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Convolutional Neural Network based Virtual Exam Controller

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Abstract—In today's IT World, online examination has become very popular. It substituted all of the Offline Test inconveniences. But there is still a big question about the security of online examination. In this system camera at the client computer is used to track the student's face during the exam, and can be used to monitor the behavior of test person and to stop any malicious practices. The system will track(detect), tag, and identify the students face using Haar Cascade Classifier and deep learning and apply some constraints to stop these practices(e.g. Multiple face detection). Our system will play a key role in securing online exams and can be a role model to already existing online exam procurement systems which are faulty and too much forgiving.

The system developed can be used in a course as part of a randomized Multiple-Choice test as well as can be integrated with online learning programs to monitor the behavior of the students for their better results which however will need further advancements.

Keywords—Online examination procurement, real-time face detection, OpenCV, Haar, cascaded classifier, convolutional neural network.

I. INTRODUCTION

In this day and age, the Internet and web technology is at its peak and so does distance learning programs, today's generation of students get more attached to online resources than to books. The World Wide Web is the largest storehouse of Education resources for students. According to the statistics observed, around 6 million students opt for at least one online course within one year. The statistic says the students who take guidance online perform much better than those who take traditional classroom education face-to-face. The online education system nowadays is very reliable for any student. But there is a big question concerning the security of the online exam. Monitoring the student's activities during the online examination is a very challenging task in terms of manpower. During human supervision manual monitoring of examination halls may be prone to error.so an automatic suspicious activity detection system is needed not only to help detect suspicious activity but also to help minimize suspicious activity. This system is designed in python using OpenCV library(cv2) and various face detection and recognition techniques include Haar Cascade classifier and CNN. These algorithms first detect the face and tag them according to the name of the examinee which he will give during signup then the model is trained with the tag and the face after this whenever face appears in the screen during the test the system will identify it according to and disqualify the person if he is not the original candidate. This system also tracks the candidate's face whether it has moved out of the examination frame, also, if multiple faces are detected in the frame, the exam will automatically be killed and the administrator will receive a notification.

II. OBJECTIVE OF THE PROJECT

The general objective of our project is to change the current online assessment procurement into a more reliable one, one whose results are more reliable.

To create a system that can correctly detect/tag/recognize the face, can monitor the student's behavior and look for any malpractices during the online assessment using the webcam. This project would be very useful for educational institutes where the regular evaluation of students is required and where the credibility of the passed students is must like a recruitment test.

III. SCOPE OF THE PROJECT

As the current online Procurement system is faulty and too much forgiving, students find loopholes in the system and tend to cheat hugely affecting the credibility of the assessment. Therefore, a system is required whose constraints are a lot stricter than the current system to stop these malpractices.

This system will be useful for online assessment, the student can be monitored during his online assessment and checked for any malpractices such as cheating and false identity. With the help of this project, the assessment can be taken anytime anywhere with just a webcam and the credibility of the passed students will be increased

several times. This system is designed mainly for institutions that cannot manually examine every student while they are giving the test, this includes distance learning programs, campus recruitment tests, and having such an ingenious idea its future application and scope is limitless.

Project Goals/Objectives: -

- To monitor/identify the student face during the whole examination.
- To apply constraints during the assessment to stop malpractices
- Increases the credibility of passed students.

IV. LITERATURE SURVEY

The most modern online education that uses Web-based commercial course management software such as Web CT. Because of security vulnerabilities, this software is not widely used for online exams and the system must rely on the honesty of the student. Online course examination is now more efficient than before; online course examination is a necessity to improve safety.

Jung I.Y proposed an enhanced, secure online test management environment mediated by group cryptography using remote ports and input monitoring and control. Holding the online course examination for any substance requires more preparation, whether by a teacher or by university student support. University on the tasks entrusted to it to provide the necessary environment entrusted to it. Everyone is there to serve the student, and we must encourage students and train them for a computerized examination psychologically, note that many universities in the world are experiencing the complexity of computerized testing on their campus. More recent research shows the advantage and disadvantages of using online course examinations, reaching good results showed a positive perception of online examination adoption. Within a Decision Support System Course at Al-Bayt University, they measured student perceptions regarding the use of online examination as an evaluation tool on the university campus.

Online examination and traditional examination, a study was conducted which shows that an online examination has better results than traditional examinations. To date, various techniques are being developed to monitor the examinations

V. PROBLEM STATEMENT

Monitoring student activities during the online exam is a very challenging task in terms of monitoring. During the assessment, the conducting institution has to depend on the student's self-honesty supervision and monitoring is tough as a student can give a test from anywhere. Moreover, students tend to develop new cheating techniques and prevention becomes difficult. The current online proctoring system promises to correctly monitors the student during the online examination but is faulty and is not at all strict. Students cheat a lot and the system sometimes is just a decoy by simply switching on the webcam. and doesn't serve an actual purpose rather than tricking the students. Therefore, an automated suspicious activity detection system is required to help detect and stop these suspicious activities.

The current system only proposes and does not deliver without calling out names there are many big names whose tests are cleared with cheating and their proctoring system fails to do stop these practices. Therefore, an online exam proctoring system is required which monitors students with the help of various AI techniques activity and warns the students if any of the activity is suspicious.

