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Enhancing Academic Integrity in Online Assessments: Introducing an Effective Online Exam Proctoring Model using YOLO

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Abstract

The issue of cheating during exams has become a significant concern, gaining widespread attention from the public and media. This issue has been made worse by the transition of educational institutions to an online format, making it simpler to engage in academic dishonesty. To overcome this problem, developed an innovative solution known as the Online Exam Proctoring Model using You Only Look Once (YOLO) Model. With the use of cutting-edge computer vision algorithms, the proposed model makes use of data from cameras and microphones to automatically spot and prevent cheating during online exams. Face orientation, face spoofing detection, mouth tracking, audio analysis, mobile device recognition, and person counting are among the primary elements built into the model. Object detection algorithms, in conjunction with pre-trained YOLO weights, empower the model to detect mobile devices and count the number of individuals present in the exam environment. The automatic termination of exams upon detection of mobile devices, multiple persons, or no persons for 10 seconds acts as a strong deterrent against cheating. The suggested methodology created a reliable and effective tool for online examinations, guaranteeing the academic integrity and enabling impartial assessment of the skills and knowledge of learners. By implementing this solution, educational institutions can foster a secure online exam environment, promoting a culture of honesty and trust between students and educators. As navigate the evolving environment of education, the model stands as a reliable ally in upholding the credibility and authenticity of online learning experiences.

Keywords: You Only Look Once; Online Exam Proctoring; Mediapipe; Antispoofing; Pyaudio

1. Introduction

Online exam proctoring is a technology-driven solutions that enables educational institutions and organizations to monitor and secure online exams[33]. With the increase in growth of online education and remote work this online exam proctoring became popular to minimize the cheating during exam[34].

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The online exam proctoring project use the specialized software and tools to monitor the students behavior during the exam[31]. This system able to track the students activity during exam. It can also use artificial intelligence algorithms to find the suspicious behavior, such as looking away from the screen, opening mouth or not, face orientation ad having someone else in room. This system can detect any suspicious behavior that violates the exam rules[1]. The online exam proctoring project has several benefits, including increased accessibility, reduced administrative workload, and enhanced credibility of online learning[32]. It provides a fair and equal opportunity for students to check their knowledge without the risk of cheating[19]. However, it is very important to ensure that the system is user-friendly and it is also accessible to all students, including for the ones with disabilities. It is also important to balance the benefits of the proctoring system with the concerns about privacy and security, as the system involves the collection and analysis of sensitive data. Many machine learning, Deep learning algorithms are utilized for online exam proctoring[14, 16, 26, 30, 5, 23, 6, 13, 29].

Academic dishonesty encompasses a wide range of actions and behaviors by students that involve deception or unethical practices aimed at taking credit for academic work that they did not genuinely create or produce. This includes actions such as plagiarism, cheating on exams, fabricating data or research findings, submitting someone else's work as their own, or engaging in any form of academic fraud or deceitful conduct with the intention of gaining an unfair academic advantage[20]. Many IOT related devises are utilized for exam proctoring system [27].

Now a days online exam proctoring topic is an active research topic. In this they have provided valuable insights to their effectiveness and limitations[39, 4]. And also about the how AI-based systems effective in preventing cheating, but also rise important concerns about privacy, accuracy and bias[31]. Security is the most important aspect of online exam. To ensure the security of online examinations they proposed a continuous online authentication system[22]. This monitoring is done based on machine learning algorithms to find the cheating behavior of student[10]. In this module if it finds any suspicious behavior it makes a record of it for viewing the real time administrators and it terminates the exam[25]. Face recognition system by using eigen face method is used to monitor the students behavior during online exams where face acts as priority index[11]. Eigen face consists of eigen vectors which are used in face recognition[34]. With the help of webcam and microphone the teacher can monitor any student at any time. The system can also keep the records of the malpractices[35]. The logs of malpractices are be used to verify the student manually in case of suspicion. For developing this model they considered several features like face recognition, multiple person detection, mobile detection and no person detection[33]. For face recognition they used the methodology called Local Binary Pattern Histogram Algorithm. LBPH is a straight forward algorithm but very effective[18]. LBPH rate under conditions of illumination, deflection of attitude and variability of expression is decreased[19]. It gives the output as binary number. For mobile detection and persons detection they used the YOLO weights. It contains nearly 80 objects. It consists of 53 convolutional layers and each of them are followed by a batch normalization layer and a RELU activation[2, 3]. Computer vision proposed as a solution for efficiently monitoring the student's attention through non invasive approach using Multi-task Convolutional Neural Network (MTCNN)[1]. The smart invigilation system will be able to mark attendance of the student through face detection[15]. Cheating is the important concern nowadays during online exams. To avoid cheating they developed a system by using webRTC that can stream audio and video using twilio api for tracking the students behavior during the exam[38]. Server-less architecture by using AWS was designed for monitoring the students during online examination. For this project face detection was done by using EMTCNN model with convolutional network[24, 20]. Exams are the only ones that defines the students learning capacity. From the time of covid many educational institutions are shifting to virtual mode, so that exams are also conducting in online. In this phase cheating is the most concerned issue during online exams. To avoid this they developed an AI agent that detects the cheating during exams[8].

