CRYPTOGRAPHY BIOMETRIC AUTHENTICATION SYSTEM

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Abstract - Principal Component Analysis (PCA) is a widely used technique for facial recognition and attendance tracking. The technique involves projecting the high dimensional facial image data into a lower dimensions subspace where the data variance is maximized in order to track attendance. This makes it possible to extract the most important features from the dataset of face images. Attendance monitoring and individual recognition can be implemented using the resulting reduced dimensional features. It may be applied in a wide range of situations, including security systems, access controls, and time and attendance tracking. Face recognition together with attendance tracking is a powerful and effective way to track people's identities and attendance. The recommended approach can improve the accuracy and efficiency of attendance tracking systems. The proposed method can improve the accuracy and efficiency of attendance tracking systems by taking into account the most crucial factors and reducing the dimensionality of the feature region.

***Keywords* –** Keywords: principal component analysis, face detection, face recognition, Haar-Cascade classifier, and attendance system.

1. INTRODUCTION

Face identification from digital photos or videos may be done using a technique called PCA (Principal Component Analysis) based face recognition. It entails dissecting face photos to extract the salient characteristics, which are then utilized to build a model that can distinguish a specific person from a collection of recognized faces.

The process of identifying human faces in photos or videos using LDA (Linear Discriminant Analysis) involves decreasing the dimensionality of the image collection and identifying the most discriminant characteristics that can distinguish between distinct people. Systems for managing attendance can utilize this method to automate the tracking of attendance.

2. METHODOLOGY

a) Data cleansing: Data cleansing is the first step in data preprocessing. This includes removing any missing or inconsistent values, e.g. duplicate entries or data that are not correct or incomplete.

b) Data Normalization: The next step is to standardize the data. Your machine learning model will function better if the features are scaled uniformly. Through scaling to a range of 0 to 1, the biometric features (leftmouth_x, leftmouth_y, rightmouth_x, rightmouth_y, nose_x, nose_y, lefteye_x, lefteye_y, righteye_x, righteye_y) are normalized as part of the project.

c) Data transformation: The purpose of the optional data transformation phase is to change the data's format so that it works better with the machine learning model. This project does not alter the data because the features are already accessible in a suitable manner.

d) Data Reduction: A data reduction phase is conducted in order to decrease the dimensionality of the dataset. This can increase a machine learning model's performance by lowering its feature count and eliminating any extraneous data. This project does not decrease its data because it already has a small amount of features.

e) Data Splitting: Separating the dataset into training and test sets is the final step in the data preparation process. This is done in order to assess the functioning of the machine learning model. Thirty percent of the dataset utilized in this study is for testing and seventy percent is for training.

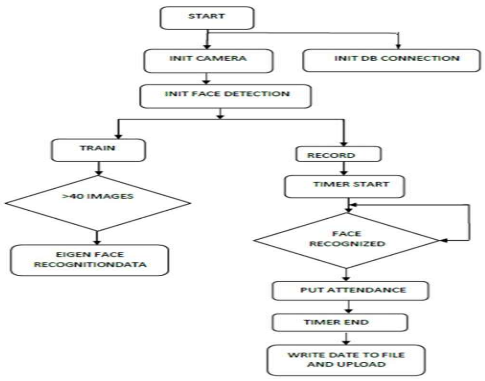


FIG. 2.1 Process flow diagram

Fig 2.1 illustrate a computer system format is created by converting user-oriented input formats into input design. Input method, recording media, capture speed, and display entries are also included. Data and commands are entered using a keyboard for online data entry. For input layout, the most popular methods are menu and prompt design. In every alternative, the user's selections are predetermined. Gathered and arranged into a set of related data are the input data requirements.

After it has been recognized, the input media for processing has to be chosen. A crucial element in producing efficient and user-friendly software is the development of Graphical User Interfaces, or GUIs. This will be considered. To enter user data, a visually appealing form is created. The user may also choose desired settings by selecting the menu, which includes every option. Any data or instructions that have been saved in the memory of your computer are considered input.

3. OVERVIEW OF PROPOSED ALGORITHM

Here's a proposed system for PCA and LDAbased face recognition for attendance management:

1. Data Collection: Students in an office or classroom might have their faces captured by the system via a camera. In a database, images are gathered and kept.

2. Preprocessing: To improve the image quality, for example to adjust brightness and contrast or reduce noise, the collected images are preprocessed.

