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CNN-Based Student Attendance System

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Abstract

The study of human face recognition is one of the advancements in computer vision. The attendance system stores face in a face database by using them as objects to be detected, identified, and recorded as a person's identification. Face recognition of the object faces photographed by the camera is achieved by comparing face image data collected by the camera with face photos that have been saved in the face database. This study's face recognition-based attendance system uses a hybrid feature extraction technique that combines CNN and PCA (Principal Component Analysis). The goal of combining these techniques is to create a feature extraction process that is more precise. This camera's face recognition-based attendance system works incredibly well and efficiently to increase the accuracy of user data. This face recognition-based attendance system uses a camera with high accuracy and very accurate data processing, resulting in a dependable and potent real-time human face identification system. Face recognition is one of the most efficient applications for image processing and plays a crucial part in the technical domain. Identifying a person's face is a current authentication problem, particularly regarding school attendance. The process of identifying students using face bio-statistics based on high-definition monitoring and other computer technologies is known as the "face recognition" attendance system. The goal of this system's creation is to digitize the dated method of taking attendance by calling names and keeping handwritten records. The methods used today to take attendance are laborious and time-consuming. Manually recording attendance allows for easy manipulation of the records.

Keywords: face recognition-based attendance system, hybrid feature extraction, CNN PCA, real-time camera, Computer vision

I. Introduction

One of the key concerns that any school, college, or institution occasionally deals with is student attendance in traditional face-to-face (F2F). The faculty staff needs to have a suitable system in place for regularly managing and validating the student attendance record to keep it accurate and legitimate. There are two main categories of student attendance systems: automatic attendance systems (AAS) and manual attendance systems (MAS). Faculty members who engage in manual recording may find it challenging to preserve and verify each student's record in routinely in a classroom setting, particularly in courses with a high student enrolment. It takes longer to record and determine each enrolled student's average attendance using the manual method.

When it comes to attendance systems that use the human facial recognition (HFR) technique, these systems typically involve the method of identifying important characteristics from any student's face that was taken when the student first entered the classroom or after everyone had taken a seat. When it is successfully recognized, the recognized student's attendance is automatically marked. In keeping with that broad concept, this paper's presentation is predicated on established face recognition algorithms to create a particular computer application that can automatically identify any enrolled student using the digital photos taken in the classroom[1].

An accurate face attendance system that can hold a big database of face images by utilizing a camera in conjunction with a facial recognition system. The creation and production of camera-based facial attendance systems are highly beneficial in enhancing the precision of user data and catering to the high degree of mobility of their users. Because it can develop a system that is durable and dependable for identifying human faces to be utilized as a time attendance on attendance machines, the facial attendance system with a camera is particularly safe and accurate for detecting users[2].

Facial recognition research has been done for human interests, particularly for security systems, surveillance, general identity verification, criminal justice systems, image database investigations, "smart card" applications, video indexing, multi-media environments, and witness face reconstruction.

Intensity images are divided into two categories: feature-based and holistic face recognition. The feature-based face recognition method reduces the input images of faces to geometric feature vectors by first processing the images to identify and extract facial features like the mouth, nose, and eyes. It then computes the geometric relationships between these face points. The first study on feature-based face recognition identified a person's face using the Geometrical Features and Template Matching approach. The study employed the Bayesian Classification approach for classification and the integral projection feature extraction method[3].

II. Related Work

The second feature-based research employing the SOM (self-organizing map) method was carried out. Unlike research, this study employed the feature mapping approach with SOM (self-organizing map) for feature extraction, whereas the classification methods The Nearest Neighbor and Multi-Layer Perceptron (MLP) methods are employed. When compared to earlier techniques, the employed method does a good job of identifying faces. The following feature-based face recognition investigation is carried out.

Holistic face recognition is an additional intensity-based facial recognition method. This all-encompassing method of face recognition looks for faces utilizing global representations, specifically characterizing them keeping in mind the entire picture rather than just the specific facial features. The most straightforward holistic method compares the direct association between the input face and every other face in the database to represent the image as a 2D array of recognition and intensity values. The first work on face recognition with a holistic approach was carried out. In this study, face identification was achieved through classification techniques and feature extraction utilizing the faces method and distance from space face measure[4].