VI. PROBLEM SOLUTION

So, with this system one can monitor the student's activity (particularly the face) to look for suspicious activities by doing so we minimize cheating and make the online assessment more legitimate and reliable. Our system will enhance the current system by accurately measuring the behavior of the student. To detect faces effectively, we have used the viola jones detector which detects faces fastest making our project particularly faster than others, it uses Haar based features. To recognize faces and detect suspicious activities we have used CNN All t of these make our system fast and efficient, our system consumes less storage and processing power and can be employed in a low spec computer too.

VII.PROPOSED MONITORING PROGRAM

During an online test, the challenge is detecting anomalous behavior.

The proposed system consists of two modules:

- Face detection (Viola jones algorithm)
- Efficient face recognition (using a neural network)

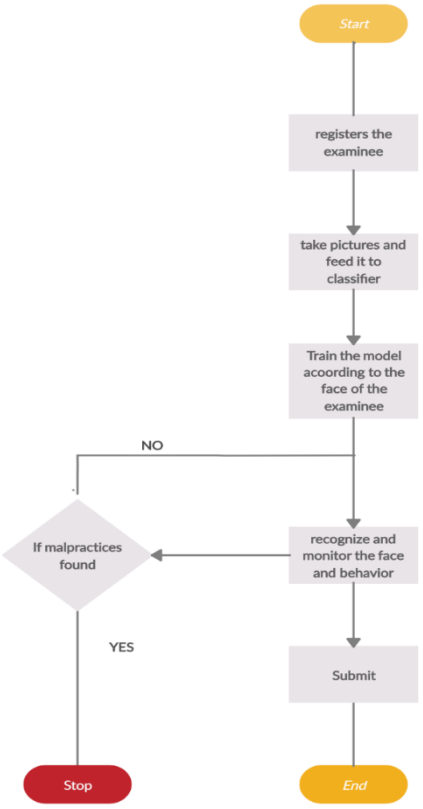

FIG.1: SYSTEM WORKING

VIII. MODULES

There are three big things that we need to take into account the algorithmic approach towards this method. apps, innovation, and safety. The proposed system has multidimensional reach for all of the three dimensions listed.

To achieve the desired performance, numerous features such as image processing, video processing, audio processing, and remote procedure invocation must be introduced. Security measures should be implemented in the implementation and deployment processes of the proposed system as it is a fully automated framework that gathers all of the proctoring data which may include personal data of the applicant. The technical framework used in all planning processes must be properly capable of handling all the complex data analysis and outcome generation.

Also, the built program will work perfectly well on the device with basic technical requirements since the end-users will mostly be the college students who usually use PCs with the average specification. Authentication is one of the methods used to protect personal identity; it also seeks to verify that users are the ones who claim to be. Unlike face-to-face tests, the online exam has no proctors or watchdogs. They are kept in a separate remote area, and unregulated. As a result, online exam authentication goals are important to check the identity of online students, as they play a key role in security.

There are two forms of authentication: static authentication and continuous authentication. Static authentication refers to the authentication that takes place at the beginning of the test, and will also be valid for the entire period until the user logs out of the examination. Continuous authentication refers to the authentication that will begin after the start of the test and will verify whether the current user is the same as the user who began the test or not.

To completely monitor the student's behavior and look for any anomalies we have the following steps:

1- Motion / object Detection (Face Detection).
2- Recognition of Objects (Facial recognition).
3- Monitoring of objects and evaluating and interpreting actions and activities.

A. VIOLA JONES DETECTOR:

Voila-Jones algorithm is an algorithm originally used to detect Arti-facts. The Voila-Jones detector consists of four main ideas:

- Haar features,
- The integral picture,
- Classifier learning with AdaBoost,
- Cascading,

also known as a summed-area table, is an algorithm used to measure the LBPH (Local binary pattern histogram) of rectangle subset of an image quickly and efficiently.

A hair-like function considers adjacent rectangular regions in a detection window at a particular location, sums up the pixel intensities in each region, and calculates the difference among these numbers. The difference is then used to categorize an image's subsections. For example, for a human face, it's a common occurrence that the region of the eyes is darker in all faces than the area of the cheeks. A typical hair detection feature is, therefore, a collection of two adjacent rectangles above the eye and the area of the cheek.

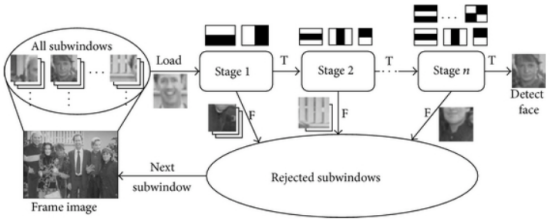

FIG.2: PROCESS OF CASCADING

Haar feature is like a convolutional kernel used in CNN which is used to detect Haar feature in an image Viola and Jones applied the integral image to compute Haar-like features easily. Once we have calculated Haar features algorithm uses 24*24 pixel windows to start evaluating these images and considering all possible parameters of Haar features(position, scale, type) we end up calculating 160000+features in a window(not possible in real-time).So we reduce the redundant features down to the most important feature this is basic dimensionality reduction and in this case, AdaboostIntegral image is

instead of summing up the entire pixel image we only sum up the top to the left making the algorithm computationally inexpensive and more efficient in real-time. The last step is cascading which is splitting the 24*24(window) features (2500) into several stages. This reduces the non-face images quickly hence detecting face quickly.