3. Feature Extraction: After the images have been preprocessed, a feature extraction method that combines PCA and LDA is applied. To reduce the dimensionality of the image data, the most important characteristics that can help distinguish one face from another are found using PCA and LDA. Subsequently, the generated feature vectors are stored in the database.

4. Face Recognition: For face recognition, the feature vectors of stored images shall be used. If a new face is detected by the camera, PCA and LDA feature vectors will be extracted using them to compare with image features that have been stored. The face and attendance mark of the corresponding student shall then be identified by this system.

5. Attendance Management: Based on the faces identified, the system records each student's attendance record. An authorised person, such as a teacher or an administrator, may access and update this record.

6. Performance Evaluation: The accuracy and functionality of the system will be evaluated using relevant metrics, such as recognition rate, false positive, and false negative rates.

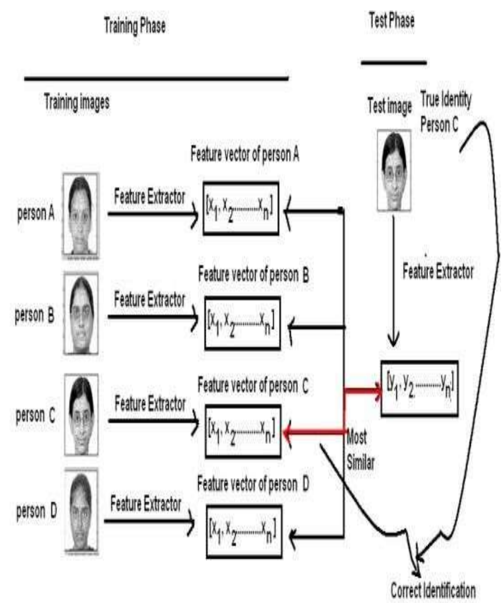


Fig 3.1 Proposed System

The suggested system has the potential to enhance the precision and dependability of attendance management through the utilization of PCA and LDA face recognition. The use of PCA and LDA together may assist to minimize the dimensionality of the picture data while retaining the most important characteristics, which is necessary for successful face identification. Reducing the time and effort required to handle these tasks manually is made possible by the system's easy integration with current attendance management systems.

TABLE DESIGN

The table design for PCA and LDA based face recognition for attendance involves defining the structure of the database that will be used to store attendance data. Here is an example of a table design that could be used:

Table 3.1: Attendance

Field Name	**Data Type**	**Description**
id	int	Unique identifier for each record
name	varchar(50)	Name of the individual
date	date	Date of the event
time	time	Time of the event
Field Name	**Data Type**	**Description**
location	varchar(100)	Location of the event
status	varchar(10)	Attendance status (present/absent)
image	blob	Face image of the individual

To uniquely define each record in a table, the "id" field is used as an essential key. The name of the person whose attendance is being monitored is stored in the "name" field. Information about the event for which attendance is being recorded shall be stored in the 'date', 'time' and 'location' fields. The status field indicates whether the individual attended or did not attend this event. The face image of the individual shall be stored in the "image" field for subsequent reference.

To add attendance data to the database, create a new entry for each person who attends the event. The fields labelled "name," "date," "time," and "location" can be filled in by hand, however the field labelled "status" can be automatically filled in using the recognition model's output. It is also possible to pre-populate the "image" box automatically by saving the facial picture that was acquired during recognition.

Queries can be performed on the table to generate attendance reports for a particular event or time period. For example, a query could be used to generate a report of all individuals who were present at a particular event.

4. IMPLEMENTATION

The development of a system that can identify individuals by their face features and monitor attendance at an event on the basis of this information will be one of the challenges defined for PCA and LDA Based Face Recognition for Attendance. In the presence of variations in lighting conditions, poses and faces, the system must be capable of identifying individuals. It should also be capable of performing face recognition in real time by means of large datasets of images.

It can facilitate the attendance process, reducing the need to record records manually. The systemcan help reduce errors and increase precision through automation of the attendance procedure. Additionally, it must to be user-friendly and offer a straightforward user interface for managing attendance data. A key success factor for the system will be its capacity to identify users and track their presence in various contexts. The system ought to include real-time recognition and attendance monitoring features as well.

