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ВИДЕО САПАСЫН ТАЛДАУ ЖӘНЕ ОНЫҢ ОНЛАЙН-ПРОКТОРИНГ ЖҮЙЕСІ ҮШІН БЕТТІ ТАНУҒА ӘСЕРІ

АНАЛИЗ КАЧЕСТВА ВИДЕО И ЕГО ВЛИЯНИЕ НА РАСПОЗНАВАНИЕ ЛИЦ ДЛЯ СИСТЕМЫ ОНЛАЙН-ПРОКТОРИНГА

ANALYSIS OF VIDEO QUALITY AND ITS IMPACT ON FACE RECOGNITION FOR AN ONLINE PROCTORING SYSTEM

Abstract. *Online proctoring is a monitoring tool that instantly recognizes any unlawful behavior both before and during the exam. Three different sources are used for surveillance: audio, video streams, and desktop screen recordings. In general, a proctor, a specifically trained professional who checks to see if the system has made a mistake and looks for violations from students taking the exam, always keeps an eye on the proctoring process. Yet, it is impossible for one individual to monitor more than two people at once, and it is also possible to let fraudulent students sit for the test. Determining how an online proctoring system will be very successful in preventing unfair testing by employing face recognition on video samples is the focus of this paper. The development of a trainable artificial intelligence network makes it possible to employ multiple variables simultaneously. We developed a deep learning technique for automatic face identification as part of this work, employing a convolutional neural network to calculate the difference between a sample and a face in a video. It was typical to employ video samples of various qualities, taken at various distances, from various angles, with various lighting conditions, and with the inclusion of accessories to get more accurate findings. The simulation results showed that, with the exception of the experiment when accessories such as a medical face mask were present, the model we trained accurately predicted the outcome for each sampling criterion. Further examples show the effectiveness of face recognition, also in the quick playback format, the percentage of face recognition reached the minimum threshold (slightly more than 75 %).*

Keywords: *monitoring tool, face recognition, deep learning, convolutional neural network, features.*

Аңдатпа. *Онлайн-прокторинг емтихан алдында да, емтихан кезінде де кез келген заңсыз әрекетті бірден танитын бақылау құралы болып табылады. Бақылау үшін үш түрлі көз пайдаланылады: аудио, бейне ағындары және жұмыс үстелі экранындағы жазбалар. Жалпы алғанда, жүйенің қателік жібергенін тексеретін және емтихан тапсыратын студенттерден заң бұзушылықтарды іздейтін арнайы дайындалған маман проектор, үнемі бақылау процесін қадағалап отырады. Дегенмен, бір адамның бірден екіден көп адамды бақылауы мүмкін емес, сонымен қатар алаяқ студенттерді тестілеуге жіберуге болады. Бейне үлгілерінде бет тану мүмкіндігін қолдану арқылы әділетсіз тестілеудің алдын алуда онлайн-прокторинг жүйесі қаншалықты табысты болатынын анықтау осы жұмыстың басты мақсаты болып табылады. Оқытуға болатын жасанды интеллект желісінің дамуы бірнеше айнымалыларды бір уақытта пайдалануға мүмкіндік береді. Біз осы жұмыстың бөлігі ретінде бейнедегі үлгі мен бет арасындағы айырмашылықты есептеу үшін конволюционды нейрондық желіні қолданып, бетті автоматты түрде анықтауға арналған терең оқыту әдістемесін жасадық. Дәлірек нәтиже алу үшін әртүрлі қашықтықта, әртүрлі бұрыштардан, әртүрлі жарық жағдайларымен және аксессуарларды қосу арқылы түсірілген әртүрлі сападағы бейне үлгілерді пайдалану әдеттегі болды. Модельдеу нәтижелері көрсеткендей,*

медициналық бет маскасы сияқты аксессуарлар болған кезде экспериментті қоспағанда, біз дайындаған модель әрбір іріктеу критерийі үшін нәтижені дәл болжаған. Одан әрі мысалдар бетті тану тиімділігін көрсетеді, сонымен қатар жылдам ойнату пішімінде бетті тану пайызы ең төменгі шекке жетті (75 %-дан артық).

