International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 04 | Apr 2023 www.irjet.net p-ISSN: 2395-0072

AUTOMATED PROCTORING SYSTEM

Jay Mayekar[1], Shubham Pal[2], Aditya Pandey[3], Bikram Pani[4], Prof. Preeti Mishra[5]

[1]*Jay Mayekar, Dept of Information Technology Engineering, Atharva College of Engineering*
[2]*Shubham Pal, Dept of Information Technology Engineering, Atharva College of Engineering*
[3]*Aditya Pandey, Dept of Information Technology Engineering, Atharva College of Engineering*
[4]*Bikram Pani, Dept of Information Technology Engineering, Atharva College of Engineering*
[5]*Prof Preeti Mishra, Dept of Information Technology Engineering, Atharva College of Engineering*
Maharashtra, India

Abstract - *Remote learning has grown over the years majorly due to the pandemic. Learning has transferred to apps like Google Meet, Microsoft Teams, Zoom, and others. The practical knowledge gained by students deteriorated due to online learning. Students started attending lectures only for the sake of attending them. The growth factor of students declined which should have affected their grades overall however, the results were a total surprise. The majority of the students outperformed their average score. This is a result of the fact that institutions lacked a proper way to perform an organized evaluation. To tackle this problem many schools and colleges came up with their own reasonable approaches. Some universities implemented remote proctoring which involved a manual proctor keeping watch on all student activities. In spite of this students still manage to cheat and score more marks through unfair means. This just isn't enough to tackle such an important problem. A system that can assist in analyzing unfair tactics used by students was much needed.*

In this paper, we have developed an automated proctoring website utilizing various technologies like computer vision, object detection, etc. It includes various measures to prevent the use of unfair means that students may use during their examinations. It comprises features like eye gaze tracking, mouth open detection, object detection and identification, head position detection, and face detection. Here we present techniques and tools through which the proctor need not be present throughout the exam. This is based on neural networks and machine learning. All of this combined creates a smart system that can detect any malpractice that may occur during their tests. This system hopes to make the world of examination, supervision, and proctoring function smoother and more effectively. This research will reveal ways to prevent cheating in online assessments using technologies like computer vision to provide proctoring and monitor multiple students at a time.

***Key Words*: Remote Learning, Automated proctoring system, Computer vision, Object Detection, Open Mouth detection, Online Tests, Online Exam Proctoring, Examinations.**

1. PROBLEM STATEMENT

The accessibility of online tests provides various advantages however, it also introduces a new set of challenges for the actual assessment of the tests. Many factors come into play when conducting an examination online. A classroom test can be conducted smoothly with the help of a physical supervisor as it allows simultaneous monitoring of students in a restricted environment. Online tests on the other hand make it difficult as students do not share any physical environment with the proctor.

Thus, we got the idea of creating an AI system that monitors the student during their tests. This system should also hold a log of the malpractices to keep a track of a student's behavior. These logs can be manually verified later to inspect any student's case further.

2. INTRODUCTION

The pandemic led to the shifting of academics to an online mode which led to the reinvention of systems aiding online education. This poses a major challenge not only from a learning point of view but also from the perspective of examinations. Conducting examinations without any wrongdoing is a big challenge for institutions. The number of internet users in our country has doubled over the past 6 years. This has been a boon for many institutions, students, and other learning platforms. This facilitated institutions to conduct examinations online, bringing the concept of online proctoring to the academic level.

The main goal of a proctoring system is to allow the invigilators to proctor remotely. Many institutions adopted this set of manual online proctoring but this led to almost no improvement in the process of stopping malpractices.

A good online proctoring system must include all the features that may be needed by a proctor during the offline mode of examinations. It should be able to detect movement, sound, and eye movement and give reasonable warnings to the students in case of any misconduct.

3. LITERATURE REVIEW

In [1] published by Asep Hadian S. G and Yoanes Bandung, followed a unique approach. A very large data set of images is used to train and identify the user in low light and general scenarios. It helped in understanding the dynamics while analyzing an image. It was not designed for first-time setup for an online examination.