The main idea of the project is to utilize the advanced technologies of computer vision methods and try to develop an efficient and an effective online exam proctoring model for detecting the student's attention during online exams[28, 7, 40].

The problem statement of the proposed work is to formulate an effective and user-friendly online exam proctoring model that holds the potential to significantly revolutionize the educational evaluation process. The core aim is to design an application capable of discerning vital cues such as body postures, object presence, audio cues, and potential face spoofing. By systematically analyzing these indicators, the model seeks to make a decisive determination on whether a student is engaging in any form of academic misconduct during the examination[36].

The objective of the work is to

- Detecting whether a student is engaging in copying during exams is typically a challenging task for teachers. However, the introduction of our online exam proctoring model simplifies this process, enabling teachers to readily identify instances of copying by students during exams.
- To find whether the student is copying or not is really hectic task and also it ma, if not proper systematic way is followed. Our objective is to provide a platform for a teacher to make the student genuine during exam.
- To help teacher to identify whether student is copying or not. This application or recommendation system is not only useful for the online exam proctoring, even it will be useful in class room monitoring. In some cases, students try to cheat in exams, with the help of this application we can easily caught them during the exam.
- It can also provide real-time feedback to students and instructors. By monitoring students during the exam, the system can identify areas where students are struggling and provide feedback and support to help them improve. This objective is particularly important in online learning, where students may not have the same level of interaction with their instructors as they would in traditional classroom settings.

2. Methodology

The proposed method utilizes a video input to identify whether the student in exam is cheating or not. Based on that video data extract the features from video by using computer vision techniques. Utilizing identifiable features, ascertain behavioral indicators, conduct testing, and subsequently predict whether a student taking an exam is engaging in cheating behavior or adhering to academic honesty as shown in Fig. 1.

2.1. Proposed method

The proposed system architecture consists of an online exam proctoring model that can be able to identify the students behavior during exam. It has 4 stages to develop an efficient online exam proctoring model. The stages are Collecting data, Computed features, Behavioral clues and cheating status. For developing this model, utilized some required python libraries and computer vision techniques such as cv2, mediapipe, tensorflow, pyaudio etc. Based on the above mentioned techniques developed the efficient class room attention model as shown in Fig. 2. This phase will encompass face recognition, face spoofing detection, and mouth tracking. It will address scenarios where multiple persons are detected, focusing on these pivotal techniques crucial for effective online exam monitoring. Utilizing OpenCV, the model will execute face detection, face spoofing detection, and mouth tracking. Tensorflow will be employed for the identification of multiple individuals, while Mediapipe will enable the detection of facial body postures. Furthermore, the tensorflow framework will be leveraged to ascertain the count of individuals, and PyAudio will facilitate audio recognition. For object detection tasks, YOLO weights will be utilized to identify items such as mobile devices[21]. Through the integration of these techniques, this model is being developed to achieve its intended objectives.Traditional in-person exams benefit from proctor supervision, which greatly reduces the chances of cheating. However, in the context of distributed online exams, monitoring individual student behavior becomes a significant challenge. Teachers struggle to assess each student's exam situation and overall learning status. Additionally, the proliferation of modern technology opens up various avenues for cheating, including text messaging, online searches, and plagiarism, further complicating the integrity of online assessments[17].