Түйін сөздер: *бақылау құралы, тұлғаны тану, терең оқыту, конволюционды нейрондық желі, мүмкіндіктер.*

Аннотация. *Онлайн-прокторинг – инструмент мониторинга, мгновенно распознающий любое противоправное поведение как до, так и во время экзамена. Для наблюдения используются три разных источника: аудио, видеопотоки и записи экрана рабочего стола. Вообще за процессом прокторинга постоянно следит проктор – специально обученный специалист, который проверяет, не допустила ли система ошибок, и ищет нарушения со стороны студентов, сдающих экзамен. Тем не менее, невозможно, чтобы один человек контролировал более двух человек одновременно, и также возможно, чтобы студенты-мошенники сдавали тест. В центре внимания этой статьи – определение того, насколько успешно система онлайн-прокторинга сможет предотвратить недобросовестное тестирование, используя распознавание лиц на образцах видео. Разработка обучаемой сети искусственного интеллекта позволяет одновременно использовать несколько переменных. В рамках этой работы мы разработали метод глубокого обучения для автоматической идентификации лица, используя сверточные нейронные сети для вычисления разницы между образцом и лицом в видео. Для получения более точных результатов было характерно использовать образцы видео различного качества, снятые с разных расстояний, под разными углами, в различных условиях освещения и с включением аксессуаров. Результаты моделирования показали, что, за исключением эксперимента, когда присутствовали такие аксессуары, как медицинская маска для лица, обученная нами модель точно предсказала результат для каждого критерия выборки. Дальнейшие примеры показывают эффективность распознавания лиц, также в формате быстрого воспроизведения процент распознавания лиц достиг минимального порога (чуть больше 75 %).*

Ключевые слова*: инструмент мониторинга, распознавание лиц, глубокое обучение, сверточная нейронная сеть, особенности.*

Introduction. The application of knowledge is currently advancing at the speed of light. Amazing scientific discoveries are made every week, as well as the development and implementation of numerous initiatives. Many courses and training programs are being launched in this area, however as the student body grows, an express knowledge testing mechanism is required. Testing is one of the techniques used to verify the growth of the substance.

Enrollment in online courses at higher education institutes (HEI) has increased by nearly 4,100% since 2000. Many complementary technologies were developed and introduced during this period of rapid growth. One of these technologies was online proctoring, which was implemented around 2011 as a technique to expand assessment flexibility while maintaining academic integrity. The market for online proctoring is predicted to reach $10 billion in the next five years.

Several proctoring methods, which actively monitor the cameras and microphones of students taking the test, are being used in computer testing to counteract this issue. Do you not think it to be a little boring? Is it possible to follow more than two persons simultaneously? Would a system like that be very successful in preventing biased testing? These concerns are difficult to answer, but based on personal experience, it is safe to claim that the human aspect itself prohibits reliable testing and consistent control.

A proctor today is someone who examines the exam video to check the validity of the proctoring program's comments and, maybe, spot any new violations while employing electronic control systems to monitor the exam process. One of the main personnel who directly affects each examiner's outcomes is the proctor. These suggestions might affect the university's choice about the applicant's acceptance or evaluation. Because of this, candidates for the job of proctor must go through a rigorous selection process, and the system of control over their behavior by businesses that offer proctoring services has been developed by special rules. In any event, the article needs to ask about work while evaluating their claim. A technique developed by Chua et

al. employs tab locking and address bank randomization to spot and stop cheating [2]. Pandey et al. [3] created E-Parakh, a technique for proctoring online exams that can only be used with mobile devices. Slusky [4] looks at a variety of cyber-security issues involving online proctoring services. The article examines challenge-response, biometrics (voice and facial recognition), and blockchain technology as multifactor authentication and authorisation strategies. The discussion of operational controls includes the use of lockdown browsers, webcam location of extortion behavioral signs, end-point security, VPN and VM, screen-sharing and keyboard tuning in programs, specialized controls to relieve the absence of spatial (physical range) controls, compliance with directions (GDPR), and so on. Alessio et al. investigate the influence of proctoring on student performance in their study [5].

Online proctoring is a control mechanism for online tests or testing in which the entire process is overseen by an administrator - a proctor [6]. He uses a webcam to monitor the subject's activity and see what is going on. This invention allows you to confirm the candidate's personality, objectively review his information, and avoid deception sheets and other traps within the exam. In this situation, the subject and proctor could be in different regions of the world. Proctoring prevents students from being drawn into the preparation center because of tests. Since the proctor is not an examiner, but rather an independent person. He does not participate in the instructional preparation, but rather takes a test and ensures that he passes all of the rules. A proctor can be a specially trained professional or a free examiner from another educational body or a private enterprise. Despite his abilities, the proctor may fail to keep track of infringement at times.

