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Attendance Monitoring System using Multiple Facial Recognition

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***Abstract:** Attendance is used to keep track of students in all educational institutes but it is a very time taking process to mark the attendance individually. To reduce time taken in this process and to improve work experience for the teachers and also for students, the software is built in order to provide better efficiency. Face recognition is used and utilized to find and recognize the student' face for keeping the attendance up to date. The project also includes the self-learning model to keep a better record of recognizable faces. Attendance is marked when the face is recognize. If the face have low confidence level, then the model is further trained to recognize that particular face. This helps in improving the efficiency of recognizing the faces.*
***Keywords:** Attendance monitoring system, face recognition, artificial intelligence.*

I. INTRODUCTION

Attendance Management System is software developed for every day attendance in schools, colleges and institutes of students and faculty. It facilitates to mark the attendance of a particular student in a designated class using facial recognition. The attendance of students is marked after the face is recognized without any further efforts. This system will likewise help in assessing attendance eligibility criteria of a student. The reason for this examination is to recognize the issues with respect to the attendance management and to execute what is required by the school to ease the process. This work is to enhance students' and teachers' attendance performance and to provide school an advancement. This study will provide a system to help the faculties and make their attendance checking simple and their work with less exertion. The system provides a user-friendly environment and effective performance system. This will give a simpler and quicker admittance to the information of each student and faculty in their Attendance Report.
This study is to provide a solution to the issues in the current existing system and to create a system that will help the school and other institutions to make the attendance monitoring more precise and to demonstrate that the system developed is compelling and accommodating.

II. LITERATURE REVIEW

So far lots of efforts and research has been made to find different ways to get the best of attendance monitoring system for the educational institutions. These techniques differ regarding the sorts of info strategy utilized and the regulators used to actualize the frameworks. The initial frame of the study is to analyze crowd.
.Crowds can explicate as a cluster of spatially proximate objects in any class. The attendance monitoring system analyzes higher density human crowds. There are several reasons that makes face recognition in crowd challenging. Initially, lower resolution of sample frames which reduces the chances of spotting. Partial obstructions are common in crowds and the differences in posing, dresses and light intensity makes it a tough task. So detecting the faces individually as the main element is not the right approach. While a task that is focused on more people in the crowd is faced with the problem of modeling a wide range of variations in their combined appearance. Also, certain aspects of the crowd such as the separation of people from the crowd are important factors.
The project[1] is based on above specified flow of work and proceeds to the detection and recognition of people in largely crowded areas instead of carving individual interaction of the people, the work utilizes information at a global level provided by the form of scene and crowded area. Several crowd detection technique keep away from hard detection task and try to deduce people count straight from low-level image evaluation. These techniques provide people count in image areas but are unsure about the position of detected faces. The approach is confirmed on challenging crowded area from multiple video data-sets.
This work [2] mostly relies on head detection for counting the number of person from an initial frame. For detection of heads in the source image firstly the point of interest is detected using gradient details from the grey-scale image. This probably gets the upper part of the main region to narrow down the search area Interest points in the source image are hidden using the front region area obtained using the background removal process. After that a small window is put that contains points of interest based on information in the estimation of the concept and is positioned as the main or non-head region which uses the division. Several nearby findings were finally combined to obtain non-facial results.

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III. EASE OF USE

A. Hardware Requirements
Android Device
A central server system

B. Software Requirements
1) Operating System: Android
2) Database: Mysql
3) Wi-fi connectivity

C. Functional Requirements
Easily mark attendance of students.

IV. ANALYSIS

The project has below mentioned phases:

1) Development of Face Recognition System.
2) Development of Attendance Marking System.

Face recognition is done with the help of machine learning algorithm and the basic approach used for it is as follows:
a) Finding a face in an image.
b) Analyzing the detected facial features.
c) Comparing against face dataset and analyzing of confidence level of the outcome
Development of an absolute attendance marking system is achieved with the help of UI and Android applications. Here the application captures the video of crowded students with the details of subject, faculty, date and time. The video of students is captured and frames of the video are sent to the Linux server where the python script runs to mark attendance. [3]

A. Algorithm Used For Face Detection
The face extraction from an image is a convenient process. Face detection from all the different angles follows the further defined process. Extraction, face detection using Haar-cascading and afterwards filtering the false positive cases using CNN. The work [4] comprises of following steps:

1) Extraction and Preparation: With the help of Query Image Function, the very first frame is extracted out from the captured reference video. The image is enhanced using histogram equalization after being converted to gray-scale. The processed image passed to face detection model for further analysation. After detecting face, the next queued frame is passed on and the same process is repeated for the rest of the frames. Fig 1 represents process of image extraction and Fig 2 represents the phases of image extraction process.

