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Face Recognition with Machine Learning

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Abstract: *In this paper, we proposed a facial recognition system using machine learning, specifically support vector machines (SVM). First, a training set of different persons' faces has to be collected and used to train a face recognizer. The resulting face model can be utilized to classify people in specific individuals or unknowns. It is called a Biometric Identification based application that uniquely identifies each individual by analyzing their facial expression, face. Even though it was initially used as a computer application, it has gained broader uses in mobile platforms and other technology sectors. Facial recognition technology has become very popular and is being used everywhere from shopping Centre, airports, venues, and by law enforcement. This technology can also be used to prevent crimes such as shoplifting by identifying ex-cons. Although this technology is gaining widespread use, there are many concerns about privacy and safety. Online examinations have turned out to be the new normal. However, it is not that easy to proctor the students as rigorously as in in-centre examinations. It is essential to find an approach to proctor the online examinations too as rigorously as possible.*

Keywords: Machine Learning, Support Vector Machine. Face Detection And Recognition and Monitoring of Students During Online Examination

I. INTRODUCTION

Today's pandemic situation has transformed the way of educating a student. Education is undertaken remotely through online platforms. In addition to the way the online course contents and online teaching, it has also changed the way of assessments. In online education, monitoring the attendance of the students is very important as the presence of students is part of a good assessment for teaching and learning. Educational institutions have adopting online examination portals for the assessments of the students. These portals make use of face recognition techniques to monitor the activities of the students and identify the malpractice done by them. This is done by capturing the students' activities through a web camera and analyzing their gestures and postures.

Image processing algorithms are widely used in the literature to perform face recognition. Despite the progress made to improve the performance of face detection systems, there are issues such as variations in human facial appearance like varying lighting condition, noise in face images, scale, pose etc., that blocks the progress to reach human level accuracy. The use of m-learning or other remote education continue to increase due to its ability to reach people who don't have access to campus. Exams are important components of educational programs as well as on an online learning program. In an exam, a proctoring method to detect and reduce the cheating possibility is very important to ensure that the students have learned the material given. Various methods had been proposed to provide an efficient, comfortable online exam proctoring. Start with implementing an exam design with hard constraints in a no proctoring exam, a remote proctoring using a webcam, a machine-based proctoring and finally research on automated online proctoring. A visual verification for the whole exam session is needed in an online exam, therefore a face verification is needed. A remaining problem in face recognition area is the system robustness for pose and lighting variations. In this paper, we proposed a method to enhance the robustness.

The improvement of e-learning and online evaluation frameworks is increasing rapidly. The Main Goal is to develop a model which is intended to distinguish the ordinary examples for activities of concern, for example, conversations during a test or the pivoting, processes more exactness and computes more accuracy. Certain presumptions about normal behavior with regards to delegating tests are made. In the existing system, it takes more computational power and speed is less. Even though it computes not much more accuracy and with the system only able to manage one invigilator for twenty

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students. Thus, it is important to develop a framework which is high precision and less the manual force. As a result, the basics of the proposed method is presented in this paper.

II. Literature Review

Due to the significant development of machine learning, the computing environment, and recognition systems, a lot of investigators have closely work with recognition algorithms and identification using different building modelling strategies. Here are some of the most common recent works on FR systems.

A. A. Sukmandhani et al. [1] in this paper, face detection calculation on an equipment stage, which is basic, yet productive in utilization is haunted. the merchandise source codes for both detection and recognition of countenances are composed utilizing OpenCV

Sanghyuk Kim et al. [2] in this paper a facial expression recognition system that was based on features of images. There were a couple of processes related to the detection of the face and recognizing facial expression. In the process related to detecting the face, the area of interest is set again to reduce changes. After extracting a histogram of directed gradients (H.O.G.), features from each facial region, the F.E.R. process is performed to identify the final expression of the face.

