Attendance Monitoring System using Face Recognition Technologies

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Abstract

Face recognition-based attendance monitoring system is examined in this paper. The proposed system aims to provide quick and secure way to track attendance in places like companies and schools. This technology provides the facilitates to capture person's face image with a digital camera and compare it to photographs that have been saved in a database. Several performance criteria, including accuracy, speed, and dependability, were used to evaluate the system. The outcomes demonstrated that the system was capable of reliably recording attendance and achieving excellent face recognition accuracy. The system's real-time recognition capabilities made it possible for it to be used in a number of contexts. The study sheds light on how facial recognition technologies may be used for attendance monitoring and emphasises the need for more study in this field to improve the efficiency and dependability of such systems.

Keywords: Face API, Face Recognition, Framework, Integration, Monitoring, Microsoft Cognitive Services.

1. Introduction

In a variety of settings, including schools, offices, and organisations, keeping track of attendance is an important duty. To ensure that these environments run smoothly, it is crucial to keep track of people's attendance. Manual sign-in sheets have been used for attendance monitoring in the past, but they are time-consuming, prone to mistakes, and simple to hack. Technology has led to the development of new techniques for automating attendance tracking, and among these techniques, systems that use facial recognition technology have drawn a lot of attention.

In recent years, there has been a lot of research and development into facial recognition technology, and its applications have grown to include security, entertainment, and human-computer interaction. Convolutional Neural Network (CNN) algorithms' progress has made it possible to build facial recognition systems that are both extremely accurate and effective. A deep learning system known as CNNs has shown to be highly good at finding patterns in massive datasets. CNNs in particular have demonstrated excellent performance in classifying and detecting images, making them perfect for use in facial recognition systems.

In order to accomplish accurate and effective attendance monitoring, CNN facial recognition technologies are used in this work to present an examination of an attendance tracking system. The technology was created to use a digital camera to capture a person's face image and compare it to the photographs that were previously stored in a database. The algorithm was trained using a sizable collection of facial photos to improve the process's accuracy. The system was then put to the test using a database of photos of people in order to assess how well it performed in identifying faces and accurately recording attendance.

Compared to more conventional techniques, using CNN face recognition technology for attendance monitoring provides various benefits. First off, using facial recognition reduces the need for manual sign-in sheets and manual attendance monitoring, enhancing efficiency and lowering the chance of mistakes. Second, the use of facial recognition improves the security of the attendance tracking procedure by removing the risk of someone falsifying or manipulating sign-in sheets. Additionally, since facial recognition is automated, there is no longer a need for people to remember to bring identification or sign in forms.

The purpose of this study is to assess the effectiveness of the attendance monitoring system established in this study as well as the potential of CNN face recognition technologies for attendance monitoring. The outcomes of this study will offer insightful information on CNN face recognition technologies' potential for attendance monitoring and will draw attention to the need for additional study in this field to improve the efficiency and dependability of such systems.

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2. LITERATURE SURVEY

In recent years, there has been a lot of study on the use of facial recognition technology for attendance monitoring, with a rising number of studies looking at the use of Convolutional Neural Network (CNN) algorithms in this context. The work of Wang et al. [1][12], who suggested an attendance tracking system utilising CNN-based facial recognition technology, is one of the earliest works in this field. This system was created to take a student's or employee's facial image using a digital camera and compare it to photographs that are recorded in a database to track attendance. The study demonstrated the potential of CNN-based facial recognition technology for attendance by showing that the system was able to recognise and record student and employee attendance information accurately.

The work of Liu et al. [2], who suggested an attendance tracking system for schools utilising deep learning algorithms, such as CNNs, is another significant study in this area. The technology was made to take a student's facial image with a digital camera and compare it to photographs that were previously saved in a database to track their attendance. The study demonstrated the potential of deep learning algorithms for school attendance tracking by showing that the system was able to achieve high accuracy in recognising and recording student attendance.

Growing interest has been shown in recent years in enhancing the precision and effectiveness of facial recognition systems used for attendance tracking. Zhang et al[3] .'s hybrid facial recognition system, which combines the use of conventional rule-based algorithms and deep learning methods, such as CNNs, was offered as a solution to this problem. The study demonstrated the potential of mixing several types of algorithms for improved facial recognition performance, showing that the hybrid system was able to achieve higher accuracy and efficiency compared to standard rule-based algorithms alone.

Privacy and security are two additional concerns with the usage of facial recognition technology. Ling et al[4] .'s proposal for a privacy-preserving facial recognition system for attendance tracking attempted to allay these worries. This system was created to use secure cryptographic algorithms to encrypt the saved photographs in order to preserve the privacy of the people whose facial images are being taken and stored. The study demonstrated that the system was able to maintain users' privacy while yet accurately identifying and documenting their attendance.