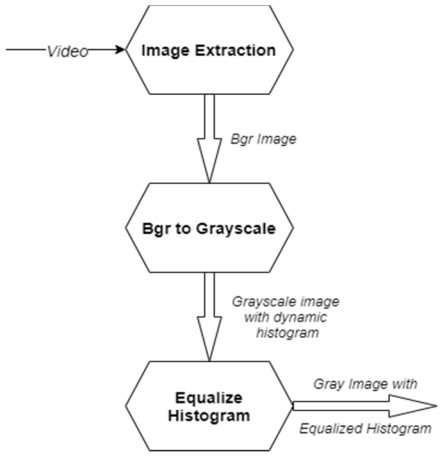

Fig 1: Image extraction and preparation block diagram

Fig 2 (a): Extracted Image

Fig 2 (b): Gray-scale Image

Fig 2 (c): Histogram Equalized Image

B. Face Detection by HAAR Cascade Classifier

The face detection is a 3-phase process and is further described below. Fig 3 represents the possible face detection cases from all the sides.

Fig 3: Face detection cases- Front, Left and Right Profiles

Initially, the detection of all front facing faces is done by calculating the values of front faces. Received face values are sorted and saved as rectangle in a list.

Fig 4 highlights the front faces found in red rectangle. The frame is further used to determine side profiles. The left sided faces are found in this step, the rectangles are compared to the front face list and tested for conflicting values.
If intersection area is greater than 0, the face is not considered a duplicate of the previously found face. The remaining values are added to output face list. Fig 4 highlights left profile faces detected in green rectangle.

Fig 4: Detected frontal faces shown by red rectangle and left faces in green rectangle

After flipping the image horizontally, the detection of right profile faces is done and the coordinates of found faces are calculated using

Inverted_x = rectangle_width – (x-1) (1)

The rectangles are tested to match the previously stored faces in the list and similar rectangles are kept apart from the list. After this step, the list contains faces with all profile sides including the false positive cases extracted from the first frame. This output list is further modified with the help of CNN to improve the face detection algorithm.
Fig 5 highlights the right profiled cases in blue rectangle.

Fig 5: Right profiled cases from inverted images

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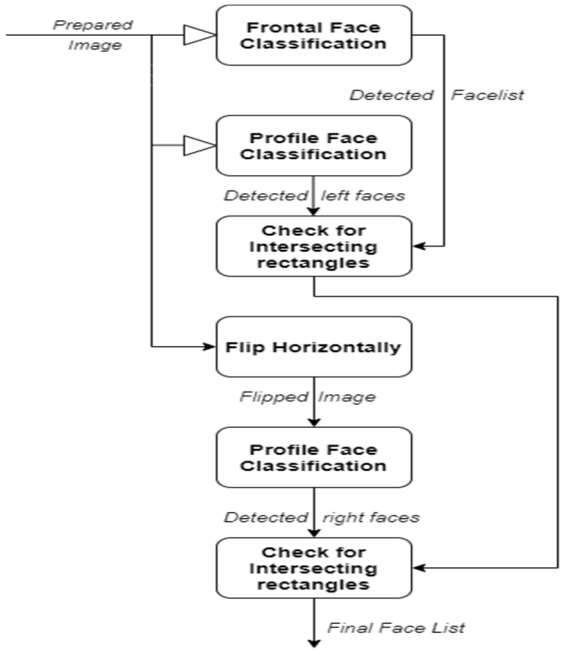

Fig 6: Facial recognition using Haar- Sequence

C. Removing the false Positives with the help of CNN

The CNNs are the unique neural network with multiple layers which are used in processing images widely. CNN discovers positional relationships in between pixels which helps to simplify the neural network by decreasing the number of parameters involved. Furthermore, CNNs uses the following ideas in its working:

1) *Local Connections:* every two consecutive layers are connected with each other through certain area unit sets;
2) *Shared Weights:* Certain weight stacks are assigned to each unit and each feature map has same weight stacks assigned to all units;
3) *Pooling:* a sub-sampling step is applied for differentiating the dimensions of feature map set;
4) *Multiple layers:* the network can have more than 10 layers.