H. Baqeel et. Al [3] in this paper that in this Real Time Face Detection and Tracking Using OpenCV writer used three distinctive algorithms like Haar cascade, Adaboost, template matching was once described. all through this paper, they symbolize a method for face detection robustly in actual time environment. Here Used of Harr-like-classifier and adaboost algorithm in this it tracks to faces on OpenCV module to detect.

E. García Amaro et al. [4] in this paper, a facial recognition system. A face detection algorithm is used to extract the face from video frames and creating a database. Next, preprocessing is performed on images of faces obtained. Next, specific ML algorithms are trained using images of faces obtained as inputs. And then, classifiers are used to classify. Results show that this approach is suitable for analyzing videos where previous face labels are not available.

T. Kundu et al. [5] in this paper, Describe recent developments in approaches and methods used to gauge the 5 primary emotions or moods often recorded in human-faced photographs. The primary emotions are normality, happiness, drowsiness, disgust, surprise by automatic machines. The focus is on ANN and SVM in classifying emotions. First, the technique analyses the information retrieved by the facial regions of the eye and mouth into a combined new image and used as an input to a neural network trained in backpropagation. The second approach demonstrates the use of Oriented Fast and Rotated (O.R.B.) to extract texture information on a single frame of images.

Mullainathan Sendhil et al. [6] in This paper shows a machine learning way of thinking that gives it its place in the econometric toolbox. It is given that, machine learning revolves around the issue of prediction: generate predictions of y from x and other economic implementations; instead, it revolves around parameter estimation: generate reasonable estimates of parameters β that underlies the relationship between y and x, and it is essential to remember that machine learning algorithms are not built for this reason. Different categories of applications of ML to economics are given. Then how machine learning works and how machine learning can be applied is given.

J. C. T. Kwong et al. [7] in this paper, 12 potential variations of Key Facial Detecting, Saliency Mapping, Local Binary Sequence, and Oriented Gradient Histogram was investigated along with 6 machine learning classification algorithms that produce a total of 72 models. The emotions are listed as fear, sadness, joy, surprise, neutral, disgust, and anger. For “in the wild” image processing and analysis, a stratified tenfold crossvalidation is conducted on both the CK+ dataset and the locally gathered data collection. Via this analysis, it was determined that of the 72 simulations, the RBF SVM HOG+LBP model achieved the highest average accuracy of 0.94, with an F1 score of 0.93 across the seven emotions.

Farhad Navabifar et al. [8] in this paper, New facial recognition techniques are classified as the classifier of faces and non-faces based on four traditional machine learning techniques. The methods for evaluating different techniques are compared with one another. A general face detection block diagram is given. The reported performance is given as a classifier for face detection systems of some different approaches and different machine learning. It was found that while it was possible to detect multiple frontal faces in pictures, detecting faces in complex surroundings with subjective perspectives and different speech and occlusion would require further attention.

Artiges, Caron et al. [9] in this paper titled “Strengths and Weaknesses of Deep Learning Models for Face Recognition Against Image Degradations” goes in depth regarding strengths and weaknesses of using Convolutional Neural Networks (CNN) in face recognition, specifically against low quality images. The article mainly discusses the ways an image can be

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classified and made low quality, and passes those images to three pre-trained CNN models; the models are VGG-Face, GoogLeNet, and SqueezeNet. The parameters used to lower the quality of the images include: blur, contrast/brightness, partial obstruction of the face, and noise. The research article concludes that the most challenging aspect to tackle in low quality images is blur. However, given proper architecture choices and training procedures for the CNN models, a deep learning model can be trained and made to detect faces in low quality images.

Q. Liu et al. [10] in this paper, the study to have a detailed overview of current security risks from two aspects: the preparation process and the testing / inferring process. Machine learning security threats were categorized into different categories. A description of relevant works on machine learning security was then issued. Adversaries can decrease the performance of classification or regression models in terms of accuracy. Illustration of poisoning attacks was given and also types of poisoning. A comparison was offered for various strategies of attacking against machine learning. They illustrated and compared different defensive techniques. Then trends in research into safety risks and compared different defensive techniques. Then trends in research into safety risks and defensive machine learning strategies were provided.