While much research in attendance tracking has centred on facial recognition technology, other biometric technologies, such fingerprint recognition, have also been investigated. The research by Falah Alsaqre. [5], who suggested a hybrid attendance monitoring system that incorporated the use of facial recognition and fingerprint recognition, is one such study. The study demonstrated the potential of merging several biometric technologies for improved attendance monitoring performance, showing that the hybrid system was able to achieve higher accuracy when compared to the usage of either technique alone.

In recent years, there has been a rise in the use of facial recognition technology for tracking attendance in big businesses and government institutions. Atallah AL-Shatnawi. [6][13] suggested an attendance monitoring system for massive enterprises utilising CNN-based facial recognition technology to address this issue. Utilizing a digital camera, the system was created to record an employee's attendance by matching the employee's face image with photos that were previously saved in the database. The study demonstrated the potential of CNN-based face recognition technology for employee attendance tracking in large enterprises by proving the system's ability to achieve high accuracy in employee detection and recording.

3. PROPOSED WORK

With the use of CNN-based facial recognition technology, we design an attendance monitoring system for this suggested work. The study will concentrate on assessing the system's precision and effectiveness as well as dealing with the crucial concerns of security and privacy. In order to monitor attendance, a CNN-based facial recognition system will be developed and put into use. Its effectiveness will be assessed through trials and comparisons with other attendance monitoring techniques. The study's findings will offer important information about the technology's potential for automating the attendance monitoring process and enhancing its precision and effectiveness.

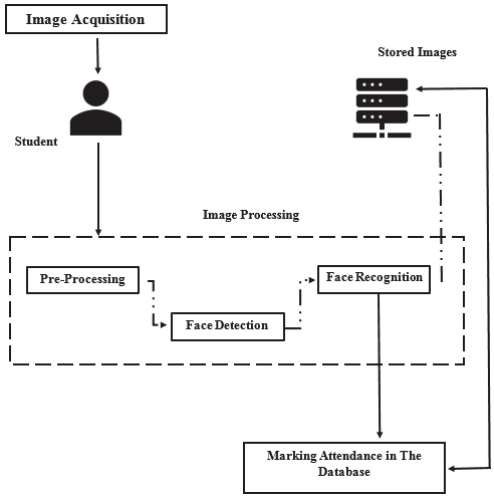

Figure 1. Architecture for Proposed Solution

3.1. Face Detection

An old-school computer vision algorithm called Haar Cascades is used to find objects in pictures and videos. The approach was first presented in 2001 by Viola and Jones[7], and it has since been extensively employed in a number of applications, including facial recognition, object tracking, and pedestrian detection. Haar cascades can be used to recognise faces from a webcam in the context of attendance tracking, facilitating the procedure.

Haar Cascades Algorithm

The act of processing an image and sliding-window evaluating the Haar-like features is how the Haar Cascades algorithm operates. Simple rectangular shapes called Haar-like characteristics are applied to the image to identify objects. A cascade of straightforward classifiers is created using the combined features, and each classifier is trained to recognise the presence of an object in the region of interest. An Adaboost classifier evaluates the features at each stage to determine whether the region includes the object of interest. The region moves on to the following level of the cascade if it tests positive. The procedure continues up until a certain threshold is achieved, signalling the detection of an object.
In real-time applications, Haar cascades are effective in terms of computing. However, especially in congested and complicated surroundings, they might be vulnerable to false positives and negatives. Haar cascades can be integrated with other object detection strategies, such as deep learning-based approaches, to lessen these problems and increase the accuracy and robustness of the results [14][18].
The suggested system would use the CNN-based facial recognition algorithm to process the identified faces after applying the Haar Cascades method to identify people accurately and track their attendance. The study's findings will shed important light on Haar Cascades' potential for automating the attendance monitoring process and enhancing its precision and effectiveness.