Most institutions employ online proctoring, which is a human tracking method. Yet, there are computer tracking systems as well as a human with a computer. Hussein et al. [7] identify the following proctoring characteristics:

– Synchronous proctoring with a human. An online or external proctor, an employee, or a properly qualified staff member monitors the exam in real time. The test taker's activity is captured in two ways: the student is recorded via their web camera, and the system records the student's desktop (computer screen). The proctor checks the student's identity (by checking their passport) before the exam, and the proctor can contact the student throughout the exam via the system chat window. A single proctor oversees the tests of up to six pupils at once.

– Asynchronous proctoring with post-validation. The computer program completes the student identity verification process and observes the entire exam process via the student's camera. By adding tags to the video, the computer detects suspicious behavior (such as the appearance of additional people in the frame or talking). When a human proctor watches the recording, they look for flagged instances.

– Automatic proctoring. Tracking of all student actions, as well as cancellation, recording of infringement, and all incidents that have occurred, occurs organically without the assistance of individuals. This method of proctoring is the least expensive, but AI is still not flawless and cannot provide a precise assessment of the subjects' activity.

Literature review and problem statement. Using computer vision, the face recognition system can automate access to protected objects. The construction of a database for those with access to the object is a key role in such a system. In this case, the construction of a database of people who have access to the working item is critical in such a system. The major component approach for implementing the facial recognition process is proposed in W. Yan Min’s work [8]. The method allows you to reduce the dimensionality of your data while losing the least amount of relevant information. It is used to detect faces, generate a database of faces, and test the recognition results. Face recognition could be an innovation that permits you to automatically identify (discover out who is within the photo) or verify (affirm that usually a confront within

the photo) of an individual in a photo, video or live. For recognition, neural networks are used that can peruse and analyze the interesting highlights of a human face, and after that compare them with the base. The primary tests in machine face recognition were displayed within the 1960s by Woody Bledsoe, a professor at the University of Texas at Austin, an AI researcher. His working bunch made a database of 800 pictures of individuals from diverse points. The researchers at that point checked the faces with 46 arrange focuses employing a model present day tablet. Employing a extraordinary algorithm, the system turned faces at diverse points, zoomed in and out. Within the moment step, the algorithm used 22 estimations, acting on Bayesian choice hypothesis, to create the generally conclusion as exact as conceivable. As a result, Bledsoe's system was 100 times quicker than a human. In 1988, Michael Kirby and Lawrence Sirovich at Brown University connected the Eigenface approach utilizing linear algebra to image analysis. They utilized less than 100 different meanings to allude to faces. In 1991, Alex Pentland and Matthew Turk at MIT progressed the Eigenfaces technology to include environmental variables. They oversee to computerize the recognition process. Within the late 1990s, the US Division of Defense Progressed Research Projects Office (DAPRA) and the National Organized of Guidelines and Innovation released the FERET program with the broadest database of faces - more than 14 thousand images. At first, it was utilized to look and recognize offenders around the world, but at that point it was presented to the public. Since 2010, Facebook has been utilizing facial recognition to find users in posted photographs and offer to tag them. In 2011, the specialists of Panama and the Joined together States propelled a joint FaceFirst venture. Typically, facial recognition technology that was utilized to break down on illegal exercises at Tocumen Airplane terminal in Panama. That same year, US police and intelligence offices started utilizing facial recognition to identify corpses, counting those of Osama bin Laden. Since 2014, face recognition has been utilized in portable phone cameras, and since 2017 in retail [9]. The accuracy of face recognition by neural networks increased 50 times between 2016 and 2020, with an error rate of 0.8%. According to the 2019 Facial Recognition Market Research, the worldwide facial recognition market was esteemed at $3.2 billion. The forecast for 2024 is $7 billion, with a yearly development of 16%. The biggest developments in face recognition come from Microsoft (GAFAM), Apple, Amazon, Facebook, and Google. In 2014, Facebook launched DeepFace, a service that decides whether two shot faces have a place to the same person with 97.25% accuracy. In 2015, Google presented its development - FaceNet. Thanks to the huge amount of information that Google services collect, FaceNet has accomplished a record accuracy of 99.63%. Google Photos uses this technology to sort images and, as a result, tag people in them. Since 2018, Amazon has been effectively advancing its cloud-based facial recognition service Recognition, which is utilized by US law authorization agencies. The system can recognize up to 100 people in a single photo and search for them in databases containing tens of millions of faces. According to the Center for Strategic and International Studies, as well as the Office of Science and Technology of the US Department of the Interior, FRT was recognized as the most excellent solution of 2020 with a recognition accuracy of 99.97% [7]. I.V. Yurko and V.N. Aldobaeva in their work investigated and gave suggestions for improving the work of face recognition methods to increase the optimal ratio of recognition efficiency and computing power under the influence of external factors such as noise, distance to the object, light level and other factors [10]. A.A. Sukmandhani and I. Suteja conducted a series of tests to determine the degree of accuracy of the presentation and the length of the testing process using the Emgu CV cross-platform image processing library and Eigenface machine learning method, as well as the accuracy of the face recognition program using the own face method for the test samples. In case the students pass the approval accurately, exam questions will show up and the students will pass the exam [11].

