

Analysis of Approaches to Identity Verification During Knowledge Assessment in E-Learning Systems

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Abstract

The article considers options for implementing proctoring tools in distance learning systems based on information and communication technologies. A comparative analysis of such systems from leading developers in this field was conducted. A classification of approaches was made and a list of functional components providing a solution to the given task was formulated. It was noted that each of the solutions has its positive sides and disadvantages, based on which the requirements for the software for the ATutor e-learning system were formulated.

Keywords¹

proctoring, face recognition, photo fixation, knowledge testing, image recognition algorithms, person identification, CEUR-WS

1. Introduction

Distance learning forms of education have been around for quite some time, but the real surge in their popularity was due to the quarantine restrictions during the COVID-19 pandemic. This rapid development of distance learning technologies happened thanks to the use of modern information and communication technologies, which became its basis. And while the problem with individual assignments was solved more or less quickly, the remote assessment of knowledge by means of testing still raises many questions, starting with the security of personal data and ending with a significant number of opportunities to violate the knowledge assessment procedure.

An important task of developers and users of e-learning systems is the integration of automated means of proctoring into these systems, which would provide effective control over the knowledge assessment procedure. One of the technical components of the proctoring system, designed to solve this problem, are specialized means of identity verification during knowledge testing.

2. Problem formulation

Modern proctoring systems are based on multimedia technical means widely used in distance education. The principle of their operation is commonly as follows: the user connects to the system through a browser, and the system confirms the identity in an automated mode, collects data from the microphone, web camera and, in some cases, from the computer screen during the knowledge assessment. At the same time, the system can automatically decide on access denial to the test or exam if the person recognized through the web camera does not match to the expected person or if they have violated other conditions of passing the test. Also, the collected data is provided for the review by the examiner, who makes final decision.

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Common e-learning systems were initially developed without proctoring tools, and therefore the development of additional modules with proctoring features that would be able to integrate with these learning management systems (Learning management system, LMS) or distance learning systems is relevant. In some cases, integration is possible using a module already created by the system developers, and in others - using API that allows implementing integration on your own.

The goal of this study was to analyze the most widely used technical solutions for identity verification in e-learning systems, to classify the main approaches and to choose the optimal option for use in an e-learning system based on LMS ATutor for an educational institution [1-3].

3. Comparative analysis of known solutions

Next, the most successful solutions to the problem of identity verification during knowledge assessment in distance learning conditions are considered, and their advantages and disadvantages are analyzed.