Euclidean Distance is the classification method used in research on face recognition which also use the same extraction method used by many cameras to conduct Face Recognition research. This study detects faces in a subject by employing numerous cameras and applying the Cylinder Head Models (CHM) methodology. The faces approach uses half of the face on average for face recognition to minimize the impact of transformation mistakes. The procedure of scanning and unwrapping CHM to 2D face images uses the average half-face. This approach is useful and effective for up to 94.4% facial recognition accuracy[5].

III. Proposed System

The subsequent holistic-based study on face recognition was carried out, which used ICA (Independent Component Analysis) as a feature in their study distance measure as a classification technique and extraction approach. After this work employed the Locality Preserving Projections (LPP) approach for feature extraction and Euclidean Distance for classification to achieve face recognition. In this study, face pictures are mapped into many sub-spaces for analysis using Locality Preserving Projections (LPP).

This LPP technique is employed to identify significant components of the observed face structure and to preserve local information. Compared to the PCA and LDA approaches, which typically employ the Euclidean Distance method for the classification process, the LPP method is distinct. The technique employed in this study can lessen a variety of illumination variations, light changes, face expressions, and other kinds of positions.It can be demonstrated from the experiment results that the Laplacian method suggested in this study can create good facial recognition and produce a low error when compared to the faces and Fisher faces Methods[6].

Additionally, conducted holistic-based facial recognition studies. The four studies employed the same feature extraction technique, Principal Component Analysis (PCA). Regarding the various classification techniques, the studies used Artificial Neural Network (ANN), Neural Network, and Error Back Propagation neural networks, respectively, and Support Vector Machine (SVM), in terms of neural networks[7].

The issue of fluctuation in lighting on the face object caught by the camera has hindered several earlier experiments on facial recognition. The detected object's facial recognition accuracy is lower under this scenario. To account for variations in the illumination of the image used, this study's processing method for images will involve developing an RGB - grayscale and re-sizing process, followed by the addition of a histogram equalization method and techniques for adjusting contrast and brightness levels. Certain supplementary techniques aim to enhance facial recognition to an optimal level by maximizing the information value of the processed image[8].

Since previous research has been done in this area, this study adopted a hybrid feature extraction method using CNN PCA for face recognition. This countenance following that, a camera-based face attendance application is created utilizing the recognition method as a guide.

IV. Research Methods

In this study, real-time cameras that serve as both a face detection tool and a human face identification system were used to build a face recognition framework model. This model was then developed as a face attendance machine using a hybrid feature extraction method using CNN PCA. Fig. 1 illustrates the steps of the facial recognition process that will be executed, which include data collecting, face detection, processing, feature extraction, and classification techniques.

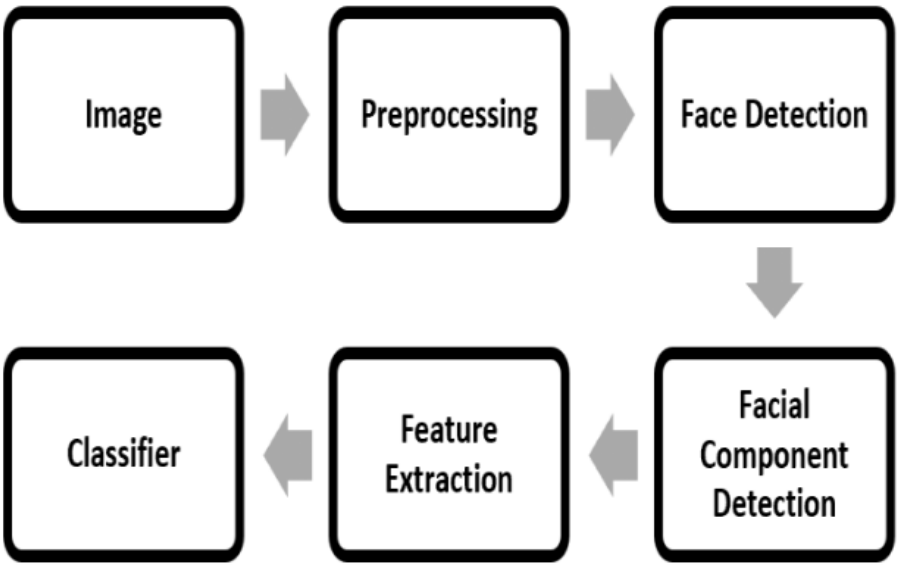

Figure 1: Facial recognition procedure stages

Face detection based on Viola-Jones from the Open CV package is utilized on the camera for the face detection process. A camera uses face detection to capture photos of things' faces. A background picture and a facial image are both present in the raw image that is captured through the camera lens. The process of finding and looking for facial features in the camera image is called face detection, and at this point, the system determines whether

patterns in the image represent faces. The location point and size of the face image's region of interest (ROI) coordinate point identify the face image that is recognized in the backdrop image created by each camera lens[9].