In [2] published by Sanjana Yadav and Archana Singh, which used computer vision for information extraction for object detection. The image is checked with a matching algorithm using the methods such as re-scaling, filtration, and binarization. Chamfer distance transformation.

In [3] published by A.T. Awaghade, D.A. Bombe, T. R. Deshmukh, and K. D. Takwane proposed that all the contributions measure and gauge the assortment of occasions, practices, and examples ordinarily connected with cheating.

In [4], the focus by Aiman Kiun is on fraud detection in video recordings of examinations using Convolutional Neural Networks (CNN), whereby image classification models were built using Rectified activation units (RAU), which in turn displayed fantastic results for big size data sets. Interface, video processing, and frame categorization were all part of their system. The interface feeds the footage of the students taking the test into a pipeline consisting of several algorithms. The enormous recording would be reduced to a small number of minimalistic frames, and several duplicate or similar-looking frames would be removed. The frames are then sent into a pipeline, where they are used to train CNNs to recognize objects in the second part of the pipeline.

In [5], The work given by N.L Clarke and P. Dowland proposes a realistic strategy to permit remote and electronic proctoring during student examinations. The technique entails using transparent recognition to provide non-disruptive and permanent identification of the student's identity during the test-taking process. A model is built, and an evaluation of the technology of the generated platform demonstrates the method's effectiveness.

In [6], A full-fledged Online Proctoring System was made to conduct assessments. The type of technology, approach, problematic reasoning, and accuracy were the key points for our learning. This work put our project to a test to perform better and work more smoothly. The data representation with the various models provided valuable references to understand all the thought processes for the final bundling of our modules.

4. PROPOSED SYSTEM

The proposed system will be the best model to mimic all the elements considered during an offline classroom assessment. Factors like movement, eye movement, whispering, and using other devices which are the prime symptoms of somebody possibly cheating come into the picture, so we propose developing a comprehensive system with numerous detection and validation mechanisms capable of detecting any malpractices.

Students first will be asked to register on a portal for the first time where they will enter their personal details, id card, and a picture will be taken. This picture will be saved in the database and it will be later used to verify them before the exam eliminating any chances of impersonation.

4.1. GAZE TRACKING

The examinee's gaze shall be tracked throughout the exam. Gaze tracking helps us deduce where the examinee is trying to look if the examinee's gaze seems to be moving constantly or seems to be steady for fixed durations over some time. The probability that the examinee is reading the answer from somewhere increases.

4.2. HEAD POSE ESTIMATION

This is proposed to find where the user is looking. This can be very beneficial to detect if the user is trying to cheat by looking at some additional display or devices. The DNN Model of OpenCV comes in clutch here with very high accuracy.

4.3. MOUTH OPENING DETECTION

This was proposed in this system to check if the examinee opens his/her mouth to say something during the exam. Here it uses the dlib facial key points and for this task, the examinee is required to sit straight and the distance between the key points (5 outer pairs and 3 inner pairs) is checked for 100 frames. If the examinee opens his mouth the distances of the points increase and if the increase in distance is more than a fixed value for at least three outer pairs and two inner pairs then the vector is generated.

4.4. MOBILE & OBJECT DETECTION

The use of other devices is strictly not permitted during examinations as everything is accessible through such devices which makes it a lot easier for the examinees to cheat. The system uses the YOLOv3 model which has pre-trained objects classified in its correlations. Any detection of such objects gives a warning to the examinee and multiple detections may result in the termination of the test.

5. SYSTEM DESIGN

5.1. COMPUTER VISION

Object detection and classification are done using computer vision. Maps and motion estimation are other use for it. It enables the computer to recognize and understand the items in its environment and use ML models to infer a particular result.

A machine learning system may automatically learn about the interpretation of visual input with the use of pre-programmed computational frameworks. Convolutional neural networks break down images into smaller chunks to help machine learning and deep learning models understand them. It employs tags, then uses the tertiary function to produce suggestions, conducts convolutions, then assesses the accuracy of those recommendations after each cycle. Overall, this gives it a human-like ability to perceive images.