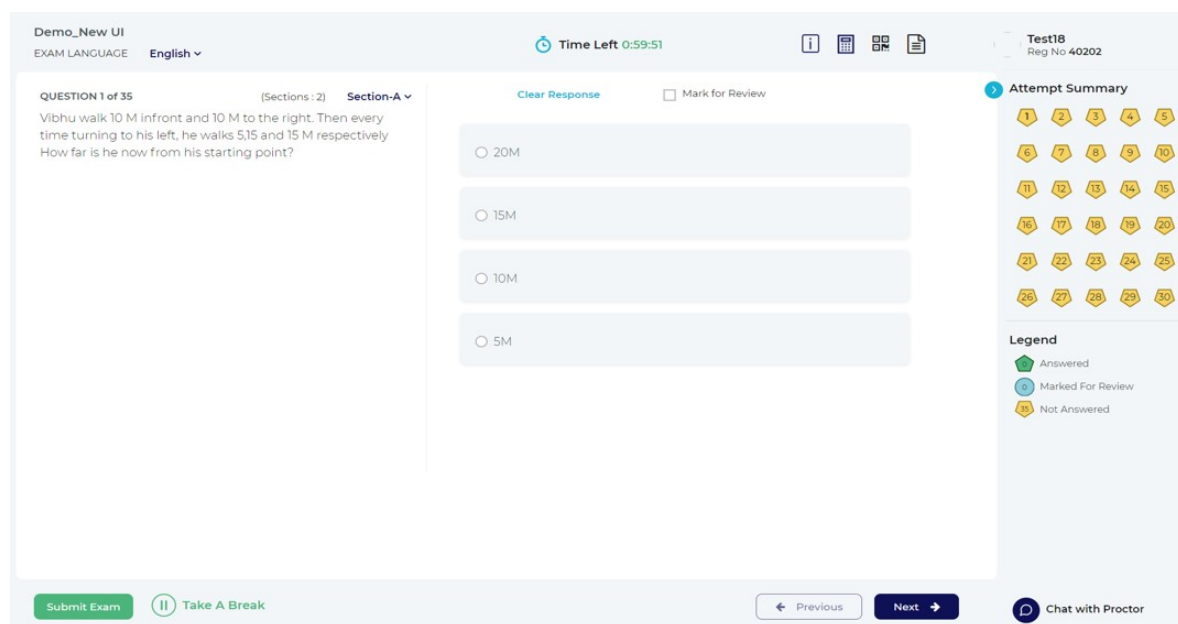


Figure 1. Passing knowledge assessment in ExamOnline

ExamOnline [4,5] is a multifunctional commercial solution for all types of online knowledge assessment - exams and other knowledge assessment forms in educational institutions, qualification exams at work, employee qualification assessment, certification, hiring in the company, etc. (Fig. 1). It is a platform that implements a full range of functions from application management to online examination, result processing and results report generation. Among the advantages: support for two video streams for cameras with a 360-degree view; detection and recognition of faces using artificial intelligence; sound recording from the microphone; Liveness Detection – the system detects if the face is unnatural or does not move at all; Fake Feed Detection – any attempt to transmit a pre-recorded/fake video feed using a browser or a third-party tool is identified by the AI system and registered as a violation; a full report with a recording of the student's actions and an automatic assessment of integrity; detection of human speech in an audio stream; the ability to connect a real human proctor to supervise the process of knowledge assessment; own browser with activity control of other programs in the operating system. Among the disadvantages: the solution is commercial and with closed source code; impossibility of embedding directly into Moodle or ATutor educational material management system, only limited integration with Moodle is available; no integration with LMS ATutor; works only in the Google Chrome browser.