B. NEURAL NETWORK:

Neural networks are computing systems that are vaguely inspired by "Human brain" and function like neurons in the human brain, they have outstanding performance compared to traditional machine learning techniques, neural networks consist of an input layer and an output layers and one or more hidden layers of each layer containing a select number of neurons that are building blocks Of the entire network. They are quite optimized for finding patterns that are far too complicated for traditional computational models. They have only been a big part of artificial intelligence in the last few decades, typically outperforming any established classical machine learning classifier. The input layer (X) is the leftmost layer in this network and the neurons within the layer are considered the reference neurons.

The most correct or the main layer contains the main neurons, or a single output neuron (Y), 'as in this case. The layers in the middle are called hidden layers since the neurons in these layers are not inputs or outputs. The architecture of the network includes the specification of its scale, distance, and activation functions for each layer. The profundity is the number of hidden layers. Width is the number of units (nodes) on each hidden layer, as neither the measurements of the input layer nor of the output layer are tracked. There are a variety of activation functions, such as the rectified linear unit, hyperbolic tangent, etc. Research has shown that deeper networks outperform networks with more secret units. It's always safer, therefore, and it won't hurt to train a deeper network (with lower returns). Given the input of M training examples, each layer of n neurons calculates the following fine transformation.

$Z = W*T + b$

Using input from its previous layer consisting of n' neurons (where W is the mass of the current layer and the matrix of n by n'), T is the output of the previous layer and the matrix of n' by M, b is the bias of the current layer and the matrix of n by 1) and then applies the activation function g(z) such as RELU the element-wise. This is achieved beginning with the first layer and continuing to do the same transformations until the output layer and this is called forward spread. RELU is used to trigger outputs in all layers except the output layer, typically the sigmoid activation is used in the output layer. The threshold is used to evaluate the class to which each instance belongs, either 0 or 1 that is named Y'.

The cost function (L) is determined after forwarding propagation which is the Mean Square Error between prediction Y ' and ground truth labels Y.

$L = 1\ n\ \Sigma\ (Y - Y')\ 2$

Propagation forward and backward is done until the (loss function) converges to a local minimum which results in a very small classification error. Usually, the testing data is split into train and test data for cross-validation purposes.

IX. RESULTS AND DISCUSSION

From the study, it is observed that Haar cascade has the fastest performance time however the correctness is not high(because results depend on Haar-like features/weak classifiers).CNN has a high detection rate but detection is slow due to the complexness of CNN. To improve the performance and give satisfying results we used CNN and Haar-Cascade both.

It can be seen that the precision obtained for the system as a whole (0.97) and the F1 Rating (0.88) beats the accuracy (0.73) and F1 rating (0.46) of the neural networks, this may not be intuitive. This is because the neural network state decision is more prone to the classification of a single frame, whereas the overall system decision is based on a looser threshold which depends on a sequence of N-frames (in our case 10 frames).

So, for example, if the neural network fails to identify an abnormal condition in one frame of the ten frames, there is still a high likelihood that the device will still mark the action of the ten frames as anomalous since there are nine other frames that can lead to reaching the threshold. In other words, the probability that the neural network's misclassified condition will be the deciding factor in classifying the actions of the ten frames is minimal (meaning the misclassified frame will be responsible for making the number of suspect frames lower (or greater) than the threshold. The performance for the overall system according to the confusion matrix in Table 5 is quite good, there are only three cases reported as false negatives, predicted as non-anomalous but they are anomalous in reality, and zero cases as false positives.

In this paper, face detection is done using Haar - cascade algorithm. By following this process, there will be an accuracy of 93% in the recognition rate.

ALGORITHM	LDA	PCA	HAARCASCADE + CNN
RECOGNITION RATE	80%	85%	93%

FIG.3: PERFORMANCE ANALYSIS

X. CONCLUSION & FUTURE SCOPE

It can be concluded that the proposed system has an exceptional recognition rate(93%) making the system more accurate than current online procurement systems also the constraints applied(multiple face detection, face tracking) to stop malpractices are a lot more strict than the current systems(which are too much forgiving) often students easily find loopholes in it and cheat freely which was seen in code-vita 2019(a reputed online coding test)

where multiple students simultaneously gave test helping each other made to test a single student, which could have been stopped with our system. Therefore, it can be concluded that our proposed system not only has a higher accuracy but is more efficient in stopping malicious activities that the current system fails to do.

So, this system can serve as a useful monitoring system for educational institutions. Autonomous facilities such as an object moving tracking algorithm will be considered in the framework for a smart surveillance system in the future. Additionally, frames of high quality can be captured using smarter web devices. Additionally, distance learning programs can integrate this system with their video conferencing system to monitor the student. Their actions during the lecture and their expressions can be monitored for a better understanding of the study material and to keep a check on them.

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