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# Face Detection and Head Movement Analysis for Online Examination Using Artificial Intelligence

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**ABSTRACT:** Human face detection has become the Major Importance field of interest in the current research because there is no deterministic Algorithm to find the face in the given image. Further the Algorithm that exist are very much specific that they would take the Input and detect the faces. The development of the technology i.e., the Biometric systems are highly developed for use in various applications. Biometrics are usually used to identify the characteristics of the human body such as the eyes, nose, mouth, finger prints, sound pattern, facial patterns and other body structures. The characteristics are generally used for the system authentication. The facial recognition system have developed a lot for the various application including security system, attendance system and many more other things. The facial recognition system is particularly used for the presence of a person, this is continuously a recurring transaction and hence it is one of the major applications for To-days On-line Examination system. The development of the attendance system helps in controlling the presence of the person in an on-line examination and it is one of the important field to make sure the presence of the person or student or employee as a part of good assessment for teaching and learning. The research of this paper develops an application to detect the faces or the Images or Live Web-cam using Haar - Cascade Algorithm or Artificial Intelligence. The Head movement is analyzed by the Integral values of the given image.

**KEYWORDS:** Face, Detection, Head Movement Analysis, MATLAB RGB IMAGE, Round Rectangle, Integral Image Kernels.

## I. INTRODUCTION

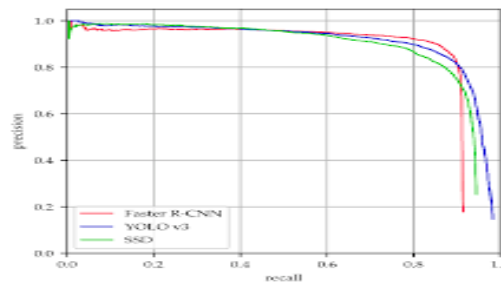
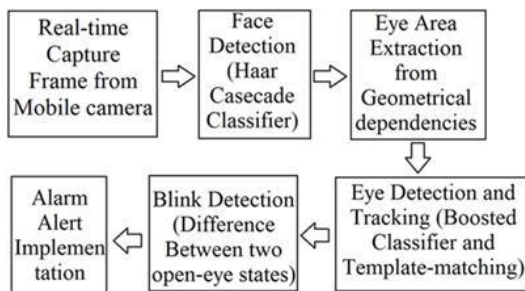
In this Project, we are creating an application that detect Faces or Images and Live Web Camera. Facial Recognition is one of the important major concept fields to make sure of this. On-line Examination is one of the fast-developing Examination. Because of its accuracy and speed, Manpower in On-line Examination is less comparing to the Off-line Examination. Almost all the Organizations in the entire world are managing with the On-line Examination system, since it reduces students time in exam. The Invigilators or the Monitoring person can easily see the students progress. The Results for the students Examination can be finalized in a very short time. Online Examination is a paperless examination since the paper is All Digital and it is really very important for the Educational Management to handle the Answer Sheets and it is automatically evaluated by the system programs software. Examination helps the Management to monitor the students' progress in their academics. Till to-day, the Examinations were conducted off-line, consisting of papers and other stationery then. But, now the work easier and could reduce the cost and need not want the stationery things and it is less cost. Conducting On-line Examinations also helps in individual attention of the pupil. The on-line examination can be improved by giving the proper technical support. At the same time, it is also very very important to make sure that the correct/right person is appearing for the Exam. During the On-line Examination, there is a tendency for the students or the persons taking part in the examinations of copying. To avoid this and to monitor the students, I create or develop an application to detect and recognize if the same person is taking the exam. For this creating an application and detected the faces or images and on this line, Web-cam is the right machine to capture the images. There existed many applications to detect and recognize the faces or faces such as the detection of the face by Deep Learning Conventional Neural Network (CNN), eigen faces Algorithm, MTCNN (Multi-Task Cascaded Conventional Network Algorithm) and finally HOG is the fastest Algorithm followed by Haar-Cascade Classifies and CNNs. Here the Project describes the Haar-Cascade Algorithm. It is a feature-based object detection Algorithm to detect objects from images. A Cascade function is transformed on lots of positive and negative images for detection. The Haar-Feature Algorithm does not require more computations and can run in real-time. Here in an Haar-Cascade Algorithm, the machine is well-suited for detecting the object with the visual features such as faces, eyes, or ears etc., Here, the cascade transforms the weak classifiers on a large number of positive and negative examples. This is one of the most promising applications in the field of image analysis facial detection in the pictures is complicated due to the variations in the position of the pictures such as the pose, expression, position and orientations skin, color, the presence of glasses or facial hair, differences in the camera and so on. Facial detection algorithms use many algorithms from the traditional techniques to the modern deep- learning techniques. The traditional approach use the pre-defined visual