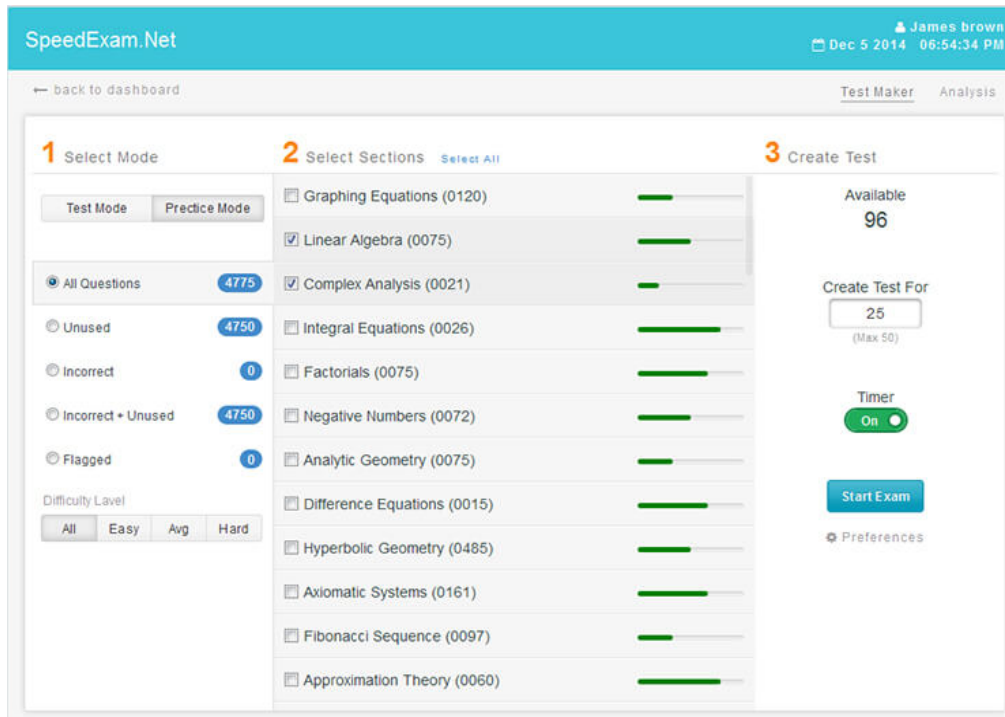


Figure 2. Creating a test in SpeedExam

SpeedExam [6] is versatile commercial online exam software that offers several advanced features such as automated grading and instant reporting. Among the advantages: screen recording; batch import of test questions from Word and Excel format, Certificate Maker – creates the certificate for the student, as well as a detailed analysis of the exams and the student’s performance. Disadvantages: the inability to work directly embedded in the LMS – it is a separate commercial solution that practically does not integrate with the LMSs and requires a separate import of a test questions bank into this system or manual input (Fig. 2).

OES [7] is an automatic proctoring system. This proctoring system is presented by a Kazakh developers. The system fully controls the student's camera, microphone, screen using AI, Computer Vision and other technologies while taking the exam. Among the advantages: high accuracy of face recognition, detection of strangers, as well as noises and voices, detection of the presence of multiple screens, right mouse button blocking, detection of attempts to copy or paste text, works with slow Internet connection and low-end PCs.

The system is able to integrate with such LMSs as Univer, Moodle, Canvas, Indigo, Sirius.

Moodle Proctoring [8] is a LMS Moodle module for identity verification and proctoring that allows users to take web camera photos to identify who is attempting to take a Moodle test. Automatically captures an image every 30 seconds (configurable) and saves it as a PNG file on the server. Also takes screenshots during the test.

Before starting the test, the module asks for permission to access the camera and permission to view the screen. After granting the permission, the user can see image of himself on the screen and start answering questions. At certain intervals, snapshots from the web camera and the screen are sent to the server, so the user can not try to do anything suspicious during assessment. Among the advantages: the solution is completely open (open source), integrates into LMS Moodle, thanks to which it works with the existing bank of test questions and the configured test solution of LMS Moodle; API for external access. By connecting the Amazon Rekognition or Brainstation Facerecognition API, it is possible to enable automatic face recognition. Among the disadvantages: it does not automatically make a decision on granting access to the test on its own - a human is needed to make a decision; there is no native implementation of face recognition algorithms - this function relies on third-party commercial APIs.