A CNN design includes convolutional and many layers which are connected within. There are many feature maps in convolutional layer. Every unit is connected to an area set in the following layer. Every feature map is obtained by linearly filtering and then summing up with bias. After this, the processed feature map is passed to a non-linear function. With the help of sub-sampling layer, the units are being evaluated [5] [6]. The computational complexity of method is reduced for further layers which has considerable shift-in-variance. Back propagation algorithm is used to round off the parameters of CNN.

Every face detected is shifted out from the source image and is passed to the CNN. CNN further processes and accepts the given image if values match the cumulative thresholds else it rejects the face and the rectangle is deleted from the list. The rectangles present in output list are represented on the source image. Fig 7 displays the modified image.

Fig 7: Refined Frame

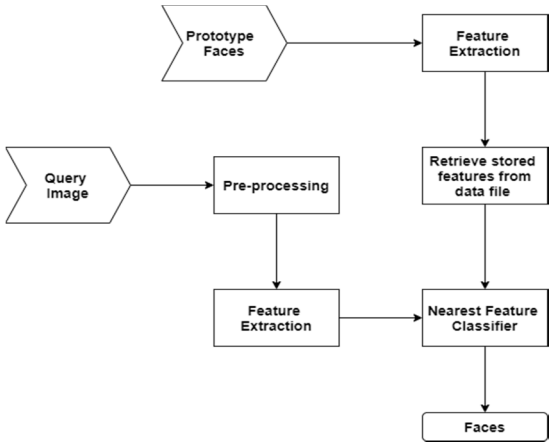

Fig 8: CNN Processing

D. Eigen Face Training, Face Recognition and Self Recognition

1) Learning: After the face detection process is over, the face recognition process is initiated with the help of Eigen face method. In order to recognize these faces, all the detected faces have to be put under training in order to map with their respective identities.

After face recognition, the same training method can be used to self-learn faces.

a) Training: The process of training is not complex and is much straight forward. Supervised training can be used in this. Initially, the first image or a first frame of the person is subjected to detection. The detected face will undergo the training. The cropped down detected faces are stored as 200x200 bitmap set. These images are modified first by gray scale conversion and histogram equalization before undergoing the face recognition process. The sequence of process is represented in Fig. 9.

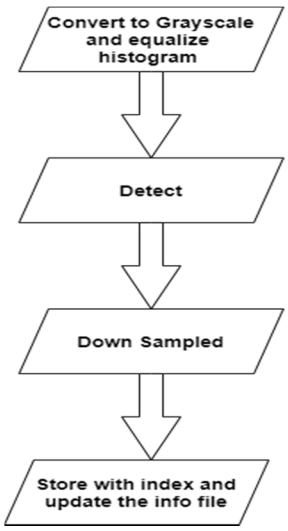

Fig 9: Training Block Diagram

b) Recognition: The fundamental idea of recognizing a face is to analyze the image set of the acquired sample as vectors and the set of all trained dataset as a stack of vectors. To recognize the faces, the nearest vector is estimated by comparing the current vector with the other vectors. When frames are represented as pixel-values-vector, it shows huge time complexity as there is recursive matching for recognizing a face. To make the process work more smoothly, subset of the captured frame is represented by Eigen-facial set. A simpler dimension (face space) is constructed by these Eigen face set which helps to distinguish these face including images in lesser complexity.

For recognizing a face, a stack of eigenfaces is formulated with the help of PCA within a large set of images. The frames of trained dataset are used. Considering a stack of normalized facial ingredients derived from distinctive analysis of preset recognized face, all other faces are biased from these normal faces. Say, a students' face may have composition of the average face including 32% from eigenface A, 55% from eigenface B, and even -6% from eigenface C. This dataset of Eigen faces are put in a stack of eigen face values. The process of recognizing Eigen-face frames is as follows:

- Computing co-variance 2D set of recogized face frames
- Computing the main parts ("eigenfaces") of K-eigenVectors with maximum eigenValues
- Representing all the facial dataset as serial pattern of "eigenfaces".