The subsequent phase involves feature computation. In this step, features will be extracted based on the input obtained from the initial stage. These features are integral for assessing students' engagement during the exam. They encompass extracted facial attributes, facial orientation, mouth tracking, audio recognition, the count of detected individuals, and mobile device identification. The extraction of facial attributes and orientation will be carried out through the utilization of the Mediapipe library, which facilitates the detection of a 32-point skeleton structure on the face. For mouth tracking, the Scipy library will be employed to calculate the distance between the lips. This distance will serve as a predictor of a person's mouth status. Furthermore, this phase will encompass mobile device detection and individual counting using the Tensorflow framework and YOLO weights. Audio recognition, on the other hand, will be accomplished using the PyAudio library. The computed features within this phase encompass facial attributes, facial orientation, mouth tracking, audio recognition, the count of detected individuals, and mobile device detection. These computed features will serve as the foundation for establishing a comprehensive behavioral classification system.

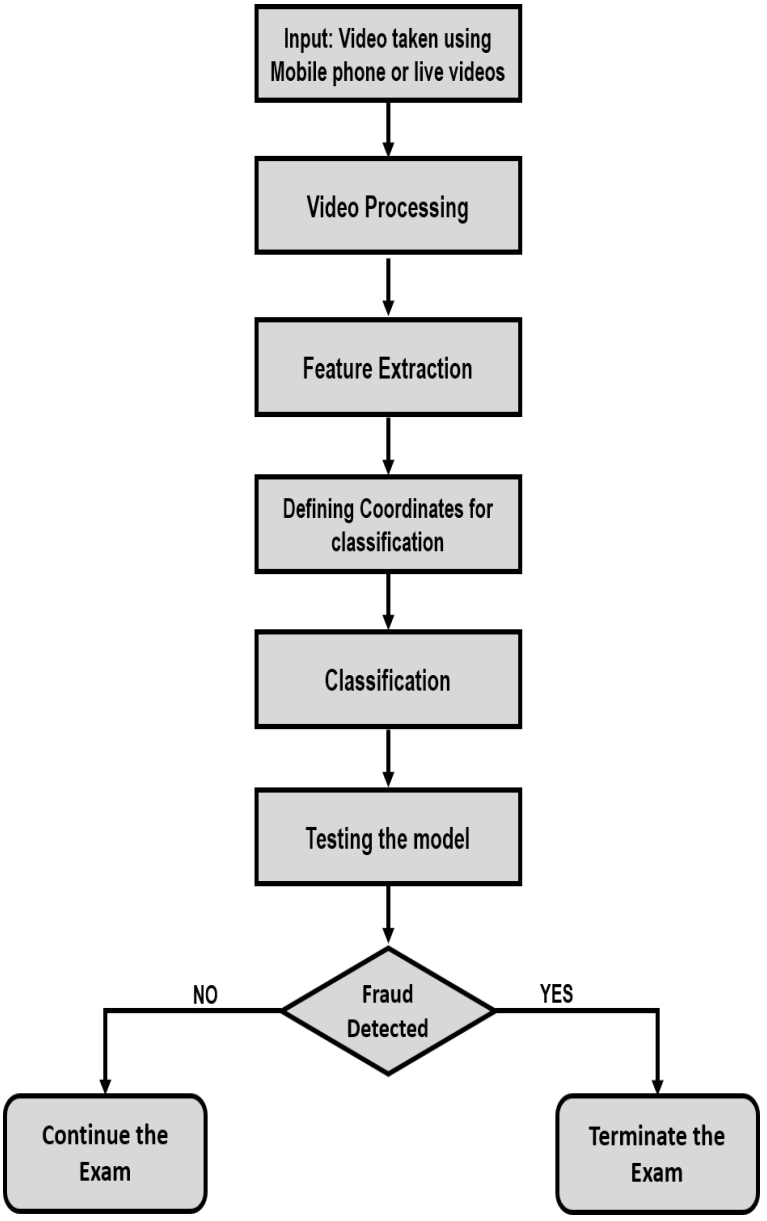

Fig. 1: Block diagram of the proposed method

Following the feature computation stage, the subsequent task involves the creation of a behavioral classification system. Within this behavioral class, the computed features will be categorized into two distinct classes: "Terminate Exam" and "Continue Exam." For the "Continue Exam" class, the relevant features include the presence of a single individual, active screen observation, head support, absence of mobile device detection, and direct gaze. Conversely, the "Terminate Exam" class is characterized by multiple persons being detected, speech recognition triggers, instances of looking away from the screen, mobile device identification, and indications of face spoofing. By evaluating these specific features, the system will be adept at determining the status of academic integrity, discerning instances of potential cheating during the exam.