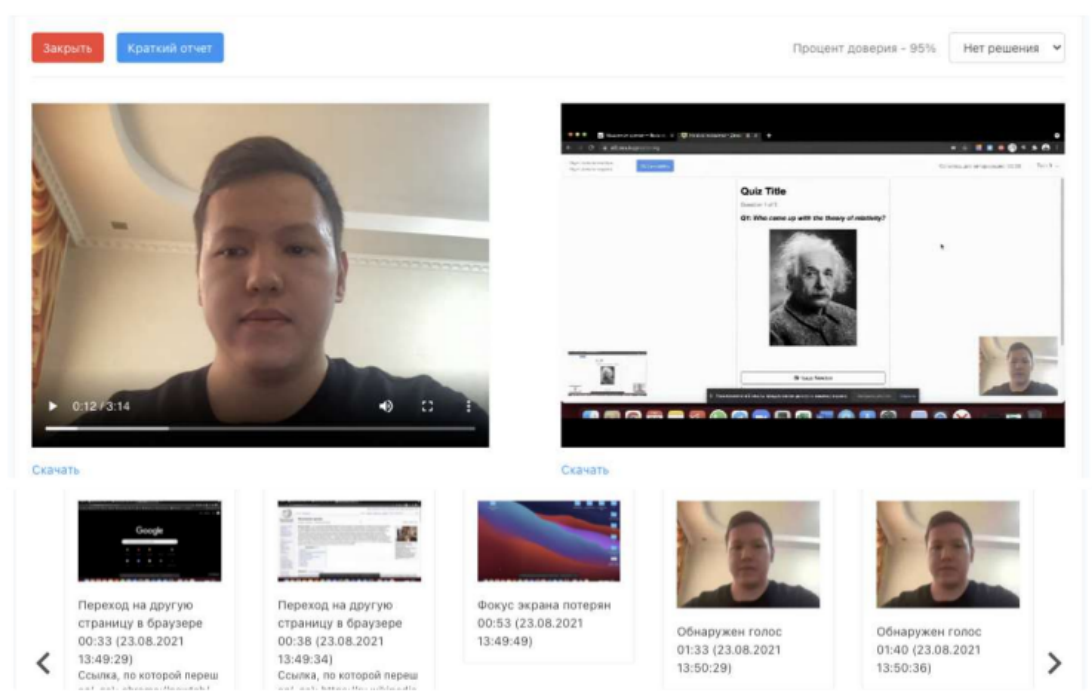


Figure 3. Capturing the image from the webcam and the desktop in OES

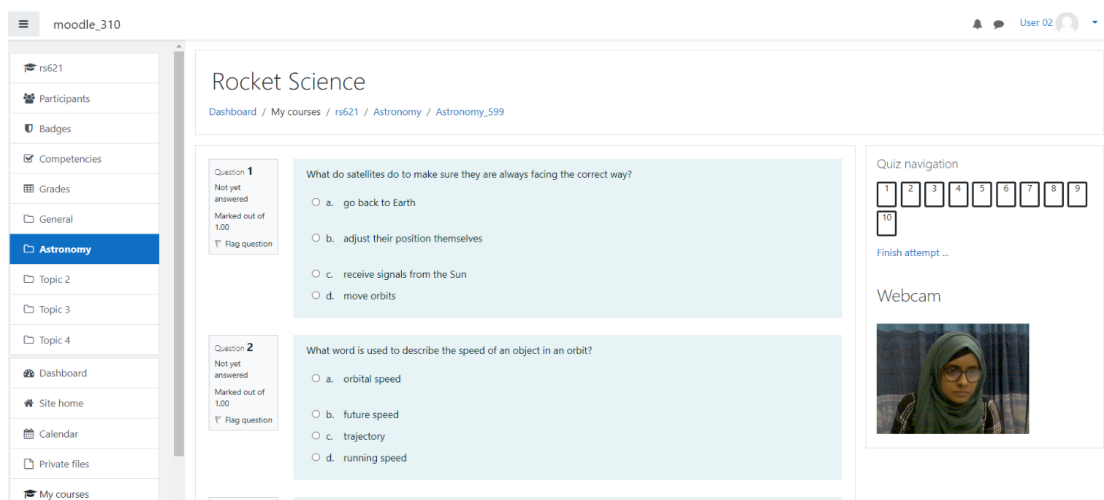


Figure 4. Passing the test using Moodle Proctoring

Proctortrack [9] is also an automatic proctoring system. Often used in many educational institutions around the world. Among the advantages: in addition to face recognition, there is ID card/student card recognition; Knuckle Scans - finger length recognition; the proctoring system is integrated with such LMSs as Sakai, Canvas, Moodle and others. Among the disadvantages, it should be noted: the need for sufficient lighting in the room, as the system may prevent the student from taking the exam.