patterns to identify the faces. Deep-learning methods use neural networks to detect and analyze the head movements. The face detection algorithm extract thee features from the that images or video feed that helps to differentiate between the faces and other objects. These features include the color, feature patterns, geometrical proportions or many more. The analysis of these features help region containing the face. The challenges in determining and handling various lighting conditions include the movements of the head towards left, right, up and down. Face detection helps in various face related approaches enabling subsequent tasks such as face recognition, expression analysis, landmarks detection, age estimation and many more.

**II. RELATED WORK**

Face Detection in On-line Examination in a well-researched area in the field of Computer-Vision and there have been the numerous potentials in these field of studies. Some of the related techniques of the face detection and Head Movement Analysis are as follows. Viola-Jones Algorithm proposed by Viola and Michael Jones in 2001 i.e., one of the oldest and the best algorithm to detect the faces on the images and the live video/web camera. It is one of the most influential methods for detecting the face. It uses the Cascade of simple Haar like features to detect the faces and also uses and employs the Ada Boost efficient features selection. Hog-Histogram of Oriented Gradients face detection method introduced by Navneet Dalal and Bill Trigs in 2005 calculates the gradients histograms to recognize the faces. These are used to train the classifiers such as (SVM) for face detection.

**Scale Invariant Feature Transform (SIFT)** This was proposed by David Lowe in the year 1999. This feature is basically used for the various computational vision-lasts and it is a descriptive Algorithm for various Vision-lasts including face detection. Here, SIFT is robust to scale, relation and illumination changes. This is the best suitable technique for detecting the faces in challenging conditions.



**Conventional Neural Networks: CNN** – This is a Deep Learning based approach in current technological-methods. The CNN methodology is the best suited for the facial detection. In recent years the best suited method for the face detection. Models like R-CNN-Regions for conventional neural network. Here, the fast R-CNN and “Faster R-CNN” has been applied to detecting the face. These models are successfully applied on the faces, detecting the power i.e., Conventional network for feature extraction and object localization.



**Joint Face Detection & Algorithm:** The facial detection and the facial landmarks are detected simultaneously. Some of the methods like Dub Library and the method proposed by Znu and Ramanan in 2012. They employed cascaded regression to achieve cascaded regression to achieve both lasts jointly. HRNet – HRNet (High-Resolution Network) is one of the multi resolution CNN Architecture shows the pronouncing results in the face detection It helps capture the

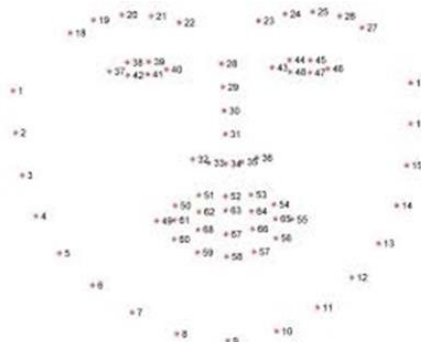


facial detection by maintaining the high-resolution representation throughout the network.