D. V. Sang et al. [11] in this paper apply recent advances in deep learning to introduce deep CNNs that can automatically decode semantic data in faces without hand-designing feature descriptors. Few distinct types of CNN architectures for recognizing facial expressions were proposed. The different layers were convolution, pooling, and fully connected layers. Some changes are also proposed to avoid overfitting. Data preprocessing and normalizing is implemented. Data augmentation techniques are also applied. In the training phase, the loss function is minimized. For testing, the original data set was divided into training and validation sets. FERC 2013 dataset was used. Data augmentation improved the model's accuracy.

III. Proposed System

In this System we purposed online exam system with face recognize using machine learning algorithm and also used Dlib library to detect the face. It will detect the student who giving the test and detect the face compare with uploaded photo present in database. It will give wronging if other person detect in the camera or more than one person is in frame

1. Provide user-friendly environment to conduct exams effortless.
2. Reduce exam anxiety and feeling of partiality among test takers by promoting fair exam.
3. Automate the marking system to relieve the human work and reduce human errors.
4. Take preventive measures to avoid possibility of secretly using unfair means to minimize cheating cases.
5. Safe and secure environment to manage the crucial data related to examination as well as candidates and organizers.
6. To reduce organization's administrative burden also save cost and time.

IV. Architecture Design

4.1 System Architecture of Facial Recognition

The architecture of the System consists of three modules, namely:

- **Enrolment Module:** It scans and captures analog or digital image of a living being.
- **Database:** An entity which handles compression, processing, storage and also accounts for comparison of the captured data with stored data.
- **Identification Module:** This module interfaces with the application system

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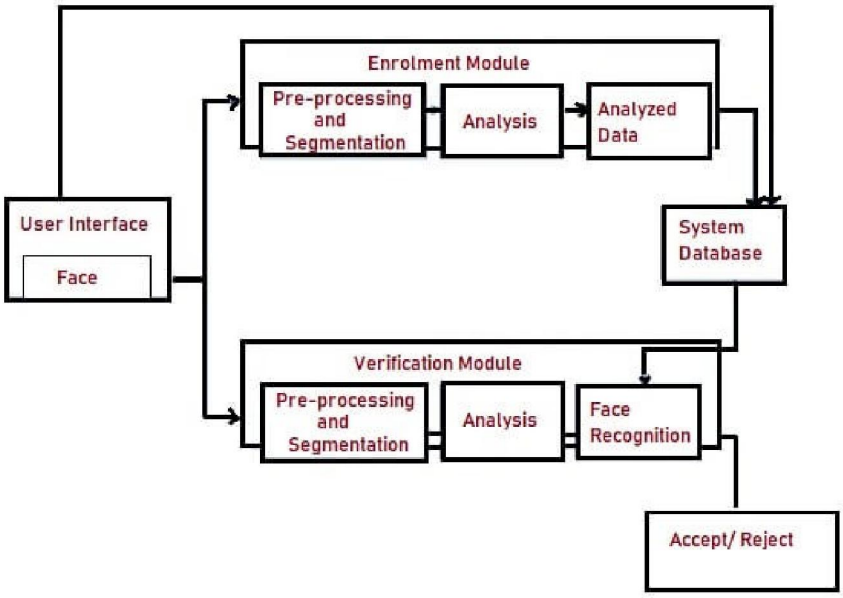

Figure 1: Architecture of Facial Recognition System

Facial Recognition process generally includes three stages:

- Face Detection
- Feature Extraction
- Face Recognition

A. Face Detection

It accepts the image as an input and checks if 'Face' appears in the image and calculates its position on the image. The output of this stage is 'Patches' which contains 'Face' and Face alignment is done which acts as pre-processing stage for

B. Feature Extraction

Face Patch is transformed in to a set of Fiducial Points corresponding to their locations or it is transformed into vectors with specific dimension.

C. Face Recognition

This step includes recognition of Face from the database. When the system receives Face image, it undergoes Face Detection and Feature Extraction process. Then, the features are compared with each Face in the Database using the nodal points on the Face.