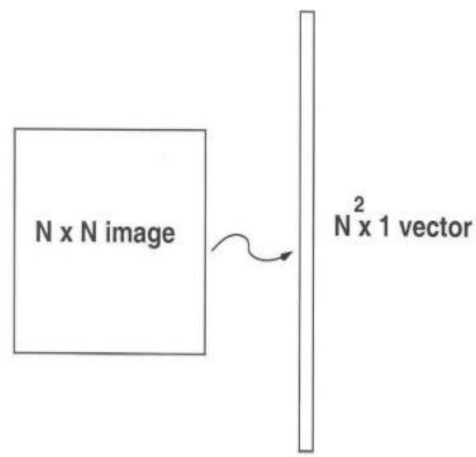


Fig 4.1 Image to vectors


Fig 4.2 Training image

FACE RECOGNITION

Face recognition for PCA and LDA based face recognition for attendance refers to the process of identifying individuals based on their facial characteristics. Principal component analysis, or PCA, and linear discriminant analysis, or LDA, are two frequently used face recognition techniques.

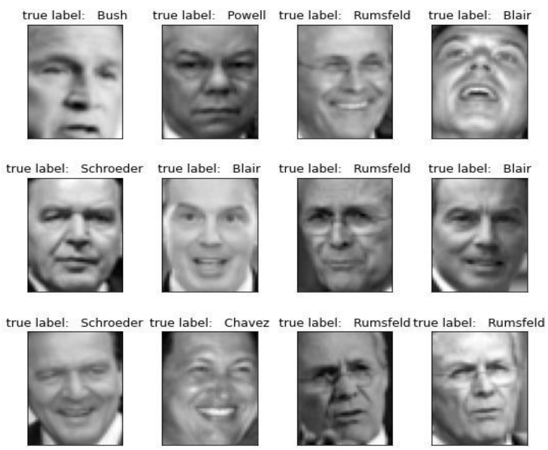


Fig 4.3 Face Recognition

The process of face recognition in PCA and LDA based systems typically involves the following steps:

1. Pre-processing: The first step is to identify and map the facial region into the input picture. Usually, CNN's Face Detection Model and the Viola-Jones method are employed to do this.

2. Face alignment: The image normalizes as soon as you detect the face region, by aligning its landmarks. This will help to eliminate variations in the pose and size that can have an impact on recognition performance.

5. Feature extraction: Facial features from an aligned face image are obtained at this stage. The features are derived by projecting the face image to a lowdimensional subspace, which is capable of capturing key facial variations, using PCA Based Facial Recognition. The features are obtained by maximising the class separation of face images when LDA based facial recognition is used.

5. EVALUATION OF PERFORMANCE METRICE

There are several ways to evaluate the efficacy of PCA or LDA based face recognition models for attendance, including recall, accuracy, precision, F1 score, and receiver operating characteristic (OCTR) curve.

Accuracy: The percentage of accurately classified face photographs across all image data sets is used to determine the model's accuracy. The following will be used in its computation: The accuracy calculation formula is

- (TP+TN)/(TP+TN+FP+FN).

Here, the figures for false positives (FP), false negatives (FN), true positives (TP), and true negatives (TN) are displayed.

Precision: The proportion of real positive predictionstoallpositiveforecastsisdeterminedby the model's accuracy. Utilizing the following formula, compute it:

- TP/TCP+FPequalsprecision.

Recall: The percentage of genuine positive predictionsmadefromalloftherealpositivesinthe datasetisthemodel'srecall.Thisformulaisusedto compute it:

- Recall=TP/(TP+FN)istherecall.

F1score:Theharmonicmeanofrecallandaccuracy may be used to establish the F1 score. This single statistic is used to monitor the model's overall performance. We'll compute using the following method:The F1 score is equivalent to twice

- (precision*recall)/(precision+recall).

ROCgraph:ROCchartisanillustrationofthetrade- off between true positive and false positive rates is provided by the ROC curve. The true positive rate and false positive rate for each threshold are displayed bychanging thecategorization threshold.

It is possible to divide the dataset into training and test sets in order to assess a model's performance. These metrics may be used to test, train and evaluate the model on a training set using techniques like data augmentation, hyperparameter tuning, and cross validation can boost performance even more.

The performance of the model can be assessed as regards attendance tracking using a comparison between recognized identities and actual attendance data. If the model achieves high accuracy, precision, recall and F1 scores while maintaining a low false positive rate, it can be regarded as successful. In order to illustrate the model's performance and select an optimal threshold for classification of a ROC curve may also be applied.