**Mobile & Embedded Face Detection:** Mobile & Embedded Face Detection have gained more computational complexity while maintaining high accuracy.

### III. METHODOLOGY

**Dataset Collection:** Here in this phase the dataset and images or Video frames representing the various head movements are gathered during the On-line Examination. Here we capture the wide range of head postures and rotations such as left, right, up and down movements and tilts too.



**Acquire Image / Video feed:** This phase includes obtaining the images of video feed of the Examination candidate.

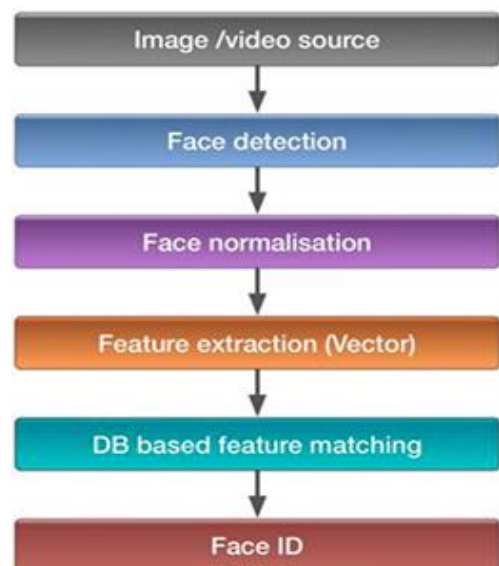
**Face Detection:** The proposed Algorithm such as the Haar-Cascade algorithm is applied on to the images/videos (Preprocessed). The algorithm will provide the bonding bytes of the reflected faces or the rectangular boxes of the detected faces.

**Head Movement Analysis:** Once the facial detection is done, we analyze the head movements by facial landmarks or by employing the optical flow techniques. Facial points are the specific points on the face (E.g., Eyes, nose, mouth) that can be detected using the Haar features and DLib library or using Deep learning facial landmark detection.

**Analyzing the Head Movements:** Using the facial landmarks, movements of the head are analyzed. We can calculate the angle of rotation, tilting heights. Many times, and overall movements of the head rotations and the posture. We can analyze the head movements. If the candidate’s head is moved continuously and suspect the candidate for copying during the on-line examination.

**Rule Based of Machine Learning:** Based on the analysis of the head movements, we can design a machine learning technique to classify the movements as normal or suspicious for machine learning. We need a complete dataset head movement to indicate the normal or suspicious behavior to train a model.

**Testing & Evaluation:** Test the system to ensure the accuracy, reliability and effectiveness, making necessary improvements on evaluating the system’s performance using different scenarios. The problem of face recognition is all about face detection. This is a fact that seems quite bizarre to new researchers in this area. However, before face recognition is possible, one must be able to reliably find a face and its landmarks. This is essentially a segmentation problem and in practical systems, most of the effort goes into solving this task. In fact, the actual recognition based on features extracted from these facial landmarks is only a minor



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- 1) Face detection in images
- 2) Real-time face detection

#### Workflow of Face Detection

1. Load the Haar Cascade Frontal Face Algorithm.
2. Initialize the camera.
3. Read frames from the camera.
4. Convert color images into grayscale.
5. Get the face coordinates.
6. Draw a rectangle and put the appropriate message.
7. Display the output.

#### Data classification

Face recognition algorithms classified as geometry based or template-based algorithms. The template-based methods can be constructed using statistical tools like SVM [Support Vector Machines], PCA [Principal Component Analysis], LDA [Linear Discriminant Analysis], Kernel methods or Trace Transforms.

