**\*\*Review of Related Literature\*\***

# **An Incremental Training on Deep Learning Face Recognition for M-Learning Online Exam Proctoring**

The emergence of m-learning, facilitated by the widespread availability of academic resources online, has significantly transformed distance education, enabling remote students to access educational materials and engage in academic activities through their devices. As part of this shift, online exams have become integral tools for assessing students' comprehension of course materials in remote education settings. However, ensuring the integrity of these exams poses a significant challenge, necessitating the implementation of effective proctoring methods to detect and deter cheating behaviors.

Various approaches have been proposed to address the need for proctoring during online exams, ranging from no-proctoring exams to automated online supervision systems. One essential aspect of proctoring is visual verification, which verifies that the student taking the exam is indeed the authorized individual. To achieve this, methods such as Convolutional Neural Network-based Facial Recognition (CNN-FR) have been employed. However, a notable challenge in facial recognition systems is their vulnerability to variations in pose and lighting conditions, which can affect recognition accuracy.

To address these challenges, researchers have explored additional processes such as image equalization and the use of Speeded Up Robust Features (SURF) to enhance facial recognition performance. In a recent study, an innovative approach involving incremental training in facial recognition training was proposed. This incremental training process aims to eliminate the need for additional preprocessing steps, thereby reducing computational costs and processing time.

The study conducted a comprehensive evaluation of four different face detection methods: Haar-cascade, Local Binary Patterns (LBP), Multi-Task Cascaded Convolutional Networks (MTCNN), and YOLO-face. Additionally, a Facenet model was tested for face recognition purposes. The results of the evaluation demonstrated that deep learning-based face detectors, particularly YOLO-face, outperformed other methods. Moreover, the incremental training approach resulted in a smaller dataset size and faster training times compared to batch training methods. Despite these optimizations, the proposed method achieved an equally high accuracy rate of 98% compared to batch training.

This research, published in the 2021 IEEE Asia Pacific Conference on Wireless and Mobile (APWiMob), highlights the significance of incorporating advanced technologies such as deep learning and facial recognition in addressing the challenges of online proctoring. By enhancing the efficiency and accuracy of proctoring methods, such as through incremental training processes, educators can better ensure the integrity of online exams in remote education environments.

\*\*Reference:\*\*

- A. H. S. Ganidisastra, Y. Bandung, "Incremental Training Process on Face Recognition Training for Online Exam Proctoring," 2021 IEEE Asia Pacific Conference on Wireless and Mobile (APWiMob), Bandung, Indonesia, 2021, pp. 1-6, doi: 10.1109/APWiMob51111.2021.9435232.

**\*\*Review of Related Literature\*\***

**2)Face Recognition Based on LBP Algorithm**

The paper explores advancements in face recognition technology, focusing on the classical Local Binary Pattern (LBP) algorithm and proposing improvements to enhance its effectiveness. The LBP algorithm, a non-parametric approach to face recognition, characterizes local features by analyzing the grayscale relations between feature pixels and surrounding pixels in an image. It serves as an efficient method for texture description, capturing natural surface features of objects without being affected by changes in lighting conditions.

One of the main challenges addressed in the study is the deficiency of the original LBP algorithm in terms of rotation invariance, particularly in recognizing faces with small poses. To overcome this limitation, the authors propose a novel "double circle" LBP algorithm, which significantly improves rotation invariance and demonstrates superior recognition performance on faces with small poses.

Building upon the success of LBP-based partitioning methods in recognizing facial features, the paper introduces the concept of "multiple partitioning + intermediate partitioning." This approach effectively complements the original segmentation line by extracting peripheral information more comprehensively, leading to improved feature extraction and recognition accuracy.

Recognizing the importance of different facial organs in image recognition, the study proposes the idea of "key block" based on the original block. This concept emphasizes the selective contribution of specific facial regions to overall face image recognition, further enhancing the discrimination and robustness of the recognition system.

Finally, the paper exemplifies the application of the improved LBP algorithm in face recognition, particularly in scenarios involving weak lighting conditions and facial expression changes. Experimental results validate the reliability and effectiveness of the proposed method, highlighting its potential for practical implementation in real-world scenarios.

This research, presented at the 2020 International Conference on Computer Network, Electronic and Automation (ICCNEA), underscores the continuous efforts to enhance face recognition algorithms and their applications in diverse environments. By addressing key challenges and proposing innovative solutions, such as the "double circle" LBP algorithm and the concept of "key block," the study contributes to advancing the state-of-the-art in face recognition technology.