5.2. YOLO WEIGHTS MODEL v3

Santosh Divvala, Joseph Redmon, and Ross have suggested the deep learning architecture known as YOLO. Its excellent precision and ability to run in real-time or be used for real-time applications make it very popular. The YOLO method "just looks once," or only requires one forward propagation pass through the network, to make predictions from the input image.

Previous detection systems carry out the detection process using localizers or classifiers. The model is then used to alter the scale and location of a picture. The image's high-scoring areas are considered for detection. The YOLO algorithm follows an entirely different methodology. A single neural network is used by the algorithm to process the entire full image. This network then divides that picture.

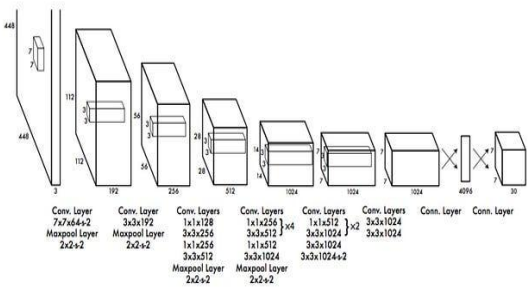


Figure I: Architecture of YOLO Model

5.3. OpenCV

The OpenCV Library is an open-source library of programming capabilities, primarily for real-time computer vision, created by Intel. It is using some of the most advanced technology, including Deep Learning, as well as offers a wide range of programming options in particular for computer vision.

The OpenCV Based DNN Face Detection is being used in this proctoring system. It's a Caffe model with a single action detector in its core and ResNet10 infrastructure to back it up. After version 3.3, it made its debut in the OpenCV Deep Neural Network module. A comparison of multiple face recognition models has revealed very small variations in accuracy, with the DNN Face Detection Model that's already been embedded into a popular OpenCV library not even taking second place.

5.4. DLIB

Dlib is a cutting-edge C++ toolkit that includes machine learning techniques and tools for developing sophisticated software to address real-world issues. Although it is less well-known than alternatives like OpenCV, its trained models perform more faster thanks to its higher accuracy. It includes a facial landmarks model that aids in the detection of a number of factors, including head pose estimation, face swapping, face alignment, gaze tracking, and other parameters. This model has 68 facial detection points.

Figure II: Facial Landmark Detection

6. COMPARATIVE ANAYLSIS

6.1. YOLO MODEL

We used instance segmentation which can be distinguishing between different labels and able to distinguish between multiple objects of that label. We used YOLOv3 already trained model to classify 80 objects. It uses Darknet-53 which has 53 convolutional layers and is 1.5 times faster than previous versions.

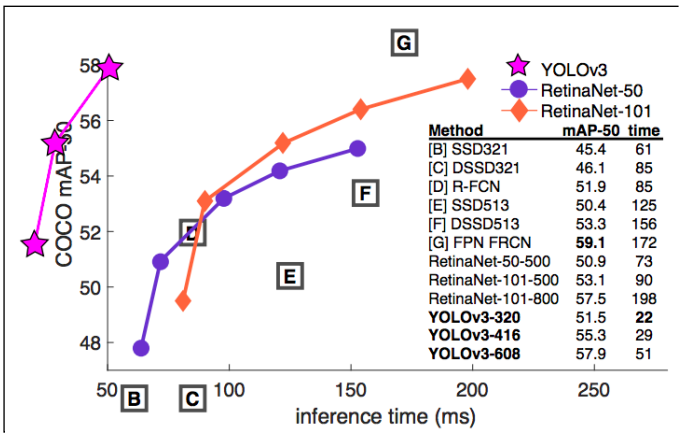


Figure III: YOLO vs Other Models

Apart from the other models, YOLO itself has multiple versions that have been released over the years. The YOLO v1 model uses GooleNet which is superior to VGG16 and made it popular during its release. The next release of YOLO uses DarkNet- 19 as its primary network which became very popular for object detection purposes. DarkNet maintained its popularity as it proved to be much faster than its competitors. The YOLOv3 model uses DarkNet-53 i.e. It has 53 convolutional layers which improved its object detection capabilities massively. Moreover, the YOLOv3 model uses a residual block, unlike its previous version which uses anchor boxes.