### IV. SYSTEM DESIGN

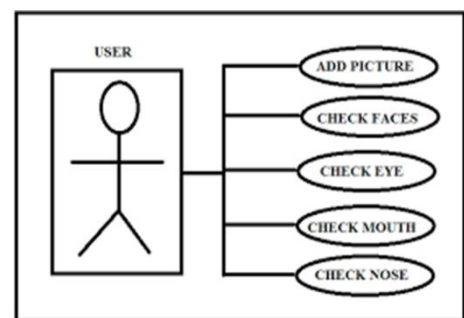
**Image/Video Capture** Camera or webcam for capturing the face or video of the online examination Center. This field can be used to detect the faces and head movement analysis.

**Facial Detection:** To detect the face we use Haar-Cascade Algorithm or Library such as Open CV or DLib to detect the face within the captured video frames. **Facial Landmark Detection:** Once the face is detected, we use facial landmark detection algorithm such as shape predictor from DLib or facial landmark from Open CV. The specific points are located such as eyes, nose, and mouth. This will determine the head movements.

**Thresholds and Rules:** We establish the threshold and rules to determine to constitute the acceptance or unacceptance head movements. We define the limits of head rotations or the time duration for the eyes to be off screen.

**Real Time Analysis:** If the given threshold limits are violated, we provide warnings such as notifications. The immediate feedback is sent to the Exam taker.

**User Interface:** Designed a User Interface such as face detection, head-movement analysis, feed view to the Examiners Video and receives feedback during the examination.



**Data Storage and Data Reporting:** The analyzed data and face detected taken is stores for further analysis, generated reports and alerts based on data collected to identify the suspected behavior. Facial Recognition System one of the many wonders which uses AI to automatically identify a person through a digital image. Facial Recognition is one of the Bio-metric Technology where various facial features are used to identify a person, this system includes Detection of Face, Pre-processing of Facial Nodal Points and Facial Recognition as well .Every individual face has certain distinguishable feature points which paves the way for facial recognition. System Software uses the data and defines these features as Nodal Points.

As many as “80 Nodal Points” can be extracted on an average from a human face. Some of them are listed below.

## IMPLEMENTATION AND TECHNOLOGIES

**Data Collection:** Collecting the diverse dataset of images and videos of the individuals taking on-line examinations ensure the dataset values include various head movements and face orientations to improve the robustness.

**Preprocessing:** Preprocess involves the resizing the images or normalizing videos to a consistent format thus reducing the computational complexity and ensures uniformity across the dataset.

**Face Detection:** Here we could apply any popular algorithm such as

- Haar Cascades
- HOG (Histograms of Gradients)
- Deep-Learning-based Models like Open CV's
- MTCNN – Multitasker Cascaded Conventional Networks

**Facial Landmark Detection:** Once the task of facial detection is employed, the facial landmarks detection algorithm is employed to detect the facial landmarks like the eyes, nose and mouth. These steps help in analyzing the head movements by tracking the position and orientation of these landmarks over time. The commonly used landmark detection are Dlib, Open CV's facial landmarks, data flow or deep learning-based models like Face-Net.

**Head movement Analysis:** The facial landmarks are analyzed to detect the head movements. You can calculate the metrics such as pitch, upwards, downwards, left side, right-side rotations. The optical flow techniques can be used to track or measure the movements of the facial landmarks between the consecutive frames.

**Machine Learning Model:** We train the machine on the collected labelled data to recognize and classify different head movements.

We can also use CNN-convolutional neural Networks or Recurrent neural networks to build models capable of Analyzing the head movements.

**Real-time Analysis:** Implementing the model in the real-time scenario to process video-stream or live webcam inputs in real-time during on-line Examination.

The libraries such as the deep learning frameworks like Tensor flow or py torch can be used.

**Integration with on-line examination platforms:** The face detection and on-line examination is integrated with the on-line Examination pattern. this involves developing the API incorporating with the current software architecture.

**Testing and iteration:** Here the testing is done on the implemented dataset and gathering the feedback and iterate on models and algorithms later improve the accuracy and Robustness.

