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Facial Recognition in Education: Revolutionizing Attendance Tracking for Enhanced Efficiency and Security

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Abstract

The goal of this project is to develop a facial recognition-based attendance system for educational institutions to improve and modernize the current system and make it more effective and efficient than it was in the past. The distinctive features of the human face allow for individual identification. Since there is little chance of a face deviating or being duplicated, it is utilized to trace identification. The article also covers the advantages of putting automated attendance systems in place, such as increased security, convenience, accuracy, and efficiency. It showcases case studies and real-world implementations from a range of industries, highlighting the usefulness and success stories of implementing face recognition-based attendance systems. To provide dependable and durable attendance tracking systems, it looks at how cameras, image processing techniques, machine learning models, and database management systems can be integrated. PCA, SVM, viola jones, OCR are the algorithms that are used. Once the student's face was identified, the attendance was updated on an Excel page.

Keywords: Face recognition, face detection, OCR, PCA, SVM, viola jones.

INTRODUCTION

Since attendance is one of the main ways that colleges and schools determine how often each student attends, it is a crucial issue. Currently, keeping track of attendance in universities and schools requires filling out an attendance sheet, which takes time. By using the same time, the student might be able to learn more from the teacher. Furthermore, because attendance is manually entered, it is easily manipulated. Verifying every student in the class is also a challenge. To preserve attendance, a face detection and recognition methodology is proposed. It saves time and prevents students from having to make up missed lessons.

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Because an automated computer will be monitoring attendance, it thus raises awareness among students to attend courses every day. One of the most effective methods for determining a person's identification is through face recognition, a topic that has seen significant research in recent years. One area of popular biometrics research is facing recognition from photos. Knowing picture analysis is one of the most beneficial uses of face recognition. [68]

Advances in face recognition can shed light on how the human brain works because of difficulties that have caught the attention of neuroscientists,

psychologists, and computer vision researchers alike. Facial recognition works without human assistance, in contrast to other biometric techniques like fingerprint analysis and retinal scans. Because of its special benefit, facial recognition is an essential technique for person identification. Although there are many algorithms available for identifying and classifying faces in photos, they frequently encounter computational difficulties and demand processing of big datasets. Ongoing research, however, is concentrated on creating new algorithms to deal with these problems and boost accuracy [910]. Fundamentally, the objective of improving facial recognition systems is to achieve more than merely technological advancements. a better comprehension of human perception and thought processes. The goal is to recognize human faces from image datasets efficiently. Research has been conducted in the field of biometric face recognition to identify individuals based on their facial traits in a group photo. Face recognition is widely used in biometric systems and security-related applications, and it has many uses. Face detection, face recognition, and training of detected faces are the three main building blocks of a face recognition system, in general [1115].

Face Detection

Only the human face may be detected using face detection; other bodily parts, such as background objects or other aspects of the subject, are not detected. It belongs to the Face Recognition subgroup.

Face Recognition

Face recognition is used to identify a body's gender and other characteristics that correspond with it. Not only can we sort human faces in them, but we can also sort a wide variety of other items. It is a facial detection superset.

Hardware And Software Requirements

Operating System: Windows 8, 10, 11, 64-bit; Hard Drive: 500GB and Above; RAM: 4GB and Above; Processor: I5 and Above; Webcam: External (Preferred) or Internal Python 3.7, Octave or MATLAB, Jupiter Notebook or Google Collab, VS Code (Enterprise/User), and MS Excel are the tools.

Algorithm Used

Principal Component Analysis (PCA)

PCA is known for dimension reduction and feature selection, however, PCA used to extract the number of principals components of the data has multidimensional.

The Human Recognition system using Principal Component Analysis was developed firstly by Turk and Pentland which was solve face recognition in two-dimensional rather than three-dimensional geometry. Since the fundamental vector created by the PCA and the taken image have the same dimensions, reconstructing the human face has been done by using it to solve the retrieval problem for huge database photos. With the recent advancements in automatic face recognition, it is now important to extract features like the lips, eyes, and nose. Furthermore, the primary objectives of PCA are to enhance face analysis, decrease original loss information, and preserve the original information of the data.

The Principal Component Analysis is the mainly of Eigenfaces was extremely large confined to dimension reduction. In has been introduced a way to do calculating the discriminant feature of PCA by using a recursive algorithm. Now we are focusing on the step of PCA in face recognition system by using Eigenface.

Support Vector Machine (SVM)

Is indeed a powerful supervised learning algorithm used primarily for classification tasks, though it can be adapted for regression as well. Its main objective is to find the optimal hyperplane that separates different classes in the feature space. This hyperplane acts as a decision boundary, allowing SVM to classify new data points into their respective categories. The key concept in SVM is the identification

of support vectors, which are the data points closest to the hyperplane and crucial for defining its position. By selecting these support vectors, SVM effectively constructs a decision boundary that maximizes the margin, or the distance between the hyperplane and the closest data points from each class. This margin maximization ensures robust generalization to new data and improves the algorithm's ability to classify accurately.