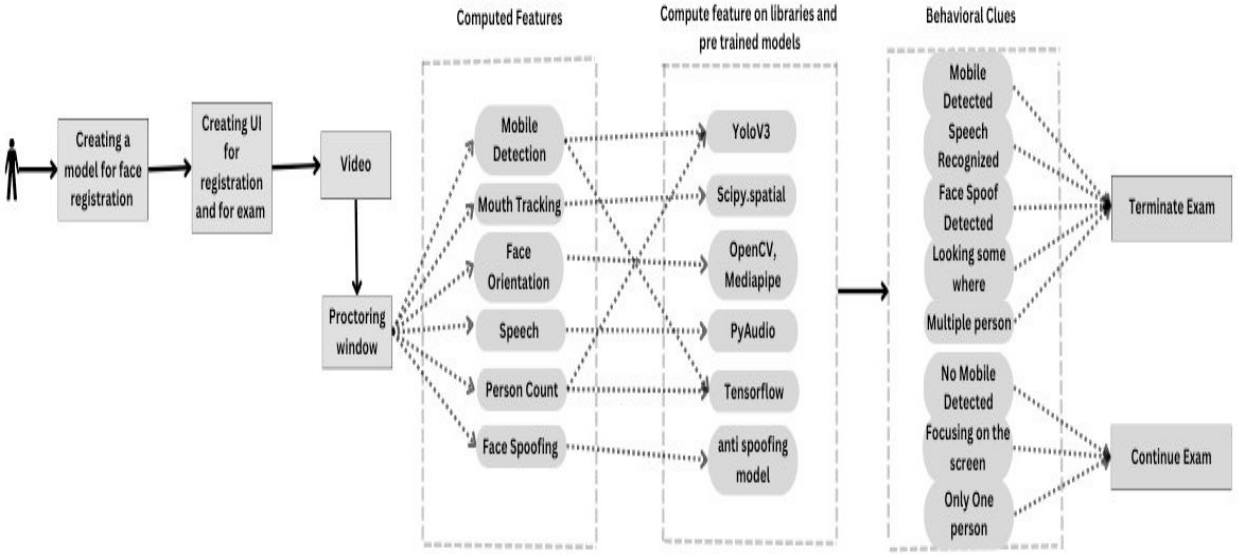

Fig. 2: Block diagram of the proposed system architecture

2.1.1. YOLO

YOLOv3 (You Only Look Once, Version 3) stands as a real-time object detection algorithm designed to pinpoint distinct objects within videos, live feeds, or images. Powered by the YOLO machine learning framework, this algorithm harnesses features acquired through a deep convolutional neural network to accurately identify and detect various objects[21, 12, 37, 9].

In the proposed work YOLO is utilized to identify the objects such as face of the student/examinee, Mouth of the examinee, Audio detection, Mobile phone, Multiple person detection, head orientation of the examinee(left/right).

3. Result and Analysis

The proposed research encompassed several aspects including face orientation, face spoofing detection, mouth tracking, audio recognition, mobile device detection, and person count estimation.

3.1. Front end part result

The work start with Face registration page window as shown in Fig. 3 and press *s* to capture the image of the student. When attempting registration with either no individuals or multiple individuals, a message will be displayed as "No face detected or Multiple faces detected. Please try again". Upon successful registration, the exam registration page will become accessible as shown in Fig. 4. At this point, students are required to register using their respective personal information. Once the exam registration is finished, the exam page will become accessible. Here, students are expected to take the exam. Upon completion of the exam, the student will receive their respective score, as depicted in Fig. 5.

3.2. Back end part result

It shows the features like face orientation, face spoofing, mouth tracking, audio detection, mobile detection, person count as shown in proctoring window Fig. 15.

Fig. 3: Registration page with image.

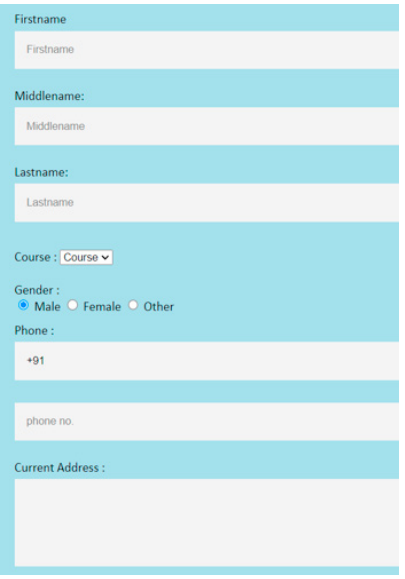

Fig. 4: Exam registration page.