The further releases of the YOLO model which are the YOLOv4 and YOLOv5 included the DarkNet approach but lacked any innovation. The YOLO v4 model majorly focused on object comparison with little to no improvement in object detection whereas the YOLO v5 model did improve its object detection capabilities, especially for smaller objects but its main focus was providing flexibility to the model size. Hence for the purpose of proctoring YOLOv3 seemed to be the most suitable approach.

6.2. OpenCV DNN

A proctoring system should be able to continuously verify if the examinee is the same person he claims to be. There are various methods for continuous user verification, we used facial recognition in our system. This model was put to test against its fellow models with the purpose of facial detection.

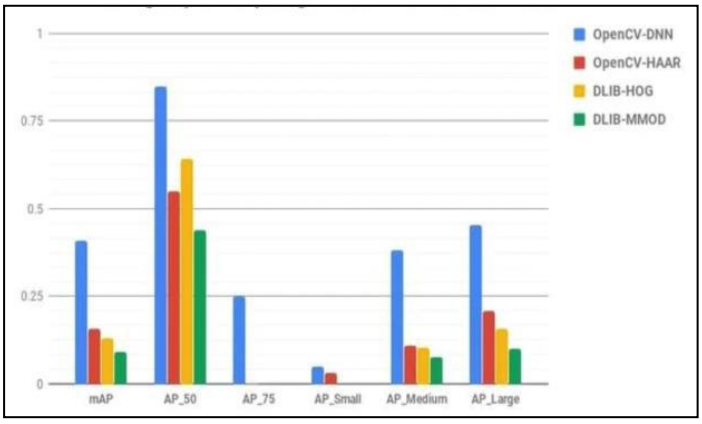


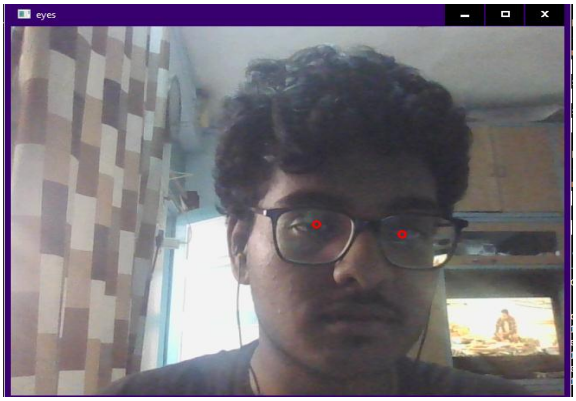
Figure IV: Open CV DNN vs Other Models

7. TESTING PROCEDURE

The test window opens in full-screen mode, which disables any attempts at switching tabs or switching windows. The test terminates if there is excessive switching of tabs or windows. The examinee will attempt the test while his/her webcam will be on for the entire duration of the test. Objects like mobile phones, laptops, calculators etc. if detected then the examinee will be given a warning. Similarly, gaze-tracking will also be conducted all the time and if any misconduct is observed the examinee will be given a warning. If any of these warnings stack up to 3 times, the test will be terminated and the examinee will be routed back to the home screen.

8. RESULT AND DISCUSSION

The proposed automated proctoring system gives decent results in all the proposed models such as Eye Gaze Tracking, Mouth Open or Close Detection, Object Detection, Head Pose Estimation, etc. The system is sufficient and holds true to the purpose of proctoring. The system is simple and convenient to use from the perspective of the test taker, as it only requires two inexpensive items i.e., cameras and a microphone. Finally, a manual proctor will be provided with the logs in case of any failure or mistake from the proctoring system.