Viola Jones Algorithm

Created in 2001 by Paul Viola and Michael Jones, the Viola-Jones algorithm is a ground-breaking technique in computer vision that is especially well-known for its efficiency in real-time face detection. Even though this framework is older, it still has a big influence, especially for applications like face recognition systems that need to detect objects quickly. Fundamentally, the Viola-Jones method works with grayscale photos, using smaller image subregions to recognize faces. To complete this process, particular facial traits must be found. Since faces can appear in an image in a variety of sizes and locations, the algorithm carefully examines these scales and locations to reliably identify faces.

The four primary steps of the Viola Jones algorithm will be covered in the sections that follow: Choosing Haar-like features, generating an integral image, executing AdaBoost training, and building classifier cascades.

Optical Character Recognition (OCR)

Is the computer-generated translation of printed, handwritten, or typed text into machine-encoded text. OCR allows for the digitization of a vast number of paper-based documents in a variety of languages and formats into machine-readable text, simplifying storage and making previously unreachable material clickable. Just consider how many archive boxes filled with paper are kept in government or city basements. These pictures and papers can be scanned as a scene photo (such as text on billboards and signage), a document, or both.

Literature Survey

In their 2017 paper, Narayan Deshpande, and Dr. S. Ravishankar introduced a method for face detection and recognition by combining the Viola-Jones algorithm with PCA and ANN techniques. The aim was to enhance the efficiency of face detection and recognition processes. Their approach was evaluated against other existing face recognition methods, demonstrating improved accuracy in recognition. Given the crucial role of face detection and recognition in identity verification, the proposed method presents a promising alternative for comparison with existing techniques.

Paper [1-2] In 2018 by Saloni Dwivedi, Nitika Gupta introduced a New Hybrid Approach on Face Detection and Recognition. This study offers an implementation of a real-time face identification and recognition system and its subsequent findings on many live image test datasets. The detection is performed using Viola-Jones Algorithm and the recognition phase uses eigen faces and Euclidean faces method. Image enhancement after detection of a face region from complex background has been used to improve the quality of the recognition system. The system performs satisfactorily well with several complex backgrounds tested in several illumination conditions. Paper [3] 2017 saw the introduction of Real-Time Face Detection and Recognition in Complex Background by Xin Zhang, Thomas Gonnot, and Jafar Saniie. In this research, an algorithm for real-time, highly accurate face detection and recognition is presented. When compared to other detection techniques, it has a faster detection speed. The accuracy of face detection is improved by using the eyes detection. Aligning the face components, enhancing contrast, and smoothing images all significantly increase facial recognition performance. In real-time, face images are gathered as training samples and recognized under different circumstances, such as in the presence of other faces. New classifiers that can be trained to recognize faces in a wider range of facial orientations will be the focus of future research. To help the system retain accurate recognition, the head rotation can be approximated to further adjust the facial picture. Text [4] A face

detection and recognition system using an open computer vision classifier was introduced by Lahiru Dinalankara in 2017.

The micro project for the visual perception and autonomy module is described in this document. It then goes on to describe the project's technologies and methods. Lastly, it presents the findings, talks about the difficulties and how they were overcome, and then has a debate. Even in cases where subjects wore spectacles, face detection using Haar-cascades performed remarkably well. The real-time video speed was adequate because there was no discernible latency. When all things are considered, LBPH and Haar-cascades can be used to create an affordable face recognition system. A system that recognizes known troublemakers in a supermarket or mall and alerts the owner to be vigilant or for automatic enrollment in a class is one example.

Paper [5] Deep Neutral Networks for Human Face Recognition are introduced in 2018 by Dr. Priya Gupta, Nidhi Saxena, Meetika Sharma, and Jagriti Tripathi. This essay explains Because less redundant input features are used; the complexity of the neural network-based recognition framework is reduced when facial features are extracted using the haar cascade and fed in place of raw pixel values. Moreover, the procedure is lighter and quicker when DNN is used in place of CovNets. Additionally, since the average accuracy obtained with the suggested method is 97.05%, accuracy is not compromised. Even with the addition of a step for extracting facial traits from every image, the procedure works better for smaller datasets.

Recognition Techniques

Numerous technical papers have demonstrated the numerical analyses for every algorithm. This table 1. includes five publications that are relevant to this field. A synopsis of all the papers is provided here, with a focus on their issues and constraints as well as an overview of the conclusions that each researcher offered in those papers.

COMPARISON OF FACE TABLE I.

