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Implementation Paper on Virtual Invigilation System using Computer Vision Techniques

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Abstract:

With the widespread adoption of online education, there arises a need for robust methods to ensure academic integrity during remote assessments. Traditional methods of proctoring such as live proctors or recorded video monitoring are resource-intensive and lack scalability. In response, automated proctoring systems leveraging computer vision techniques have emerged as a promising solution. This paper presents an automated proctoring system that utilizes computer vision algorithms to monitor and detect suspicious behavior during online examinations. The proposed system employs a multi-step process that involves face detection, gaze tracking, posture analysis, and activity recognition to identify potential instances of cheating or misconduct. The face detection module employs convolutional neural networks (CNNs) to detect and track the faces of test-takers throughout the examination session. Gaze tracking algorithms determine where the examinee's eyes are focused, identifying instances of off-screen activity or reference to external materials. Posture analysis algorithms assess the test-taker's body language and posture to detect signs of discomfort or engagement in unauthorized activities. Furthermore, the system utilizes activity recognition techniques to detect anomalous behaviors such as excessive movement or interactions with prohibited objects. By integrating these components into a unified framework, the automated proctoring system can accurately flag instances of potential cheating or academic dishonesty in real-time. Experimental results demonstrate the effectiveness and efficiency of the proposed system in detecting various forms of cheating behavior while minimizing false positives. The system's scalability and adaptability make it suitable for large-scale online assessments across diverse educational settings.

Keywords: Automated Proctoring, Computer Vision, Online Education, Academic Integrity, Behavior Analysis, Machine Learning, Exam Security.

Introduction:

In recent years, the landscape of education has undergone a significant transformation with the increasing prevalence of online learning platforms and remote assessments. While online education offers flexibility and accessibility, it also presents challenges in maintaining academic integrity during examinations. Ensuring fairness and preventing cheating in remote assessments is crucial for upholding the credibility and validity of educational outcomes. Traditional methods of proctoring, such as live proctors or recorded video monitoring, are often costly, labor-intensive, and may not scale effectively to accommodate the growing demand for online assessments. To address these challenges, automated proctoring systems leveraging computer vision techniques have emerged as a promising solution. By harnessing the power of artificial intelligence and machine learning, these systems can autonomously monitor and detect suspicious behavior during online examinations, providing a scalable and cost-effective means of upholding academic integrity. The aim of this paper is to propose and evaluate an automated proctoring system that utilizes computer vision algorithms to monitor and analyze test-taker behavior during online assessments. The proposed system integrates a combination of face detection, gaze tracking, posture analysis, and activity recognition techniques to identify potential instances of cheating or academic dishonesty in real-time. In this introduction, we provide an overview of the motivation behind the development of automated proctoring systems, discuss the challenges associated with maintaining academic integrity in online assessments, and outline the objectives and contributions of our proposed system.

Literature Survey

Jay Mayekar et al: In this paper,In this paper, we have proposed and implemented an automated proctoring system using computer vision techniques. The system helps in conducting examinations by fair means and hence, maintains its integrity. This study demonstrates how to avoid cheating in online examinations by employing semi-automated proctoring based on vision and audio capabilities, as well as monitoring several students.

Simon Wenig et al.: In this paper, a simulation framework for MMC-based multi terminal HVDC systems is presented. The selected modeling concept offers insight into global arm quantities, considered as essential parameters to investigate transient system controllability. Besides the feature to handle unbalanced voltage conditions in one of the interfaced ac networks, this control approach facilitates active regulation strategies of all converter arm energies to keep the system within a predefined operating area during and subsequent to dynamic events.

Aiman A Turani et al: In this work, In this paper, we have focused on the limitations and concerns regarding the online proctoring. The two main concerns were test integrity and student performance. Avoiding frauds and cheating attempts within online proctoring sessions without affecting test-taker's performance is considered to be very challenging. We suggested using the 360-degree security camera over the webcam for improving the proctoring process.

AsepHadianSudrajatGanidisastra et al: The evaluation results have shows us that incremental training has a better performance compared to batch training in speed and dataset size. The decrease of training speed and dataset size is not giving a negative influence on the accuracy rate, on the contrary, the proposed method will result in smaller storage space, smaller memory usage, and faster training speed. On the other hand, the face detection method can result in better face recognition accuracy.