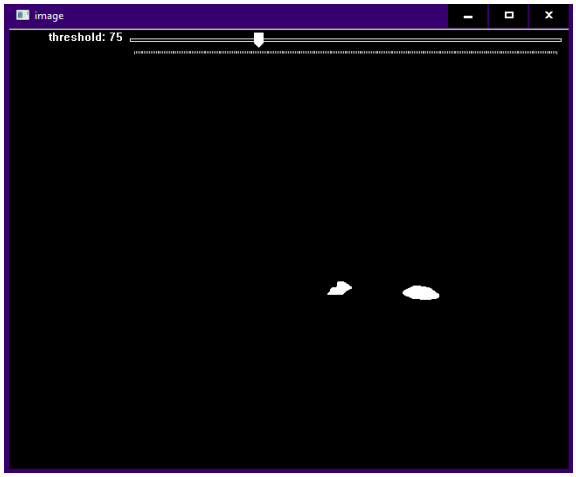


Figure V: Eye Gaze Tracking

The eye tracking module updates every half a second giving the direction of the eye gaze as the output. This helps the system to detect even the slightest eye movements. This frequency could be changed later on depending on the seriousness of the examination and the examinee's system.

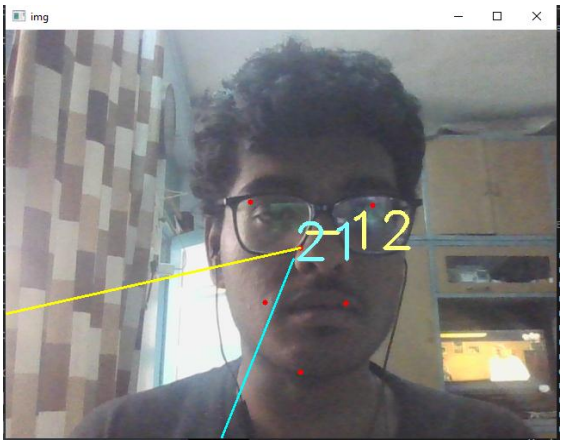
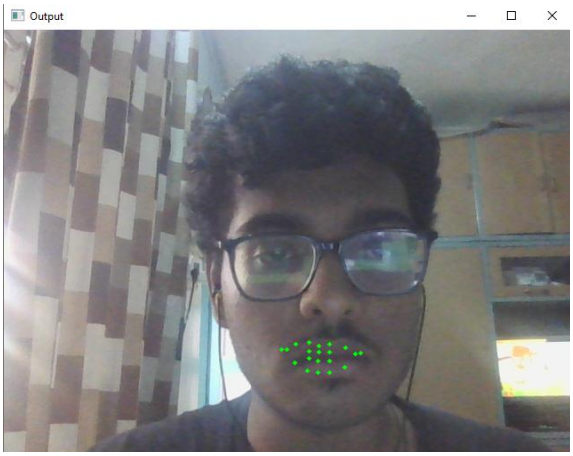