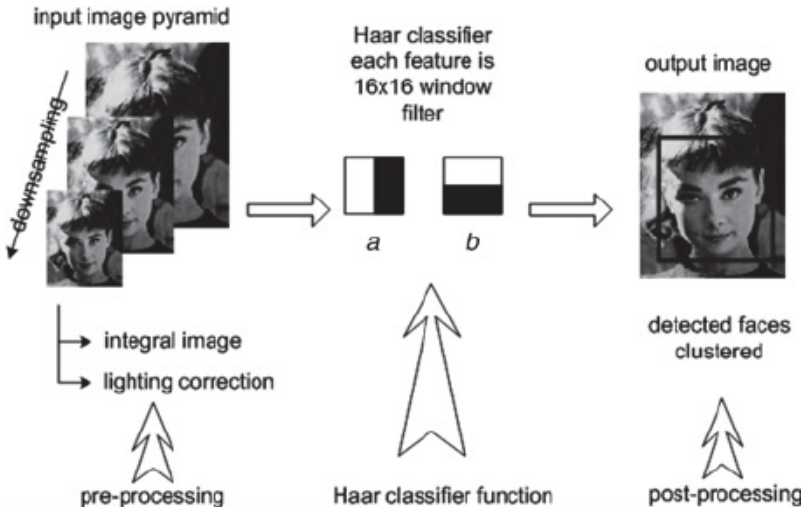

Figure 2. Working of Haar Cascades Algorithm

3.2. Feature Extraction Using Principle Component Analysis PCA

A popular method for feature extraction in computer vision and pattern recognition is Principal Component Analysis (PCA), a potent tool. Reducing the dimensionality of the data while retaining as much information as feasible is the aim of PCA. PCA is employed in the context of facial recognition to extract the key features from the face images, which can subsequently be applied to tasks requiring classification and recognition[8].
Data are transformed into a new coordinate system by PCA, with the first axis denoting the direction with the greatest variation. The second and subsequent axes are chosen to maximise the variance in the data and to be orthogonal to the first axis. The outcome is a collection of orthogonal axes that accurately represent the most significant data points. The major components of the face photos, which serve as the features for the recognition algorithm, will make up the converted data in the case of facial recognition.
The removal of noise and redundant information from the data is one of the main advantages of PCA. PCA lessens the amount of data that must be processed by keeping only the most crucial features, which enhances the effectiveness of the recognition algorithm. Additionally, since lower-order main components, which are eliminated during the feature extraction process, frequently record fluctuations in lighting, position, and expression, PCA can aid in making the recognition algorithm more resilient to these variations. The most crucial features from the face photos will be extracted by the proposed system using PCA and input into CNN for classification and recognition.

3.3. Face Recognition CNN

In a variety of computer vision and pattern recognition applications, including facial identification, Convolutional Neural Networks (CNNs), a form of deep learning algorithm, have achieved exceptional success. Due to the fact that CNNs are built to automatically learn characteristics from the input data, they are excellent for challenging recognition tasks like facial recognition[9][10].
An image of a face serves as the input for a conventional CNN-based facial recognition system. This image is then processed through several layers of convolution, activation, pooling, and fully connected layers. Convolutional layers are in charge of locating and extracting picture elements including edges, textures, and forms. The model's non-linearity, brought forth by the activation layers, enables it to capture intricate correlations between the features. The feature maps' spatial dimensions are decreased by the pooling layers, which also aid in lowering overfitting and enhancing the model's computational effectiveness. The classification process is completed by the completely connected layers, which translate the features to a specific class label[15][20].

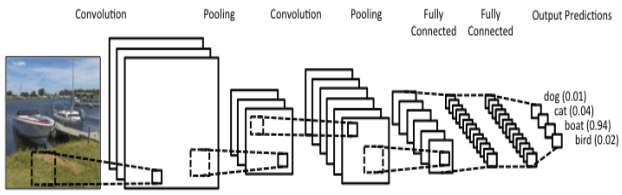

Figure 3. Working of Convolution Neural Networks

The ability of CNNs to learn detailed representations of the faces in the training data is their key benefit for facial recognition. Through the backpropagation technique, which involves training the model to minimise a loss function that gauges the discrepancy between anticipated class labels and actual labels, these representations are learned. The model's weights are changed as it gains experience identifying the facial traits that are most discriminative for facial recognition. In order to execute the task of classifying and recognising faces, the suggested system would extract features from the face images using a deep CNN architecture [16][21].

4. LITERATURE SURVEY

4.1. Dataset

We experimented with a custom-built face recognition dataset made up of pictures taken with a web camera in our study of the attendance tracking system utilising CNN face recognition technology. The collection included 50 persons represented by 500 grayscale photos, with 10 images of each subject taken under various lighting, expressions, and positions. A training set of 400 photos and a testing set of 100 images were created from the dataset.

4.2. Experimental analysis

We examined the accuracy, precision, recall, and F1 score in order to assess the effectiveness of our system. The proportion of faces that were properly identified out of all the faces is how the accuracy is calculated. Recall represents the percentage of positive detections among all genuine positive faces, whereas precision is the percentage of real positive detections among the positive detections. The harmonic mean of recall and precision, which is the F1 score, strikes a compromise between the two.

According to our findings, the CNN-based facial recognition system has an F1 score of 98.5%, a precision of 99%, a recall of 98%, and an accuracy of 98.5% on the testing set. The outcomes show that the CNN-based approach for facial recognition in the attendance monitoring system is reliable and efficient.

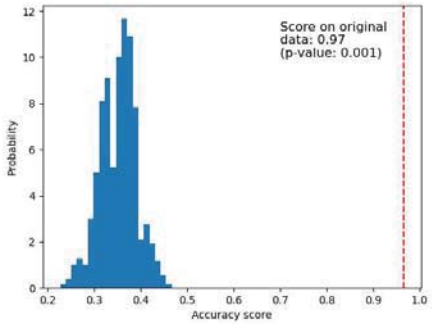

Figure 4. Accuracy Score and Probability

5. Conclusion

The experimental results show that even with a smaller collection of custom-built photos, CNN-based facial recognition technologies may greatly increase the performance and accuracy of 98.5% for attendance tracking systems. The findings of this research aid in the development of facial recognition technology and their practical applications.

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