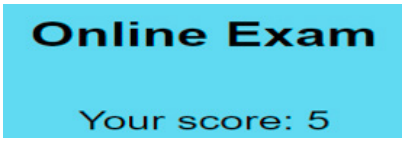

Fig. 5: Exam Score.

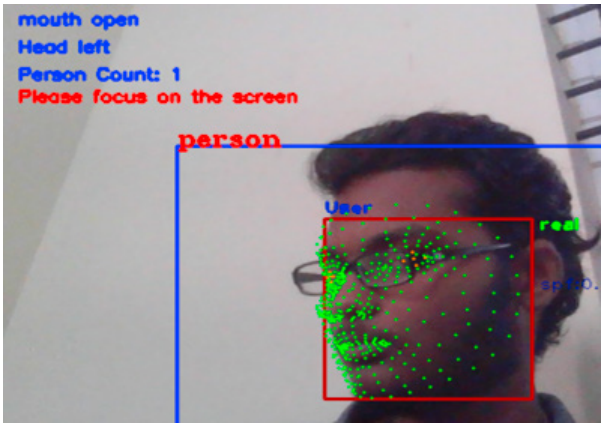

Fig. 6: Face orientation.

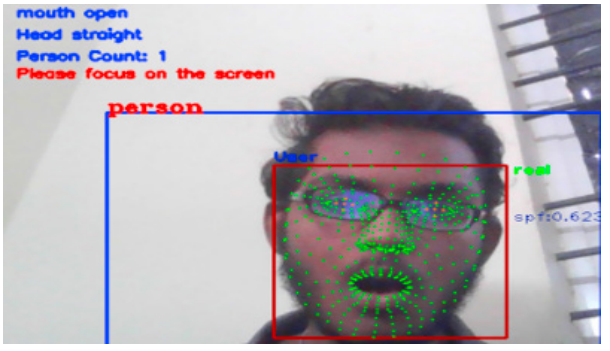

Fig. 7: Mouth Tracking.

3.2.1. Face orientation result

The system indicates the orientation of the student's face, including positions like straight, left, right, up, or down as shown in Fig. 6. In cases where the face orientation is not aligned properly, a message is displayed instructing the student to focus on the screen.

3.2.2. Face Spoofing result

The system detects face spoofing in a student as shown in Fig. 15. This involves determining whether the individual taking the exam is an actual person or an image. In the event that an image is detected, a message labeled "spoof" is displayed.

3.2.3. Mouth tracking result

The system performs mouth tracking on the student's face to entails monitoring whether the mouth is open or closed as shown in Fig. 7.

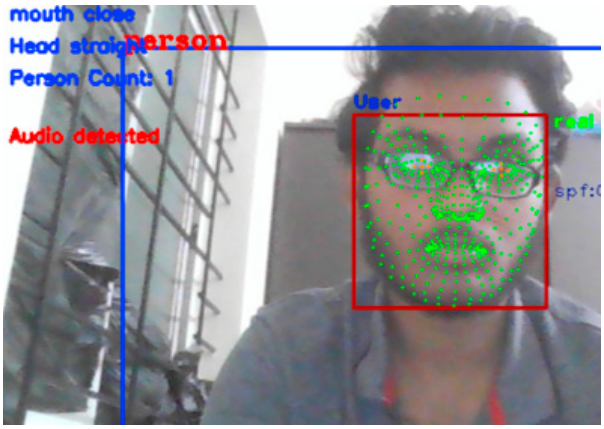

Fig. 8: Audio Detection.

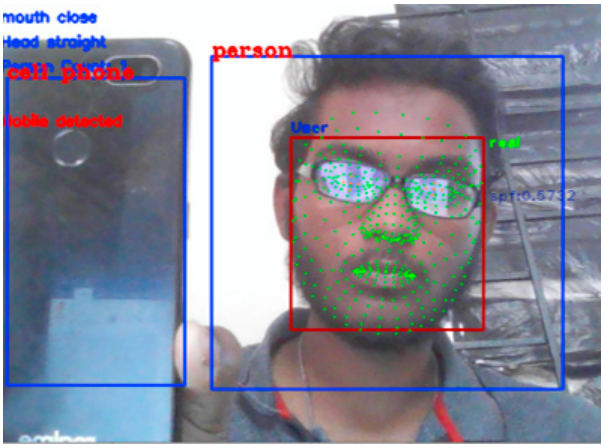

Fig. 9: Mobile Detection.