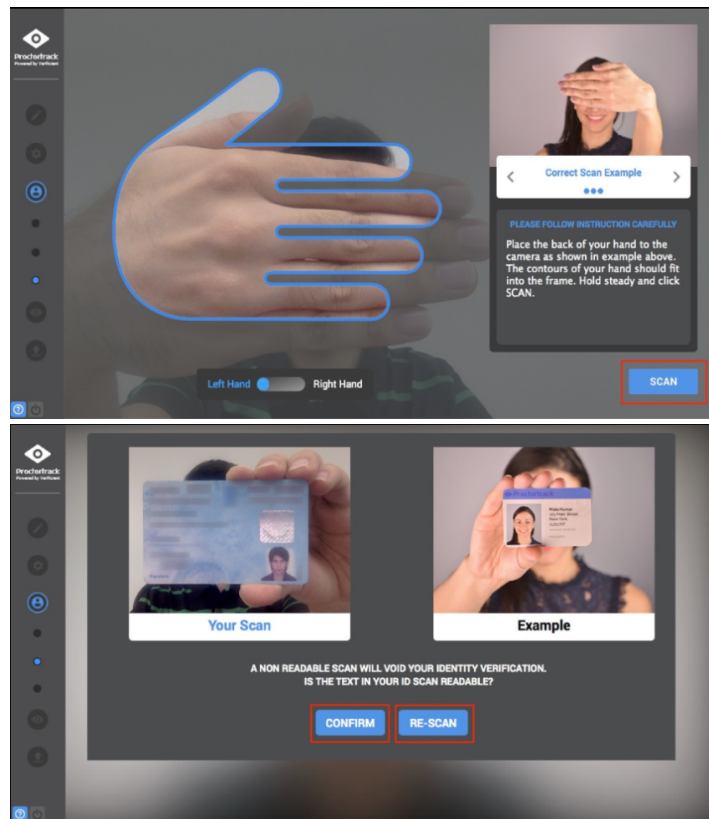


Figure 5. Recognition of finger length and ID card in Proctortrack

Proctorio [10] is a proctoring system characterized by a high degree of information protection. All data collected after the exam is transmitted in encrypted form to the student or the institution. Among the advantages: automated ID verification by a person conducting the test - Automated ID Verification, as well as the same, but by the company's support service - Live ID Verification; Desk Scan – feature for scanning of student’s work setting; detection of plagiarism; protection of the test screen from copying and information distribution to the public; protection to avoid secondary login so that an unauthorized person cannot enter the system after actual student was identified and granted access.

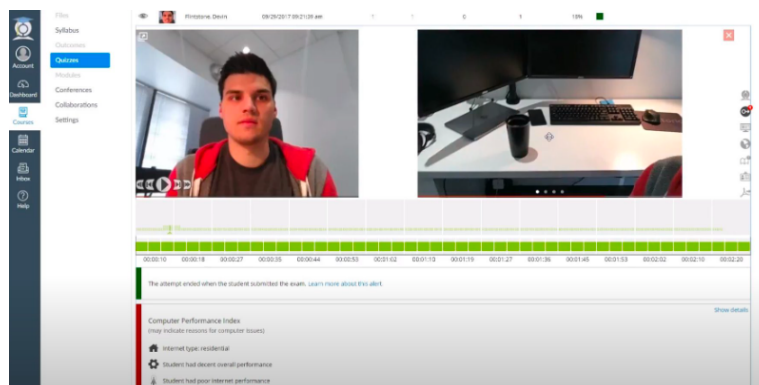


Figure 6. Operation of the Desk Scan feature in Proctorio

4. Conclusion

Based on the results of the analysis of known existing solutions for identity verification during knowledge assessment, the following conclusions can be drawn:

- solutions like OES, Moodle Proctoring, Proctortrack, Proctorio allow to fully integrate them into common electronic learning systems (LMS) to use existing database of test questions and already configured tools for knowledge assessment, the rest do not;

- all solutions except Moodle Proctoring are commercial and closed source, and therefore do not allow any modification, customization and improvement;
- the considered technical solutions do not have the ability of direct integration with LMS ATutor in any way;
- none of the solutions provide a guaranteed high percentage (95% or more) error-free result.

In identity verification, the main task is high-accuracy face recognition, which starts with face detection in an image, which is one of the variations of the general task of object detection. Face recognition can be defined as determining whether a given image contains faces, and if it does, finding the location of each face. Today, there are dozens of computer-based face detection and recognition methods. However, these methods do not provide 100% accuracy and reliability, also at the same time, often have limitations in recognition performance.

Among the main challenges and problems that arise in the implementation of human face recognition algorithms are: insufficient illumination conditions; variable expressions of emotions in the faces; different types of skin tones; varying distances from the camera to the face; varying face orientations; complex background, partial overlapping of faces with glasses, elements of clothing, hands, hair, medical masks, etc., insufficient resolution of video equipment, etc.

All these reasons determine the need for further research, with the aim of developing and implementing a technical solution using AI technologies, which would ensure automatic and effective verification of identity during knowledge assessment in the LMS of an educational institution, which would be based on the use of web technologies and common (including mobile) software and hardware of users that they use on daily basis. The desired solution should have at least 95% accuracy and perform 1 second per identification or better. It also should be able to integrate with LMS ATutor to use its test question database and knowledge assessment tools.

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