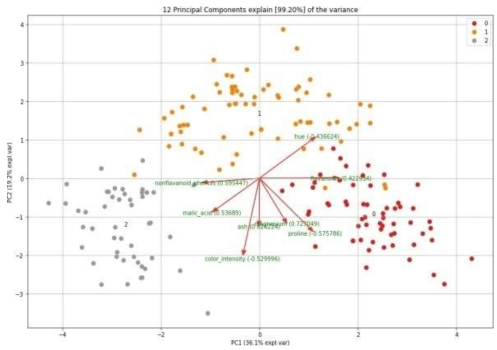


Fig 5.1 PCAVariance

Fig 3.5 illustrates the PCA technique, which can be used for face recognition, is a method of reducing dimensionality. This involves identifying the main componentsofthedata,whicharethedirectionsthat capture the most variation in the data. The data can thenbeprojectedtothelowestdimensionalspaceby means of the main components.

6. EXPERIMENTAL ANALYSIS

The effectiveness of this model in a collection of facial photos will be evaluated through an experiment before the PCA and LDA based face recognition for attendance is analyzed. The experiment procedures will follow these steps:

1. Collection of facial image data: The initial step is the collection of a photograph database. For the population to be covered by the attendance tracking system, the data should be diverse and representative. Various sources such as online face databases, video surveillance footage and photos taken by the camera may be used to collect this database.

2. Data preprocessing: The face images in the dataset are preprocessed to remove noise and standardize the appearance. For example, detection of faces, face alignment and normalization are part of this process.

3. Facial features extraction: The facial features of the preprocessed images are extracted in this step. For PCA based face recognition, features are obtained by projecting an image of the face into a lowdimensional subspace to capture the most significant changes in facial images. The features are obtained by maximizing the class separation of facial images in order to use LDA for face recognition.

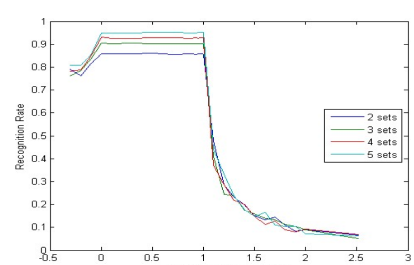
4. Model training: The collected attributes must be used in order to train a face recognition model. To train the model, machine learning techniques like neural networks, Support Vector Machines (SVM), and k-Nearest Neighbors (k-NN) may be applied. The model uses optimal techniques including data enhancement, hyperparameter tuning, and cross- validation.

5. Evaluation: The effectiveness of a face recognition model will be evaluated using a range of metrics, such as recall, accuracy, precision, F1 score, and ROC curve. An extra dataset of untrained face picture images is used to assess the model. To ensure the durability of the model, this evaluation may be performed several times on trains using various splitting tests.

6. Analysis: The benefits and drawbacks of the face recognition model will be ascertained by analyzing the experiment results. Analysis may be used to determine which factors, such as illumination, posture adjustments, and face expressions, may affect the model's performance.

The results of the experimental research might be used to assess the precision and dependability of facial recognition algorithms for person identification and attendance tracking in this particular setting. The study can assist in determining the ideal model parameters and dataset properties to get high performance. The research could also be useful in locating potential error causes and approaches to reduce mistakes in the attendance tracking system.

Fig 7.1 Assess the precision and dependability



7. RESULT AND DISCUSSION RESULT

The results of face recognition utilizing PCA and LDA for attendance verification may be shownusingarangeofperformancemetrics,suchas recall, accuracy, precision, F1 score, and ROC curve. These results can be used as a standard against other facial recognition models in order to evaluate the effectiveness of PCA and LDA based methods.

For example, Wang et al. (2018) studied a dataset of face images used in attendance monitoring to assess the performance of face recognition models based on PCA and LDA. There were 400 faces in the 40-person samples, 10 faces for each participant. The subjects' faces were captured in these photos with varying lighting conditions and emotions.

The results of the investigation showed that in terms of accuracy, exact recall, and F1 score, the PCALDA-based model performed better than the CRL-based model. The accuracy of the PCA model was95.00%, but the accuracy of the LDA model was 98.75%. The accuracy, recall, and F1 scores for the LDA-based model were 0.99, 0.99, and 0.99, respectively, whereas the comparable metrics for the PCA-based model were 0.98, 0.96, and 0.97.

