as the model for analysing people's actions on video sequences, as it has shown good performance on Action Classification (Kinetics-400 dataset) and Action Recognition (Something-Something V2 dataset): Top-1 Accuracy [4] is equal to 91.1 and 77.2 respectively. The performance of this metric means that the model correctly classified and recognised the action of the object that was detected with the highest probability in 77.2-91.1% cases. In the context of analysing student action, we are not interested in large numbers of people on stage (Easy Crowd Index), so this model is appropriate for the usage.

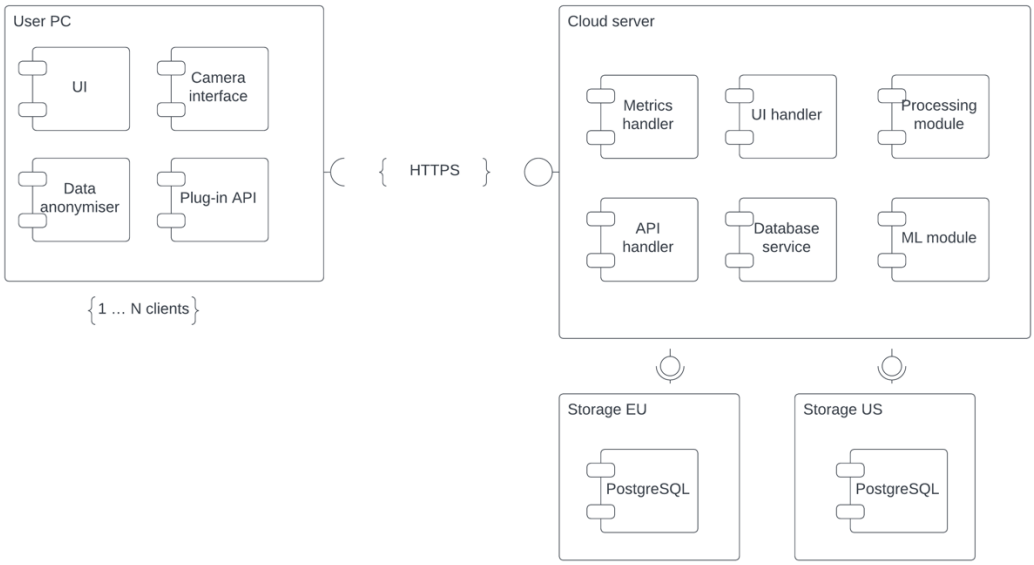

Figure 3 – The UML component diagram of suggested Automated Online Proctoring System

Conclusions. In scope of this work, several different existing software solutions were analyzed, and a bunch of issues were discovered, including data governance issues, performance issues and usability and user experience issues. As a result of this and to improve the current situation, it was suggested that existing OPS requirements should be supplemented with physical activity monitoring functionality. This solution would both improve the process of monitoring the quality of the student's work and reduce the impact of sitting at a computer on the student's health, as prescribed in the official documents on the control of working conditions. It was decided to implement the software product as an addon to an existing solution like Google Forms, in order to reduce the user needs to install additional software. InternVideo-T was proposed as the ML model used to analysis the student's actions, as it showed good performance in classification and recognition process.

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