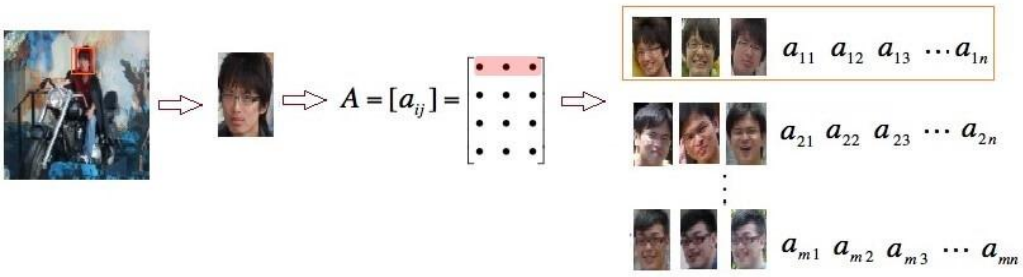

Figure 2: Different Stages of Facial Recognition System

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Identification and Verification procedure is carried out where the system makes a probable identification of the Image and is verified whether the probability is True or False. i.e. comparison of the input vectors with the stored vectors in the Database occurs using different classification techniques.

4.2 Algorithm

You might be good at recognizing faces. You probably find it a cinch to identify the face of a family member, friend, or acquaintance. You're familiar with their facial features — their eyes, nose, mouth — and how they come together.

That's how a facial recognition system works, but on a grand, algorithmic scale. Where you see a face, recognition technology sees data. That data can be stored and accessed. For instance, half of all American adults have their images stored in one or more facial-recognition databases that law enforcement agencies can search, according to a Georgetown University study. So how does facial recognition work? Technologies vary, but here are the basic steps:

- **Step 1:** A picture of your face is captured from a photo or video. Your face might appear alone or in a crowd. Your image may show you looking straight ahead or nearly in profile.
- **Step 2:** Facial recognition software reads the geometry of your face. Key factors include the distance between your eyes and the distance from forehead to chin. The software identifies facial landmarks — one system identifies 68 of them — that are key to distinguishing your face. The result: your facial signature.
- **Step 3:** Your facial signature — a mathematical formula — is compared to a database of known faces. And consider this: At least 117 million Americans have images of their faces in one or more police databases. According to a May 2018 report, the FBI has had access to 412 million facial images for searches.
- **Step 4:** A determination is made. Your faceprint may match that of an image in a facial recognition system database.

4.3 Mathematical Model

A mathematical model is a description of a system using mathematical concepts and language. A model may help to explain a system and to study effects of different components of a system to predict the behavior of system. The mathematical modeling for our system is as follows

$S= \{\sum, F, \delta, C\}$

Where S = Face Recognition.

$\sum$ = set of input symbols = {Video File, image, character information}

F = set of output symbol = {Match Found then notification to user, Not Found}

δ =1. Start

2. Read training set of N*N image
3. Resize image dimensions to $N^2 * 2$
4. Select training set of $N^2 * M$ Dimensions, M: number of sample images
5. Find average face, subtract from the faces in the training set, create matrix A

$$\Psi = 1/M \sum \Gamma i$$

Where, Ψ= average image,

M= number of images, and

Γi= image vector.

$$\Phi i = \Gamma i - \Psi \qquad \text{where, } i = 1, 2, 3, \ldots, M.$$

$A = [\Phi 1, \Phi 2, \Phi 3 \ldots \Phi M]$

6. Calculate covariance matrix: AA'

$$C = C^A * A$$

7. Calculate eigenvectors of the c covariance matrix.
8. Calculate eigenfaces = No. of training images –no. of classes (total number of people) of eigenvectors.
9. Create reduced eigenface space. The selected set of eigenvectors are multiplied by the A matrix to create a reduced eigenface
10. Calculate eigenface of image in question.
11. Calculate Euclidian distances between the image and the eigenfaces.