It is worth considering that now there are many types and systems for recognition and identification of a person's face. But very few systems can recognize poor video/image quality with different criteria.

Our model and our experiment can be used in other studies, such as cardiology, pulmonology, etc., since data on these diseases are similarly studied during screening, using video recordings of certain places and through their segmentation, which is impossible not to note [12-14].

The following tasks were included in the effort to help accomplish this goal: 1. Review of the literature on this topic; 2. Collection of biometric indicators; 3. Study of the verification method based on biometric indicators; 4. Development of a client verification method based on biometric indicators; 5. Run and test the method.

The purpose and objectives of the research. The study's goal is to analyze video samples based on many criteria for inspecting, admitting, and passing the student's test / exam via the online proctoring system. The epidemic provided a great opportunity to "switch" education to a distance format, but it was the forced transfer of the process to online that highlighted teachers', students', and the entire education system's unpreparedness for this [15]. It also allowed attention to be focused on other matters, such as verifying with the dealer. We have a lot of powerful tools to accomplish these kinds of tasks with amazing features thanks to the state of the art in ML [16] and computer vision... You don't have to reinvent the wheel; you just have to know how to use it to improve your car.

The benefits of this work include the ability to prevent the student from being replaced by another person, mark his personal visit, and allow him to pass the exam by applying machine learning algorithms for student verification. Furthermore, in contrast to prior deep learning-based approaches given in the literature review, we aimed to construct a model that analyzes every criterion at once and delivers good verification results.

Materials and methods of research. This article describes a deep learning architecture for face recognition that uses the basic architecture to combine the concepts of machine learning and image categorization. 100 pictures and 40 video samples were used to train the CNN model. As a result, the proposed system offers an effective categorization model for identifying a person. Those aged 20 to 30 who can be called students, master's students, or doctorate students are the research materials.

Dataset. Following a review of numerous research, it was chosen to employ a deep learning algorithm as a face recognition parameter, which can take an input image, give relevance (trainable weights and biases) to different areas/objects in the image, and identify one from another. The experiment used photos from videos of varying quality captured on several devices. On Figure 1, samples were taken at various distances, from various sides of the screen, in accelerated mode, with various lighting and accessories.

a

b

Figure 1. Samples, a) images; b) photo, video with criteria (from left to right: different quality, with accessories, from different sides of the screen, at different distances, with different lighting)

Data preparation. Photo and video samples of various quality and from various devices were taken for the experiment, including iPhone 12 pro max: 500x620 pixels (with distortion), 1080x1920, 2316x3088, 2160x3840, 1080x1706, 1080x1270, on a MacBook with a quality of 1440x960 pixels, and an Ultrabook ASUS VivoBook Flip TP401MA with 1280x720 pixels. Video samples were also collected using the following criteria: with headgear, with a medical mask, from close and long distances, with different forms of illumination, and from different sides of the screen. As a result, we used 80% of the dataset for training and 20% for testing our model.