SarthakManiar et al: In this paper, we have proposed and implemented anautomated proctoring system using computer vision techniques. The system helps in conducting examinations by fair means and hence, maintains its integrity. This study demonstrates how to avoid cheating in online examinations by employing semi-automated proctoring based on vision and audio capabilities, as well as monitoring several students at once. However, if there is a person sitting behind the laptop, the student can communicate with that person by reading the question. This can be catered by having a 360 degree camera monitoring the whole room of the student.

Renuka Devi et al.: This paper deals with designing an approach wherein it tries to detect any abnormal behaviors present in the videos. The system first works by detecting all students present in the video. After detecting all the students, it tracks the detected students throughout the course of the video. The features of the tracked students are calculated using HoG feature descriptor and then sent to the K-Nearest Neighbor classifier. The classifier is pre-trained to detect normal or abnormal actions. System is made to be adaptable to lots of different conditions as in, a user can choose the behaviors that they want the system to detect and train the system specifically for that.

Yousef Atoum et al.: This paper presents a multimedia analytics system for online exam proctoring, which aims to maintain academic integrity in e-learning. The system is affordable and convenient touse from the text taker's perspective, since it only requireshaving two inexpensive cameras and a microphone. With the captured videos and audio, we extract low-level features from six basic components: user verification, text detection, speech detection, active window detection, gaze estimation, and phone detection.

YusepRosmansyah et al.: In this paper, online learning or e-learning has become increasingly popular and evolved. Many academic institutions use the Learning Management System (LMS) as a medium for delivering e-learning. A vital feature in such a system is the electronic examination (e-exam), where verifying student's authentic competence is a challenge. This paper aims to present countermeasures for impersonation attacks. This research was a more focused effort and a continuation of previously owned one and many others found in works of literature. The method of protection is presented in the form of an attack-defense tree model.

Aditya Nigam et al.: In this paper, online testing is the next wave of adoption after online learning which has seen a significant rise in demand due to the problems posed by the ongoing COVID-19 Pandemic. OPS do not claim to

be completely fool proof but are rapidly changing the adoption of online testing from home, a scenario that previously would have been thought to be preposterous amongst the masses.

TejaswiPotluri et al.: The main objective of this paper is to develop a well-rounded automation system that is capable of helping the proctor to monitor the students attending an online examination. Out of the several proposed features of the system, our paper has developed the ability to do multiple person detection, face spoofing, and head pose estimation.

Methodology:

Creating an automated proctoring system using computer vision techniques involves several steps. Here is a general methodology to help you get started:

1. Data Collection:

Acquire a diverse dataset of video recordings from online examinations. These recordings should include a variety of test scenarios, such as different subjects, test formats, and test-taking behaviors. Ensure that the dataset encompasses a range of demographic characteristics, including gender, age, and ethnicity, to promote the robustness and generalizability of the automated proctoring system.

2. Preprocessing:

Perform preprocessing steps to enhance the quality of the video data and facilitate feature extraction. This may include tasks such as noise reduction, frame stabilization, and resolution normalization. Segment the video data into individual frames or time intervals for analysis, depending on the requirements of the computer vision algorithms employed in subsequent steps.

3. Feature Extraction:

Utilize computer vision algorithms to extract relevant features from the preprocessed video data. These features may include facial landmarks, eye movements, body posture, and hand gestures. Apply techniques such as convolutional neural networks (CNNs), optical flow analysis, and pose estimation to extract informative features that characterize test-taker behavior during online examinations.

4. Model Training:

Design and train machine learning models to recognize patterns and detect suspicious behavior based on the extracted features. This may involve supervised learning, semi-supervised learning, or unsupervised learning approaches, depending on the availability of labeled training data. Fine-tune the models using techniques such as

data augmentation, transfer learning, and hyperparameter optimization to improve their performance and generalizability.

5. System Integration: - Integrate the trained models into a unified automated proctoring system that can process video streams in real-time during online examinations. Implement modules for face detection, gaze tracking, posture analysis, and activity recognition, each utilizing the corresponding machine learning models to identify potential instances of cheating or academic dishonesty.

6. Evaluation:

Evaluate the performance of the automated proctoring system using a separate validation dataset or through controlled experiments in simulated test environments. Measure key performance metrics such as accuracy, precision, recall, and F1 score to assess the system's effectiveness in detecting cheating behavior while minimizing false positives. Conduct qualitative analysis and user feedback sessions to identify areas for improvement and refine the system's design and functionality.