Furthermore, the nearest neighbor algorithm is implemented on the retrieved coefficients. For recognizing a face, the detected face is initially transformed to eigen -values with the help of eigen-value-generator. Furthermore, these values are put in comparison to the facial void with the help of a cluster-mean-classifier. The confidence level is checked thoroughly within the process and the id which has the maximum confidence level is recognized. The detected faces which do not have sufficient confidence level are not considered.

c) *Self-Learning:* Self-learning is the solution to recognize those faces which are detected but are not recognized because of some middle process. The reason for not recognizing these faces could be bad light or an inappropriate angle. During the whole activity, a track of recognized faces is maintained. The faces are stored in a stack. If the face is detected but falls too low to be recognized for some identity, then the comparison of stack data is done with that regional area. If id with lower confidence level matches with the stack data, the face is recognition is considered and along with this, the unrecognized frame is considered in trained dataset so that the face is recognizable for the next time under same conditions. The whole process is described in figure 10.

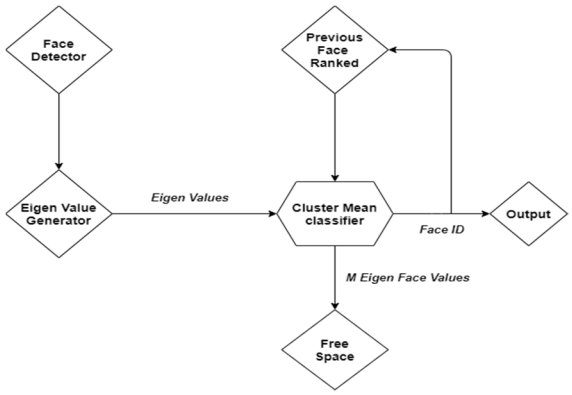

Fig 10: Face Recognition and Self-leaning

V. PROPOSED WORK

In view of the background of related work on Face Recognition using various algorithms described above, the authors have been able to propose an extensive use of Neural Network for detecting & recognizing faces as well as analyzing facial expressions in varied fields. It is an effective model for feature detection and analysis in faces providing us with high accuracy and promising results when used on a very large scale. In order to describe the work being done by us, it has been divided into two separate tasks. Firstly, to recognize faces using Face Detection & Matching and secondly, to generate the attendance based on the list generated.

The faculty will capture a short video from a certain point where the view of whole class is observable. Post this video capturing process, the teacher will have to start the process of face 2D Facial Detection. After this, a directory having the data of students is created in the database. This directory contains the list of students' of a certain class. The faces detected in the frames are compared with the database pre recognized images. The pre-trained images of each student are compared with each of these entries. If the students' face is recognized, the student name is added to the list. The script continues with the next frames to recognize maximum faces possible.. The list of students whose faces were detected will be displayed to the faculty for verification. After verification, the attendance list will be stored locally and can be synced with server anytime later. If in any scenario the number of faces recognized is not equal to the count head, then the faculty will have an option to add names in the attendance list.

A. Functional Design

1) *Step 1:* Create a database of images from the real-time snapshots of students' faces which will serve as the training set for facial recognition.
2) *Step 2:* Set up the system to mark the attendance. The process can begin after the faculty chooses the desired slot
3) *Step 3:* Start the Python code after fetching information and confirmation from the faculty by clicking the button which will be there on the main window
4) *Step 4:* Trained data will be collected initially for the python code. T
5) *Step 5:* Capture the faces: the application will then initiate the face detection process with the same methods sequentially comparing with the previously trained data.
6) *Step 6:* Recognize the valid faces after the analysis
7) *Step 7:* Marking the attendance post recognizing the students' face, a list of the marked attendance is sent over to server to mark the attendance.
8) *Step 8:* Faculty can sync the local saved data to the server later anytime.

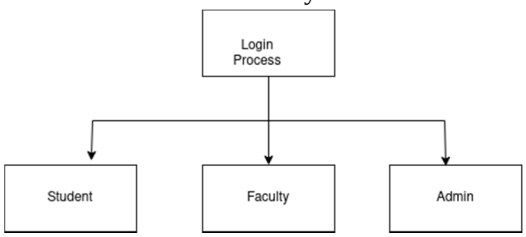

Fig 11: Login Process for the application

Login page will be different for different users.

VI. CONCLUSION AND FUTURE WORK

A more examination is required on a venture in that capacity. The techniques utilized could be joined with others to accomplish incredible outcomes. Various strategies have been executed in the past as per the literature review.

The utilization with visual recognition of the attendance system method can be implemented and tested. This will require additional time as it is just a preliminary that will be made contemplating the strategy that as of now exists to have a total groundbreaking thought. A login functionality would be actualized on the framework for security purposes.