\*\*Reference:\*\*

- Y. Tao and Y. He, "Advancements in Face Recognition Technology: Enhancements to the Local Binary Pattern Algorithm," 2020 International Conference on Computer Network, Electronic and Automation (ICCNEA), Xi'an, China, 2020, pp. 1-6, doi: 10.1109/ICCNEA50255.2020.00015.

**3)\*\*Review of Related Literature: YOLO-face: A Real-time Face Detector\*\***

Face detection plays a crucial role in various applications, serving as the initial step for pattern recognition and identity authentication. With the rapid advancement of deep learning-based algorithms in object detection, there has been a notable progression in the accuracy and efficiency of face detection systems. In recent years, two main categories of object detection algorithms have emerged: two-stage detectors, such as Faster R-CNN, and one-stage detectors, exemplified by YOLO (You Only Look Once).

While two-stage detectors often excel in accuracy, one-stage detectors like YOLO offer significantly faster processing speeds. However, traditional YOLO models face challenges when detecting small objects or objects with large-scale variations, such as faces. To address these limitations and enhance face detection performance, Weijun Chen et al. propose a novel face detector named YOLO-face, based on the YOLOv3 architecture.

The YOLO-face detector introduces several key improvements to optimize face detection accuracy and speed. Firstly, it adopts anchor boxes specifically designed for face detection, thereby enhancing the model's ability to detect faces of varying sizes. Additionally, the detector incorporates a more precise regression loss function to improve localization accuracy.

Experimental evaluations conducted on benchmark datasets, including WIDER FACE and FDDB, demonstrate the superior performance of the proposed YOLO-face detector compared to traditional YOLO models and their variants. The improved algorithm achieves notable gains in accuracy while maintaining fast detection speeds, making it well-suited for real-time face detection applications.

This research, published in \*The Visual Computer\*, represents a significant advancement in real-time face detection technology. By addressing the challenges associated with varying face scales and optimizing the YOLO framework for face detection, the YOLO-face detector offers practical solutions for a wide range of applications, including surveillance, security, and facial recognition systems.

\*\*Reference:\*\*

- Chen, W., Huang, H., Peng, S., Zhou, C., & Zhang, C. (2021). YOLO-face: A Real-time Face Detector. \*The Visual Computer\*, 37(3), 805–813. DOI: [10.1007/s00371-020-01941-x](https://doi.org/10.1007/s00371-020-01941-x)

Review of Related Literature: Face Recognition based Automated Remote Proctoring Platform

Online education has witnessed a significant surge in popularity, prompting schools and universities worldwide to adopt online teaching methods and proctored exams. However, conducting exams remotely poses challenges, particularly regarding ensuring exam integrity. Common malpractices during online exams, such as switching between tabs, deviating from the webcam, using mobile devices, and involving multiple persons, undermine the integrity of the assessment process.

To address these challenges, integrating technologies such as face detection, object detection, face recognition, and tab locking mechanisms using secure browsers into a unified platform can help mitigate malpractices. By leveraging various methodologies, an effective online proctoring platform can be developed to conduct exams seamlessly and securely, benefiting both students and examiners.

Automated online proctoring serves as a bridge between education stakeholders, facilitating fair and transparent assessment processes. Over time, online proctoring has evolved into a sophisticated software tool that aids examiners in conducting exams across various domains, including education, hiring, company certification exams, and competitive exams.

This paper, presented at the 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), highlights the significance of automated online proctoring platforms in modern education. Authored by Sasikala N, B. Meenakshi Sundaram, Vishal Nikhil Kumar, Sumanth J, and Hrithik S from New Horizon College of Engineering, Bangalore, India, the study underscores the importance of leveraging technology to ensure the integrity of online assessments and examinations.

The proposed face recognition-based automated remote proctoring platform represents a practical solution to the challenges associated with conducting exams remotely. By integrating advanced technologies and methodologies, such a platform can enhance the credibility and fairness of online assessments, fostering trust and confidence in the online education ecosystem.

Reference:

Sasikala N, B. Meenakshi Sundaram, Vishal Nikhil Kumar, Sumanth J, Hrithik S. "Face Recognition based Automated Remote Proctoring Platform." In: 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), Coimbatore, India, 2022, pp. 1-6, doi: 10.1109/ICAIS53314.2022.9743134.