By following this methodology, we can develop a robust and effective automated proctoring system that leverages computer vision techniques to monitor and detect suspicious behavior during online examinations, thereby upholding academic integrity and ensuring the credibility of remote assessments.

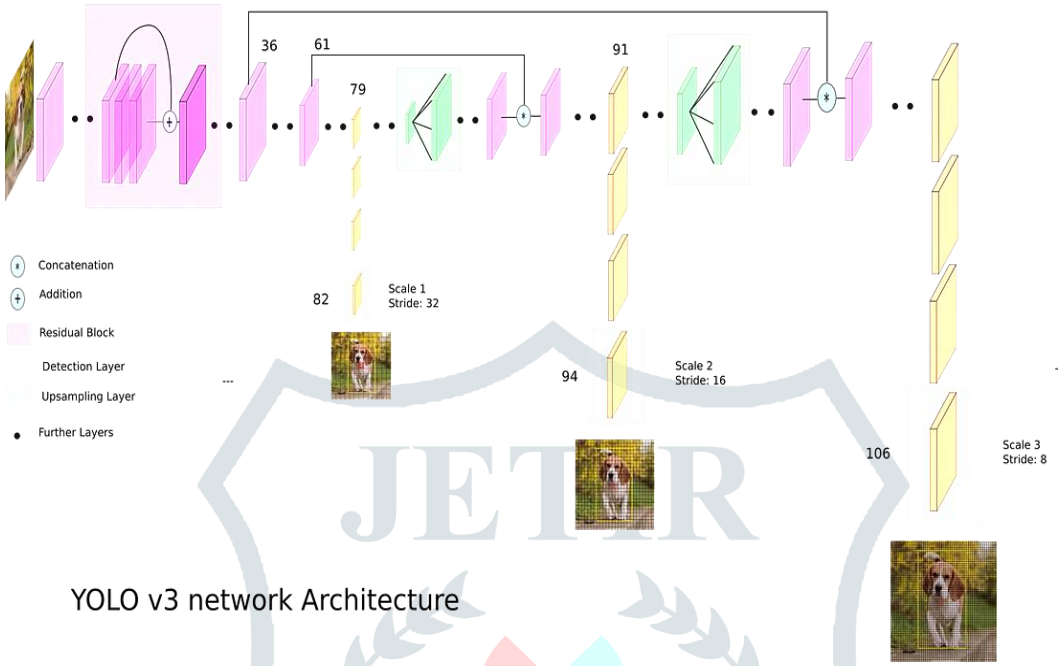
Implementation

In this system, we demonstrate how to build a full multi-model system using computer vision to eliminate the need for humans to be present throughout the inspection. We suggest a system that has a number of characteristics that test-takers may use, including item recognition, mouth open or closed detection, eye gaze tracking, and head posture estimation utilising facial landmarks and face detection. Our method can also convert a student's speech into text, which might be helpful for recording the student's spoken remarks. This might help the examiner determine whether the student is conversing with a close friend or relative. In conclusion, this study shows how to stop cheating in online examinations by employing semi-automated proctoring based on vision and audio capabilities and simultaneously monitoring many students.

Algorithm

- YOLOv3 takes an input image and divides it into a grid.
- The image is divided into a grid of cells, and each cell is responsible for predicting objects located within it.

- For each bounding box, YOLOv3 predicts class probabilities for a fixed number of object classes (e.g., 80 classes for the COCO dataset). These probabilities indicate the likelihood of the detected object belonging to each class.



YOLO v3 network Architecture

Conclusion:

The development and implementation of an Virtual Invigilation system using computer vision techniques represent a significant advancement in the field of online education and remote assessment. Through the integration of face detection, gaze tracking, posture analysis, and activity recognition algorithms, the system offers a comprehensive solution for monitoring and detecting suspicious behavior during online examinations.The Virtual Invigilation system using computer vision techniques represents a valuable tool for maintaining academic integrity and ensuring the credibility of remote assessments. By leveraging cutting-edge technologies and addressing ethical considerations, the system contributes to the advancement of reliable and non-intrusive solutions for online education environments. Continued innovation and collaboration are essential for further refining the system and adapting to the evolving needs and challenges of remote assessment in the digital age..

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