3.2.4. Audio detection result

The system assesses whether the student is speaking by analyzing the incoming sound from the student's side. If any disruptions are detected in the audio, a message labeled "audio detected" is displayed as shown in Fig. 8.

3.2.5. Mobile detection result

The system is designed to detect the presence of mobile devices during the exam as shown in Fig 9. In case a mobile device is detected while the exam is in progress, a message "mobile detected" is displayed. If the mobile device is continuously detected for a duration of 10 seconds, the exam will be terminated.

3.2.6. Person count result

The system provides a count of the individuals present within the camera frame during the exam as displayed in Fig.10. The person count is displayed on the proctoring window. If the system detects either multiple individuals or no person within the frame continuously for a period of 10 seconds, the exam will be terminated.

3.3. System Testing

To determine whether our expected outcomes and actual results were the same, first established a few specific cases and scenarios. To accomplish this, captured 70 movies and tested all of the defined cases and scenarios on those videos.

3.3.1. The expected outcome match the actual result

As depicted in Fig. 11, it is evident that the video frame contains two individuals, with the second person observed holding a mobile phone. The expected outcome was the detection of a mobile phone and the presence of multiple persons, aligning with the actual outcome of detecting a mobile phone and identifying multiple persons. This congruence between the expected and observed outcomes validates the successful passing of the test.

As depicted in Fig. 12, the video frame clearly illustrates an individual holding a mobile phone, with their head positioned downwards as they engage with the device. As anticipated, the expected outcome encompassed the detection of an open mouth, the presence of a mobile phone, the head oriented to the right, and a request to focus on the screen. Remarkably, the observed outcome mirrored these expectations precisely, thereby confirming the successful passage of this particular test case. In Fig. 13, the visual representation indicates the individual holding a remote control instead of a mobile phone. As projected, the expected outcome involved the identification of a remote control rather than a mobile device. Optimistically, the actual outcome corresponded accurately by categorizing the object as a remote control, thereby aligning with the anticipated result.

Fig. 10: Person Count.

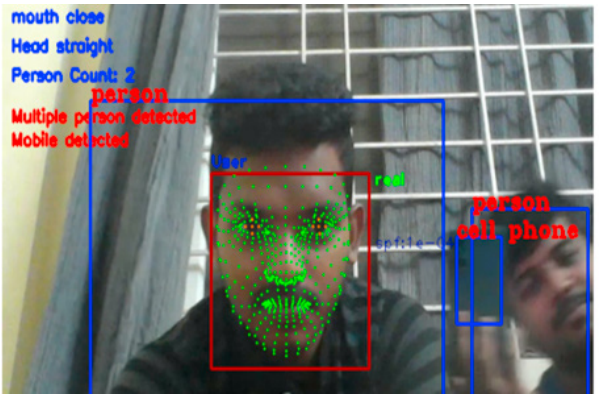

Fig. 11: Mobile and multiple person testing.

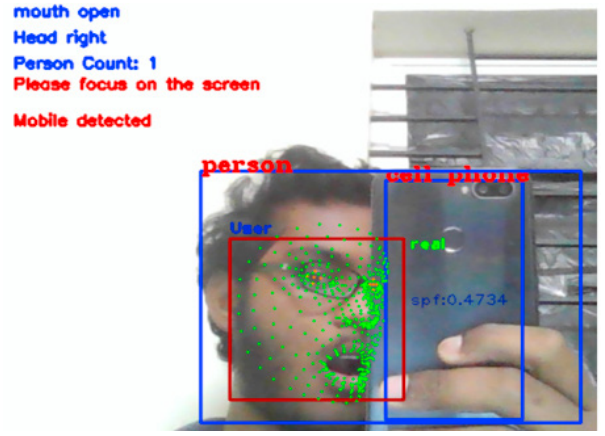

Fig. 12: Head position, mouth status and mobile testing.