Paper Title	Algorithm Used	Accuracy
Face Detection and Recognition using Viola- Jones algorithm and Fusion of PC and ANN. (2017)	In this PCA and ANN algorithm are used.	**74%**
A New Hybrid Approach to Face Detection and Recognition. (2018)	In this we used CNN algorithm because it was faster than PCA and SVM.	**86%**
Real-Time Face Detection and Recognition in Complex Background. (2017)	In this we used CNN algorithm because it was faster than PCA and SVM.	**91.01%**
Face Detection and Face Recognition Using Open Computer Vision Classifier. (2017)	In this we used CNN algorithm along with polling classifiers algorithm to minimize the dimensions of the image.	**89.04%**
Deep Neutral Networks for Human Face Recognition. (2018)	In this we used CNN algorithm along with polling classifiers algorithm to minimize the dimensions of the image.	**93.04%**

The various papers have been implemented with Principal Component Analysis with AdaBoost, PCA with Back-Propagation, PCA with ANN and Wavelet. Every publication demonstrates that the accuracy of the system is greater than earlier research in which PCA was not combined with ANN.

Our Approach

We used OCR(optical character recognition) algorithm but instead of character we detect the image of a human face, and then we call Background removal algorithm or module this algorithm is used for removing the background of an image and also removed the noise in the image, through applying this algorithm we can save a lot amount of memory and also save the computation process as it will reduce the surface of the image to be read and execute and then we will use sliding window algorithm on the screen/frame to detect the image required (pixel by pixel it is executed from the top left corner of the screen until the required image is detected. It has a high frame rate thus generating more data in return and with great accuracy see in below figure.1 and in figure.2-3 shows the Ceiling Analysis with or wi t h o u t adding background remove algorithms

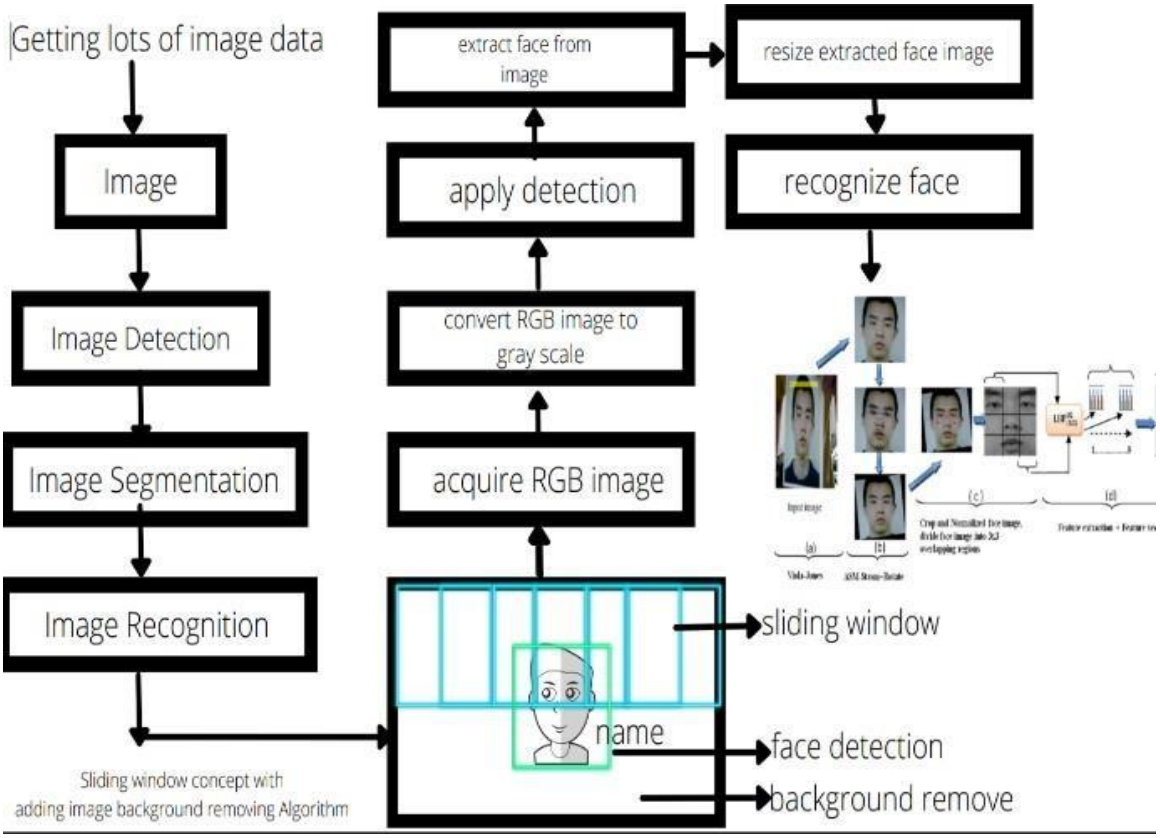

Figure 1. Workflow of an OCR A

Figure 2. Ceiling Analysis w i t h a o u t Adding Background Remove Algorithms

Figure 3. Ceiling Analysis by Adding Background Remove Algorithms

CONCLUSION

This paper can accomplish its purpose of examining every method, including overall system capacity, throughput, and accuracy, after analyzing a variety of approaches. Analysis of those papers demonstrates that the PCA approach has been shown to be quite successful in a large database. PCA, CovNets with OCR method is superior to optimize for image recognition after analysis of each document, and it also provides better ceiling analysis overall accuracy of 95.04%.

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