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12. Find the minimum Euclidian distance.
13. Output: image with the minimum Euclidian distance or image unrecognizable

C = {The system will not process the audio data, Eigenfaces will generate the grayscale images, The algorithm will run only on key frames.}

V. METHODOLOGY USED

To solve the problem of online exam cheating we are also add some more features mobile detection, detection of more than one person in the exam, Gaze Estimation: Estimating the position of student body & eyes movements, Taking Students images logs at every 5 seconds, CUT, COPY, PASTE, Taking Screenshots Function is disabled.

5.1 Requirements

- OpneCV
- Dlib
- Aforge

For counting mobile devices and persons during the exam periods on web cam, we used the pre-defined weights of YOLOv3 trained on COCO data set to detect people and mobile phones Also, we have aim to track eyeballs of the test-taker and report if he looks back or left and right using the Gaze tracking Module.

VI. ADVANTAGES, DISADVANTAGES AND APPLICATION

6.1 Advantages

- Increased Security– With the help of this technology, it is easier to track down any thieves or other trespassers and it can also help identify terrorists or any other criminals with the help of the face scan only.
- Fast and Accurate– The process of recognizing a face is very fast, takes a second or less.
- Automation of identification– Now there is no need of human assistance for identification process. Identification process is completely automated Facial Recognition technology and not only takes seconds but is also incredibly accurate.
- Cost-efficiency– Since this technology is automated, it also reduces the need for human assistance to personally verify a match. This means, it can save costs on hiring security staff and other security measures.
- No Contact– It is preferred over other bio-metric options like fingerprint scanning because of its non-contact process. People need not to worry about the problems related to fingerprint identification technology such as germs or smudges.
- Easy integration– Mostly, Facial Recognition tools work seamlessly with the existing security software.

6.2 Disadvantages

- Surveillance Angle – Identification process is under great pressure of the surveillance angle that was responsible for face capturing. To capture a face through the recognition software, the multiple angles are being used.
- Data Storage – Data storage is gold in today's world. To store many thousands of faces, lot of space is required.
- Legislation – There are concerns that bio-metrics is progressing too rapidly for regulators, legislators, and the judicial system to set up standardized rules and precedents around their use.

6.3 Application

- The Facial Recognition system has been used in a variety of fields for many applications. Day by day, the use of this technology is increasing. It is used from business solutions to solutions for the home.
- One of the most important use of the face detection and recognition is monitoring student during online exam. Also used in attendance of students in class. This technology also use big tech company's like apple, one plus, mi to make system of face lock to unlock phones. Its perfect way to protect private information in case phone stolen or lost. Another critical use of Biometric technology is to grant only authorized people entry to sensitive areas of offices, labs, boardrooms, bank vaults, government buildings, and public events for security reasons.

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- Face recognition can also be used in customs to keep any unnecessary visitors out of the country. We can use this to compare the face with passport photo. Many countries are using this technology. This must be used in India where many people use others I.D for voting this is illegally for money

The applications include:

- Unlock Phones
- Find missing people
- Track attendance
- Computer security
- Banking using ATM
- Identify people on social media platforms
- Recognize VIPs at events
- Prison visitor systems
- Border control
- Voting system
- Physical access control of buildings, areas

VII. CONCLUSION

This paper gives an overall information about Facial recognition system for online proctoring system using global approach to feature extraction based on Histogram-Oriented Gradient. An approach this paper for real-time face detection and tracking which can be very useful for machine interaction systems. In a machine interaction environment this system starts with accurate Real time learning process and then allows the machine to follow the person and to be sure it is always interacting with the right one under a wide range of conditions including: scale, pose and camera variation. The face tracking system works as a pre-processing stage to the face detection system, which allows it to concentrate the face detection task in a sub-window previously classified as face. Then we also extracted the of SVM (support vector machine). Running the model on both train and test database, resulted in over 90% accuracy in matching the input face to face correct person from the screen. face recognition with the its confidence level these all will be possible future enhancement for Face Detection with Machine Learning

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