1. **Facial recognition and open camera while taking the exam (Foreign, 2022)**

**Title: Proctor Ex: An Automated Online Exam Proctoring Exam**

When the COVID-19 pandemic happened, there was an alternative to distance learning, like giving online exams to students, and there was a problem where the student was cheating while taking the online exam. The researcher proposed Proctor Ex, an online exam proctoring web application with face detection when the user moves away from the computer, gaze tracking when the user is looking away from the screen, head pose estimation when the user is facing away from the screen, and browser monitoring when the user switches tabs. When a face is detected using Dlib, which predicts the mapping of 68 coordinates to facial structures, it is processed for facial landmark detection. When tracking a student's gaze, OpenCV's solvePNP function uses five facial feature points and Euler angles to determine which way the student is facing. This allows for the isolation of the eye region using eye landmarks for iris detection through binarization and the extraction of the iris by removing the surrounding environment. The researcher's aim in this study is to monitor the behavior of students when taking an online exam real-time. This is one way that reduces the possibility of cheating would go unnoticed and provides educators a way to keep an eye on a large number of their students throughout an online test and stopping cheating so students don't get used to this type of work is really important to keeping the school honest.

Link: <https://philstat.org/special_issue/index.php/MSEA/article/view/320/316>

Reference: Kasinathan, V., Yan, C. E., Mustapha, A., Hameed, V. A., Ching, T. H., & Thiruchelvam, V. (2022). ProctorEx: An Automated Online Exam Proctoring System. Mathematical Statistician and Engineering Applications, 71(3s2), 876-889.

1. **\*\*Review of Related Literature: Facial Recognition in Online Proctoring\*\***

The COVID-19 pandemic has catalyzed a rapid shift towards online learning and assessment methodologies worldwide. As educational institutions adapt to remote learning environments, the need for robust online proctoring systems has become increasingly evident. In response to this demand, researchers from MIT ADT University, Pune, India, conducted a study in 2021 focusing on the integration of facial recognition technology in online proctoring systems.

Led by a team of researchers including Akshat Shrivastava, Ashray Parmar, Anurag Sen, Ayush Soun, and Prof. Suresh Kapare, all affiliated with the Computer Science and Engineering department at MIT ADT University in Pune, India, the study aimed to address the challenges of ensuring exam integrity and preventing malpractices during online exams.

The study emphasized the significance of proctoring in maintaining the fairness and validity of online assessments. Traditional methods of exam proctoring, such as human invigilators, are impractical in remote learning settings, necessitating the adoption of automated proctoring systems. Facial recognition technology emerged as a promising tool for verifying the identity of exam takers and detecting cheating behaviors during online exams.

Facial recognition algorithms analyze facial features and movements, such as eye tracking and head pose estimation, to identify suspicious behaviors indicative of cheating. By integrating facial recognition with online proctoring systems, the researchers aimed to create a scalable and efficient solution for conducting secure online exams.

The proposed methodology builds upon previous research in the field of online proctoring and leverages advancements in computer vision and artificial intelligence. By utilizing facial recognition technology, the researchers sought to enhance the authentication process and ensure the integrity of online assessments.

Overall, the study conducted by Shrivastava et al. from MIT ADT University represents a significant contribution to the field of online education. By applying facial recognition technology to online proctoring, the researchers aimed to address the challenges associated with remote learning and create a more secure and trustworthy environment for online exams.

\*\*Reference:\*\*

- Shrivastava, A., Parmar, A., Sen, A., Soun, A., & Kapare, S. (2021). "Facial Recognition in Online Proctoring: A Study by Researchers from MIT ADT University, Pune, India." \*Journal/Conference Name\*, Volume(Issue), Page Range.

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1. **Review of Related Literature: Face Recognition in Examination Online Proctoring (FREOP)**

In the contemporary era, technological advancements have reshaped various aspects of human life, including education. Traditional examination methods have evolved alongside technology, incorporating innovative solutions to enhance security and efficiency. Among these advancements, face recognition technology has emerged as a prominent tool for identity verification and security in academic assessments.

Almuhdor's (2020) study explores the integration of face recognition technology within the context of online proctoring, a method used to monitor and ensure the integrity of examinations conducted remotely. The study acknowledges the evolving nature of assessments, transitioning from traditional written and verbal tests to more sophisticated digital formats. Face recognition technology represents a significant advancement in this evolution, offering a reliable means of facial identification.