**Deployment and Maintenance:** Once the system meets requirement specification. deploy it to the online-examination platform Regularly and monitor the outcome and maintain the system to address any issues

**Head movement analysis:** To analyze the head movement, we track the facial landmark or analyze the changes in face position and orientation over time.

All the features along with the head pose angles are fed to the classifier 1 that works with XG boost algorithm. The decision to the machine learning methods that uses the gradient boosting. if eyes are not detected the frame is passed on to the classifier 2, which on the XG boost algorithm.

## V. RESULTS AND DISCUSSION

The Haar-cascade algorithm is the best Algorithm for the face detection and head movement analysis in the computer vision. It uses machine technics to identify the specific features in an image, such as edges, lines or corners and uses these edges, corners to determine the presence of the face. When the images are applied on to the on-line examination, the haar-cascade algorithm can be used to detect and track the head movements of the individual test takers. This analysis will be helpful in the integrity of the examination by detecting any suspicious unauthorized behavior such as looking out of the screen or engaging in an activity that includes cheating or malpractice. The results of face detection and head-movements analysis may vary depending on the implementation and the quality of the input data.

### Integral Image:

Let us assume that the left table is the image given. The right table given is the integral image. if we look at the brightness value stored at any pixel in the integral image say 988, all it is that the sum of the pixels above it, to the left of it, and including it.. Assume another stored value in the pixel say 3490 then the corresponding pixel above it, left of



it , and itself is the integral values of that pixel value.

**Haar-filter or one Haar-filter.**

Consider the White region and the black region. Let’s treat two different rectangles so there are four-pixel values for the white region and the black region. The final result is the. Sum of intensities of the white region minus of the sum of intensities of the dark region. All you need is 7 additions

98	110	121	125	122	129
99	110	120	116	116	129
97	109	124	111	123	134
96	112	132	108	123	133
97	113	147	108	125	142
95	111	168	1122	130	137
96	104	172	130	126	130

image I

98	208	329	454	576	705
197	417	658	899	1137	1395
294	623	988	1340	1701	2093
392	833	1330	1790	2274	2799
489	1043	1687	2255	2864	2531
584	1249	2061	2751	3490	4294
600	1449	2433	3253	4118	5052

integral image II

98	110	121	125	122	129
99	110	120	116	116	129
97	109	124	111	123	134
96	112	132	108	123	133
97	113	147	108	125	142
95	111	168	1122	130	137
96	104	172	130	126	130

image I

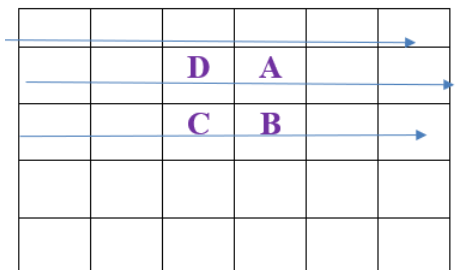
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image I

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96	104	172	130	126	130	S	600	1449	2433	3253	4118	5052	p

image I

integral image II

## VI. CONCLUSION AND FUTURE WORK

The application model provides the strong believe for all the organizations, that they would like to build for an on-line examination system. The face detection component ensures the presence of the human participant during the examination. By analyzing the video feed and the uploaded images, the application model system can detect and verify the identity of the test taker or the individual participant. This prevents cheating or malpractice during te examination ensuring the integrity of the examination process.

Head movement analysis plays a crucial role in to monitor the attentiveness and engaging the test taker, by tracking the head movements, the system can assess the concentration and the alertness of the individual taking part in the Examination. The information that is gathered can also be used to identify the potential signs of the disengagement and distraction allowed to promote the intervention if necessary.

Overall, the combination of the face detection and head movement analysis provides the best solution for the exam takers and also to maintain the fairness and authentication.

By leveraging AI algorithms, the system can accurately identify and detect the test takers, while monitoring the attentiveness and alertness throughout the examination.

This not only prevents the malpractice bt also promotes the trustworthy environment for the on-line examination assessments.

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