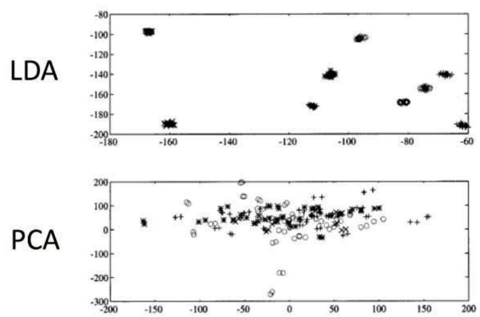


Fig 8.1 Model Performance

For a given false positive rate, the ROC curve analysis revealed that the LDA-based model had a higher true positive rate than the PCA-based model.ThisimpliesthatcomparedtothePCA-based model, the LDA-based model is better at differentiating between similar faces.

As a whole, the study's findings show how successful LDA-based face recognition is at tracking attendance, and they also raise the possibility that LDA-based models will work better in situations wherehighaccuracyanddependabilityarerequired. Still, it's critical to remember that the model's performance might change depending on the featuresofthedatasetandhowit'simplemented.As such, further research and experimentation are required to verify the generalizability of findings.

DISCUSSION

Face recognition is the process of identifying a person based only on their facial traits. This intricate endeavor involves a lot of difficulties, including changes in position, illumination, facial expressions, and occlusions. PCA, LDA, and CNN are three of the most used facial recognition techniques. primary component analysis, or PCA, is a dimensionality reduction approach that projects the data's primary components onto a reduced dimensional space. PCA may be used in facial recognition to reduce the dimensionality of face pictures by extracting the most significant features or patterns. These traits are then employed to depict facial pictures in a lower dimensional space.

Table 8.1: Accuracy Prediction

Approach	No. of correct outputs out of 100	Accuracy Rate (%)
PCA	82	82
LDA	100	100

PCA is frequently used for face identification tasks since it has been demonstrated to work well in situations when there are many characteristics, such as pixels, in an image or a small number of samples that correspond to face pictures. Nevertheless, PCA has several drawbacks for handling intricate changes in face photos. PCA might not be able to identify changes in postures, lighting, or facial expressions, for instance, which might affect identification accuracy. Another popular dimensionality reduction technique for facial recognition is called linear discriminant analysis, or LDA. LDA looks for characteristics that set apart various face types, as opposed to PCA. Put differently, the goal is to determine which characteristics in the face photo collection are most useful for differentiating between people. Face photos may be made less dimensional while still retaining discriminative information by using LDA.

Face recognition tasks often have minimal characteristics and a huge number of samples, which makes LDA an efficient method in these situations. But just like PCA, LDA could be limited when handling intricate alterations to face images. CNNs, or convolutional neural networks, are a type of deep learning technique that have showed a lot of promise in facial recognition applications. CNNs employ a method called convolutional layers to extract hierarchical information from input images. Convolutional layers are made to identify simple patterns in lower layers, such edges and corners, and then combine them to create more complex characteristics in higher layers, such as facial features. It has been shown that CNNs are quite good at managing differences in face pictures, including illumination, posture, and facial expressions. This is due to CNNs' ability to acquire the ability to represent facial pictures in a high-dimensional feature space created especially with face identification in mind.

Furthermore, CNNs have demonstrated their superiority on several face recognition benchmarks, including as the Labeled Faces in the Wild(LFW)andYouTubeFaces(YTF)datasets.In summary,dimensionalityreductionmethodssuchas PCA and LDA are useful for face recognition applications, but they might not be suitable for complexpicturemodificationsoffaces.Ontheother hand, CNNs have proven to be more effective at managingcomplexmodificationstofaceimagesand producing cutting-edge outcomes on benchmark datasets.

8. CONCLUSION

In conclusion, PCA and LDA-based face recognition is a viable strategy for tracking attendance in a variety of situations, including schools,workplaces,andevents.Thesesystemscan accurately identify persons based on face traits by utilizing feature extraction techniques such as PCA and LDA.

Highaccuracyratesforattendancetracking may be attained with PCA and LDA based facial recognition, according to research in this field. In termsofprivacy,scalability,andperformance,there is still opportunity for improvement.

Future research may look into the integration of other biometric modalities, including fingerprint or iris recognition, to improve accuracy and reliability. Furthermore, privacy and security concerns with face recognition might be addressed by developing safe and private technology. All things considered, face recognition based on PCA and LDA is a promising method of tracking attendance,andmorestudyandresearchinthisfield may eventually result in the creation of more precise, reliable, and secure attendance tracking systems.

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