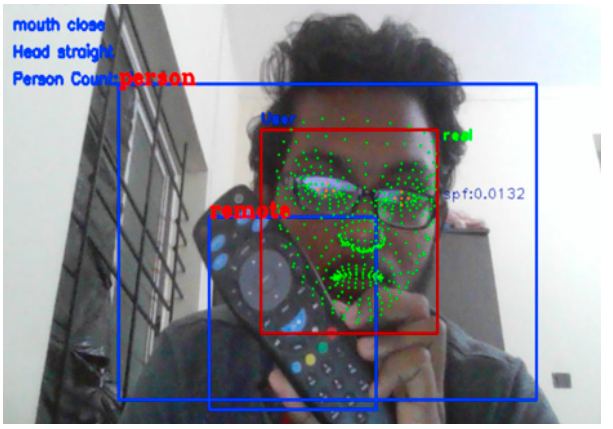

Fig. 13: Object detection testing.

3.3.2. The expected outcome did not match the actual result

In Fig. 14, it can be observed that the individual within the video frame is not authentic; rather, an image was positioned in front of the camera, constituting a spoof. As anticipated, the system correctly identified this as a spoof, but unexpectedly, it also recognized the image as a genuine person, thereby erroneously increasing the person count to 1.

In Fig. 15, it is evident that the individual depicted is not authentic; rather, it is an image. In such scenarios, the expected response should label it as a spoof, resulting in a person count of 0. Furthermore, no head or mouth status should be indicated. Surprisingly, the actual outcome deviated from this expectation. The system detected head and mouth status, and contrary to the anticipated spoof classification, it identified the image as a genuine person, consequently displaying a person count of 1.

4. Conclusion

Following the surge in demand caused by the ongoing COVID-19 Pandemic, online exams has emerged as the subsequent trend for adoption, following in the footsteps of the already popular online learning. The proctor ensures that there are no unethical practises occurring throughout the exam. The proposed work's main goal is to make it easier for teachers to determine whether a student has engaged in any sort of scamming during an exam. In order to achieve this goal, created an online exam proctoring system that makes use of a facial recognition algorithm. This algorithm serves a dual purpose: verifying the user's identity and detecting any inappropriate behaviors exhibited by

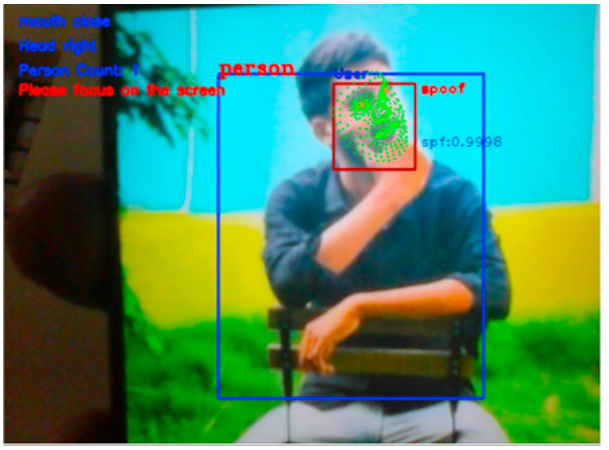

Fig. 14: Spoof and person count testing.

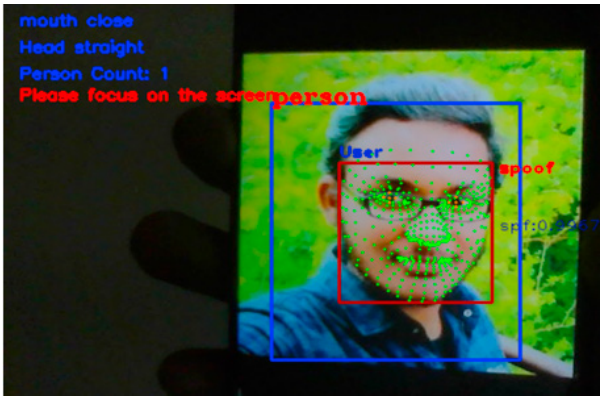

Fig. 15: Spoof, person count and head orientation testing in the proctoring window.

the student throughout the online examination. The proposed model encompasses a comprehensive range of features, including face recognition, identification of face spoofing attempts, monitoring of mouth movements, quantification of detected individuals, identification of mobile device usage, and even audio analysis.

Advanced AI algorithms and larger feature set will produce a more reliable and accurate system, improving its proctoring and exam security abilities.

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