The research aims to develop a face recognition program tailored specifically for academic purposes, particularly in the realm of online proctoring. This program seeks to combine the capabilities of face recognition with the functionalities of online proctoring systems, thereby enhancing the security and reliability of online examinations. The study identifies three main aspects of the application: face recognition, email integration, and online proctoring features.

By integrating face recognition technology into online proctoring systems, the study anticipates several benefits, including enhanced authentication processes, improved monitoring of exam sessions, and deterrence of cheating behaviors. Face recognition adds an additional layer of security to online assessments, mitigating risks associated with identity fraud and unauthorized access to examination materials.

The significance of Almuhdor's study lies in its contribution to the ongoing discourse on leveraging technology to uphold the integrity of academic assessments. By exploring the intersection of face recognition and online proctoring, the research seeks to address the evolving needs of educational institutions in a digital age.

In conclusion, Almuhdor's study on Face Recognition in Examination Online Proctoring (FREOP) represents a valuable contribution to the field of educational technology. By harnessing the capabilities of face recognition technology, the research aims to enhance the security and reliability of online examinations, thereby supporting the integrity of academic assessments in an increasingly digitalized world.

Reference:

Almuhdor, A. T. (2020). "Face Recognition in Examination Online Proctoring (FREOP)." Retrieved from <http://repository.president.ac.id/handle/123456789/3722>

1. **Title: A Novel Deep Learning-based Online Proctoring System using Face Recognition, Eye Blinking, and Object Detection Techniques**

Year: 2021

Introduction:

The shift towards online education, accelerated by factors such as the COVID-19 pandemic, has highlighted the need for effective online examination proctoring systems. Traditional methods of examination proctoring are not feasible in online settings due to the lack of physical presence. Consequently, there is a growing demand for innovative solutions that can monitor and ensure the integrity of online exams. In response to this need, researchers Istiak Ahmad, Fahad AlQurashi, Ehab Abozinadah, and Rashid Mehmood from King Abdulaziz University, Saudi Arabia, proposed a novel online proctoring system that leverages deep learning techniques for face recognition, eye blinking detection, and object detection. Their research, published in the International Journal of Advanced Computer Science and Applications, Vol. 12, No. 10, 2021, presents a comprehensive approach to address the challenges associated with online examination proctoring.

Literature Review:

The authors provide a thorough review of existing research in both academic and commercial domains related to online proctoring systems. Academic research has explored various biometric authentication methods, including face recognition, fingerprint recognition, and voice recognition, to ensure the integrity of online exams. Commercial systems offer advanced features such as multi-level proctoring, real-time monitoring, and AI-based intervention to detect and prevent cheating during online exams. However, the authors note that many existing solutions are proprietary and lack transparency, highlighting the need for open-source and innovative approaches.

Proposed Methodology:

The proposed online proctoring system integrates deep learning techniques for face recognition, eye blinking detection, and object detection. The system utilizes the Histogram of Oriented Gradients (HOG) face detector and the OpenCV face recognition algorithm to accurately identify and authenticate students during exams. Eye blinking detection is employed to detect stationary pictures, while object detection techniques are used to identify unauthorized gadgets such as mobile phones and laptops. The system is implemented as a software solution and evaluated using standard datasets to assess its performance and accuracy.

Evaluation and Results:

The authors conducted thorough evaluations of the proposed system using the Face Detection Data Set and Benchmark (FDDB) and Labeled Faces in the Wild (LFW) datasets. The results demonstrate high accuracies of up to 97% for face detection and 99.3% for face recognition, validating the effectiveness of the deep learning-based approach. The system's ability to detect unauthorized gadgets and ensure fairness during exams further enhances its utility in online proctoring scenarios.

Conclusion:

In conclusion, the research conducted by Ahmad et al. presents a novel and comprehensive approach to online examination proctoring using deep learning techniques. By integrating face recognition, eye blinking detection, and object detection, the proposed system offers robust solutions to address the challenges of online exam monitoring. The high accuracies achieved in the evaluations validate the effectiveness of the system and highlight its potential to enhance the integrity of online education and assessment processes.

Keywords: Online learning, online proctoring, deep learning, face recognition, eye blinking detection, object detection, examination integrity.

References:

Ahmad, I., AlQurashi, F., Abozinadah, E., & Mehmood, R. (2021). A Novel Deep Learning-based Online Proctoring System using Face Recognition, Eye Blinking, and Object Detection Techniques. International Journal of Advanced Computer Science and Applications, 12(10).