Information secrecy is significant. Toward the beginning of each school year, the pictures of new understudies are taken and put away by the college. Every understudy will reserve the option to be educated about the utilization of their appearances for a face acknowledgment participation framework. This should be in accordance with the public authority laws on moral issues and information security laws and rights. The understudies should agree to their pictures utilized with the end goal of participation. The framework that has been conveyed and should just be utilized for exploratory purposes as it isn't totally dependable.

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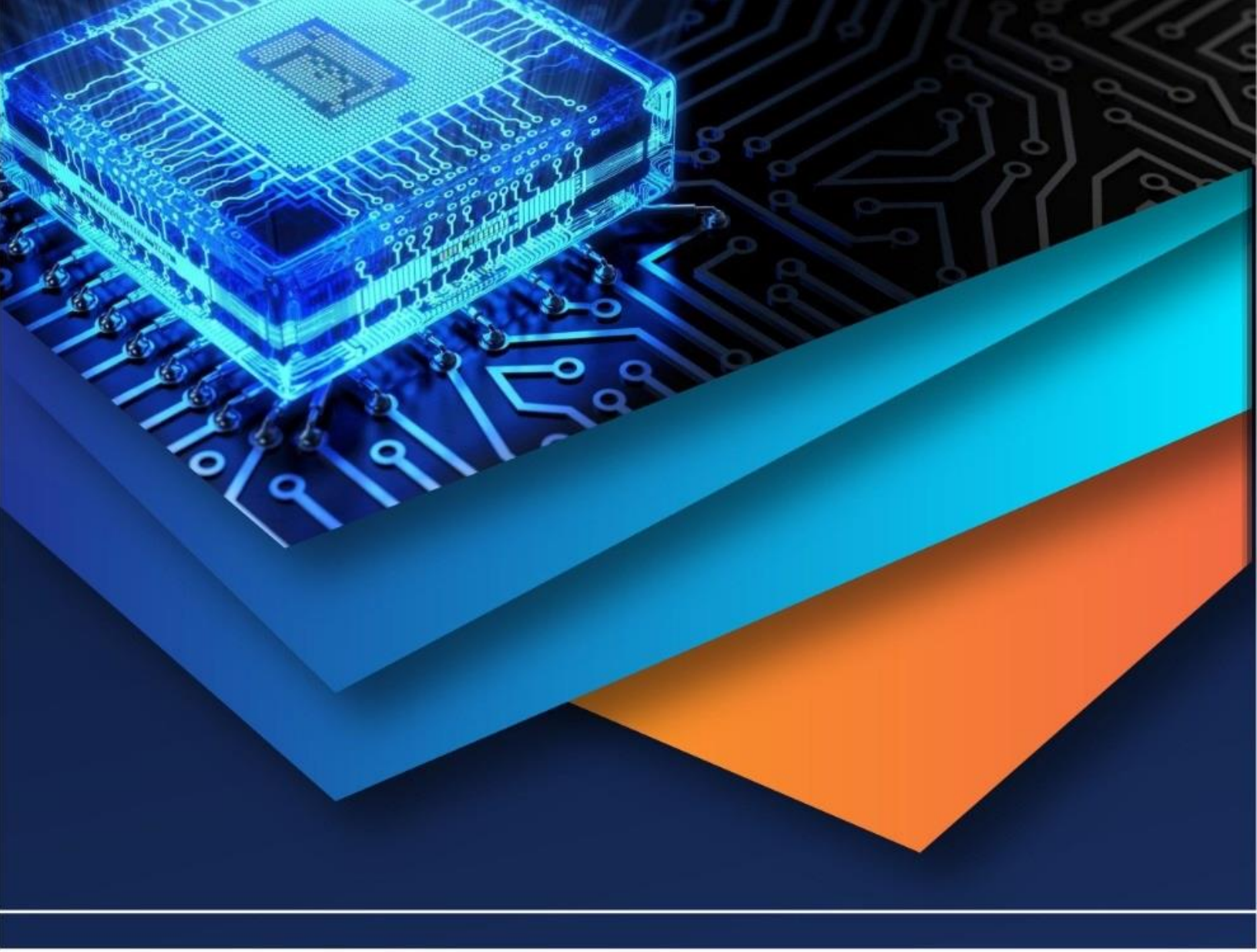

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