CNN architecture. In this study, the CNN was illustrated utilizing an input layer, a convolution layer, a max pooling layer, a fully connected layer, and an output layer. As a trigger measure to assess the likelihood of an exit, a sigmoid sort prediction was developed, which should yield a result in the range of (false) to 1. (true). A graphic representation of the CNN readings utilized in this investigation. As input for the experiment, an image was employed. The convolutional layer is made up of 32 filters that pass the bit measure as a 7x7 tuple. The filter is then moved one pixel to the right, reapplied to the input volume, and run until it reaches the farthest right restraint of the volume in which the filter moves. The next step in the process is to apply bunch normalization. Max Pooling was coupled to reduce the spatial measurements of the yield volume. Upon the conclusion of the operation, the show will conduct the functions of information enactment. The size of the input image is lowered to lessen the measure of the biggest pool. The feature map is then blended and smoothed. Smoothing converts the lattice into a one-column vector that is handled by a fully associated layer.

As a result, we developed a CNN model for facial picture identification. The number of neurons in it as well as the number of convolutional layers can all be increased or decreased. It goes without saying that the demonstration becomes slower the more layers or neurons you include. However, once you have many images, say 50 KB or more, the portable workstation processor might not be able to process so many images [17], or when applying the computation to video, performance suffers significantly, and strong GPUs are needed to operate effectively. You'll need to make use of cloud management systems like AWS or Google Cloud.

Results and discussion. We employed 80 pictures and 60 video samples for training and assessment. We additionally divided these images for testing and training into 80% for training and 20% for aspect ratio testing. The model uses 500x620 pixels (with distortion), 1080x1920 pixels, 2316x3088 pixels, 2160x3840 pixels, 1080x1706 pixels, 1080x1270 pixels, 1440x960 pixels, and 1280x720 pixels. We got a maximum training accuracy of 92.62% after training the model with a test size of up to 118 frames acquired from a 1080x1920 HD video sample in a dimly lit setting.

There is a difference between testing samples and actual footage when compared to testing samples. As illustrated in Figure 2, the difference spans from 40 to 50%. However, the face de-

tection accuracy is set to a tolerance of 60%. The model was able to recognize faces in films with high accuracy and shown that higher quality samples and movies improve identification scores, but it has a significant impact on recognition time and requires a more powerful system to handle on time feed.

```
Loading known faces...
Faces are encoded!
, found 1 face(s)
 - Alikhan([0.43545714 0.34965983]) from [True, True]
, found 1 face(s)
 - Alikhan([0.5042045  0.39281215]) from [True, True]
, found 1 face(s)
```

Figure 2. Test results

Notably, studies were successfully performed in accordance with all criteria while investigating models with species from different categories, except for the presence of animals wearing medical masks because of the lack of symptoms. The model passed face recognition tests up to a distance with ease when the video sample from various distances was likewise tested at that distance. The computed difference between the sample and the subject's face in the video was 44%. The estimate of the sample's and the face's differences in the video was 29%, as shown in Figure 3, due to the distorted quality of the video sample.

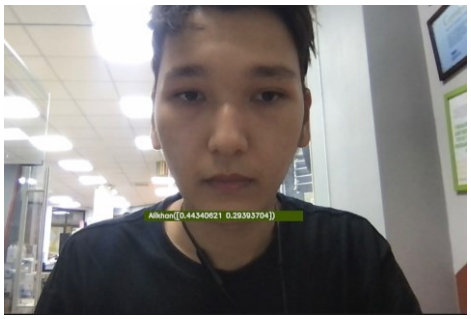

Figure 3. Difference between the sample and the face

Conclusion. A proctor oversees the full process of online proctoring, which is a control mechanism for online tests or testing [7]. Using a webcam, it keeps an eye on the subject's movements and observes what is happening. As was already noted, a proctor can be a qualified specialist, an independent teacher from another educational institution, or a representative of a commercial business. Despite his powers, the proctor occasionally fails to record transgressions. The advantages of this strategy include the use of machine learning to verify a student's identification, the ability to stop a student from being substituted by another person, the marking of his personal visit, and the ability for him to pass the exam. The novelty of the work also resides in the fact that we attempted to develop a model that takes into account every criterion simultaneously and provides strong validation results, in contrast to previous deep learning approaches outlined in the literature review. Using all these training criteria, we got results of 9% efficiency, 44% video sample deviation measurement, and 29% distorted quality measurement, which demonstrates a not entirely successful outcome of the experiment. But the percentage of face recognition in the quick playback format met the required level (a little more than 75%). In the next work, we will try to improve the method and the corresponding results of the study, as well as calculate the maximum face recognition distance.

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