The region of interest (ROI) coordinate point of the face image, which is the location point and the size of the ROI face image created from figure 2, designates the face image recognized in the backdrop image produced by each camera lens. Processing, also known as normalization, produces a face image that has been identified during the face detection procedure.

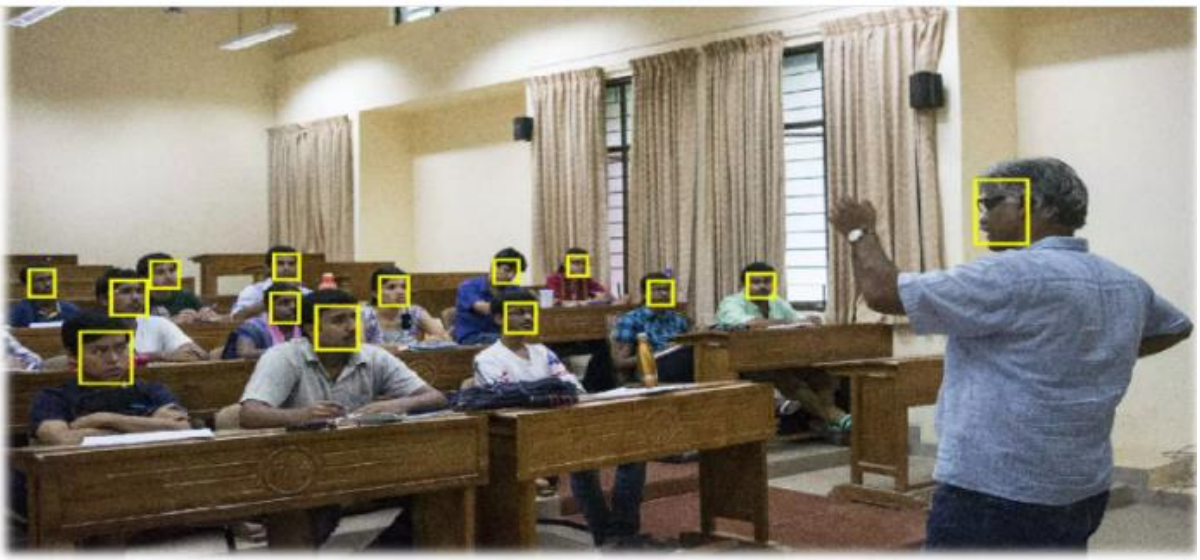

Figure2: Capturing the face image

During the normalization stage, multiple facial image processing models are combined. To improve the facial identification, we employed the cropping technique and histogram equalization as a contrast-brightness modification. The processing technique sharpens the image to account for various lighting fluctuations that frequently occur when taking pictures of faces[10].

In this study, a face database that is utilized in the face recognition process is created by storing the output of the 2D–3D image reconstruction technique in the two-dimensional. It is anticipated that the 3D image reconstruction method will significantly impact face identification and recognition, resulting in high computational speed and accuracy.

This study employs a method to create a 3D model for 2D picture reconstruction using a Convolution Neural Network (CNN). 3D face images are created from 2D face photographs using the CNN technique. The vector shape and texture are then combined to create a correlation point on the new face image that is like the original image that was used. A database is used to process the output of the face recognition process once the vector forms and textures from 3D face photos have been combined. CNN's 2D–3D picture reconstruction method.

Equation (1) can be used to build 2D–3D picture reconstruction using CNN.

$$S = \acute{S} + Ud.\alpha d + Ue .\alpha e \quad (1)$$

Ud is the major component of the 3D face image, αd is the identification vector, Ue is the main component of training in 3D images, αe is the parameter vector, and S is the 3D face output.

Principal component analysis (PCA), a feature extraction technique, is used in this investigation. The resolution of a face image is reduced using PCA. The instructor component analysis is a useful technique for transforming large-scale variable data into a representation of smaller variables. We compare the training features of a face that is stored in the database with the features of the facial picture during the testing phase to ascertain the similarity of facial features. These outcomes will generate identity information that is saved as attendance information.