Figure VI: Head Position Estimation



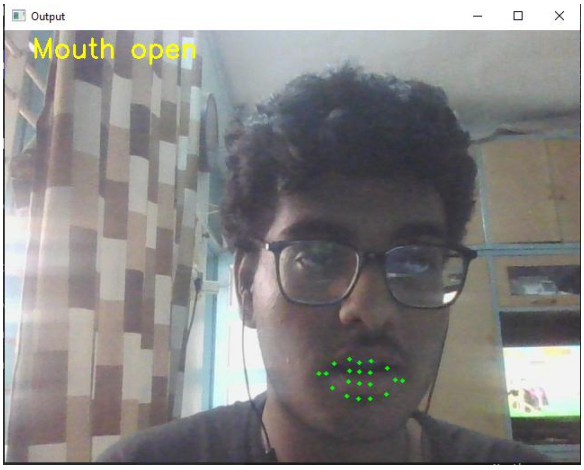


Figure VII: Mouth Opening Detection

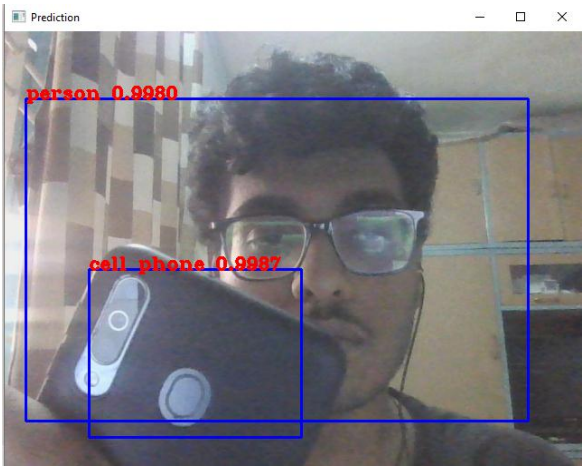


Figure VIII: Mobile Phone Detection

In Object detection, the person, and objects like, the bed, the mobile, notebook, i.e., each object in the frame on the camera is detected. Major objects include a person and a mobile phone. The accuracy for person detection came out to be 99.91 % and that for mobile phone detection is 97.08 %.

9. CONCLUSION

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.

The system provides promising environment for any organization to conduct their examination. It also provides user-friendly interface which make it easier for the examinee to give their exams with comfort. Furthermore, a manual

assistances team could also be setup per examination with the help of the exam conducting organization to smoothen out the whole examination process.

10. FUTURE WORK

It would be more efficient if the system could include YOLOv7 model or its versions as it has sustainable improvement in its object detection capabilities but it requires higher computation cost which makes it difficult to implement. Vision-based capabilities like ID-card verification can also be included in the system. The proctoring platform could be expanded to multilingual platforms and the system could also provide support for different multilingual examinations.

ACKNOWLEDGMENT

This research work was performed under the guidance of Prof. Preeti Mishra. Thanks to her guidance, the publication has accomplished its aim of serving the intended purpose.

The authors would like to thank Atharva College of Engineering for providing all of the necessary resources. The authors appreciate all the help they got from the mentioned peers.

REFERENCES

[1] "A Design of Continuous User Verification for Online Exam Proctoring on M-Learning", Hadian S. G. Asep; Yoanes Bandung, 2019 International Conference on Electrical Engineering and Informatics (ICEEI), 9-10 July 2019.

[2] An Image Matching and Object Recognition System using Webcam Robot", Sanjana Yadav; Archana Singh, 2016 Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC), 22-24 Dec. 2016.

[3] "Online Exam Proctoring System", A.T. Awaghade, D. A. Bombe, T. R. Deshmukh, K. D. Takawane, International Journal of Advance Engineering and Research Development (IJAERD) "E.T.C.W", January -2017.

[4] "Fraud detection in video recordings of exams using Convolutional Neural Networks", Aiman Kuin, University of Amsterdam, June 20, 2018.

[5] e-Invigilator: A biometric-based supervision system for e- Assessments", N.L Clarke, P. Dowland, S.M. Furnell International Conference on Information Society (iSociety 2013), 24-26 June 2013.

[6] "Smart AI-based Online Proctoring System", Neil Malhotra, Ram Suri, Puru Verma, Rajesh Kumar, IEEE, April - 2022

[7] Kimberly K. Hollister, Mark L. Berenson Proctored Versus non-proctored Online Exams: Studying the Impact of Exam environment on Student Performance, Decision Sciences, Volume 7, Issue1 January 2009, Pages 271-294.

[8] Examining Online College Cyber Cheating Methods and Prevention Measures James Moten Jr., Alex Fitterer, Elise Brazier, Jonathan.

[9] "YOLO3 Real-Time Object Detection" by Joseph Redmon, and Ali Farhadi published by Cornell University on April 8, 2018.

[10] "Facial landmarks with dlib, OpenCV, and Python" by Adrian Rosebrock on Apr 3, 2017.

[11] Examining the Effect of Proctoring on Online Test Scores - Helaine M. Alessio, Nancy Malay, Karsten Maurer, A. John Bailer, and Beth Rubin.