V. Result Discussion

Based on the study conducted, CNN PCA can be used to create an attendance system that recognizes faces as shown in figure 3.

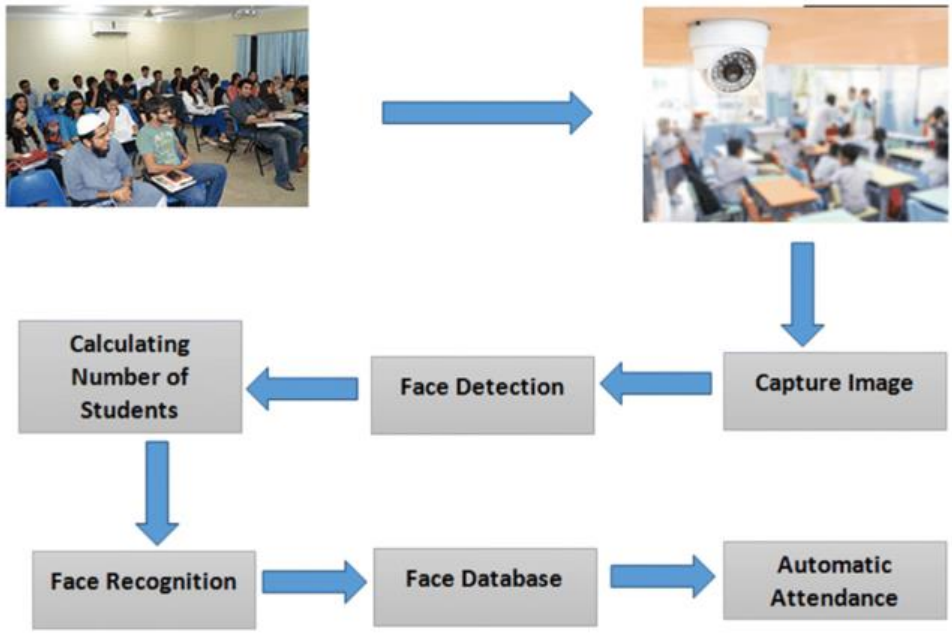

Figure 3: The interface of the face recognition based attendance system

Experiments to test the suggested face attendance system are displayed in Table 1. When feature extraction using PCA is used, the facial recognition system on the suggested attendance machine can achieve an accuracy of 90% to 96%. The accuracy of the suggested research can range from 90% to 98% when CNN PCA is used. CNN PCA can enhance the performance of a facial recognition-based attendance system compared to PCA alone.

Object	Accuracy (%)	
	PCA	CNN-PCA
10	90.00	90.00
20	90.00	95.00
30	93.33	96.67
40	95.00	97.50
50	96.00	98.00

Table 1. The proposed facial attendance systems facial recognition accuracy

VI. Future Scope

For security purposes, we can utilize a detection and recognition system. This technique can be used to detect criminals at bus stations, railway stations, and other public places. This will be beneficial to the cops. In this system, we will employ a GSM module. If the culprit is identified, the signal can be relayed to the police station's central control room via a GSM module. Using the ISDN number of GSM, the surviving area can be identified.

VII. Conclusion

Many approaches, like RFID, are inefficient and time-consuming. So, overcoming the aforesaid system is the superior and more dependable solution in terms of time and security. We successfully developed a dependable and efficient attendance system that uses an image processing algorithm to detect and precisely recognize faces in the classroom for attendance marking.

Numerous techniques and algorithms, particularly the usage of reconstruction algorithms from 2D photos to 3D forms that are utilized as a database in face recognition, have not yet been thoroughly examined despite numerous studies on the subject. This study investigates facial recognition using PCA as the feature extraction technique and Convolution Neural Networks (CNN) to generate 2D to 3D picture reconstruction models. A 2D face image can be converted into a 3D face image using the CNN technique. In the proposed face recognition-based attendance system, the PCA approach for feature extraction and the method for classification can both function effectively. Up to 98% of faces can be recognized accurately using the suggested method.

VIII. Result

The automatic student attendance system in the classroom that makes use of facial recognition technology performs admirably. Without a doubt, it can be made better to produce better results, especially by being more careful during the feature extraction or recognition process. This enhancement might contribute to the recognition process's strengthening. About 82% of the pupils seated in the classroom can have their facial photographs recognized by the suggested technology.

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