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A Survey Paper on Attendance Management using Real-time Face Recognition

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Abstract: *The attendance system being developed for the college aims to simplify the process of marking attendance for students and faculty members. The system utilizes facial recognition technology to collect and train face data of individuals, which is then used to automatically mark attendance in the future. This system aims to reduce the time and effort required to take attendance while increasing accuracy and efficiency. The collected data is securely stored and can only be accessed by authorized personnel. The attendance system will also have a user-friendly interface that can be accessed via a mobile application or web portal. Students and faculty members will be able to quickly and easily view their attendance records and monitor their progress throughout the semester. The system will also provide real-time notifications to alert individuals if they have missed a class or have been marked absent in error. Overall, the attendance system being developed for the college promises to revolutionize the way attendance is taken and recorded. By leveraging facial recognition technology and machine learning algorithms, the system will simplify the process and provide a more accurate and efficient way to track attendance.*

Keywords: Face recognition, image processing, Biometric authentication, artificial intelligence

I. INTRODUCTION

An attendance management system using face recognition is a modern and efficient way to track employee attendance in organizations. It includes face detection, face position, identity recognition, image preprocessing, etc. The face detection algorithms are used to find the coordinates of the faces that are present in an image. This process is used to scan the entire image to determine whether a face is present in the image or not.

An attendance management system using face recognition utilizes biometric technology to automate the tracking process of employee attendance. The system captures an image of an employee's face, which is then compared to a database of known faces to verify the employee's identity and attendance. An attendance management system using face recognition typically consists of a camera, software, and a database. When a student or an employee enters, the camera captures an image of their face and then compares it to the images in the database. If a match is found, the employee's attendance is marked as present, and if no match is found, the attendance is marked as absent.This system offers several advantages over traditional methods of attendance management. Firstly, it eliminates the need for manual attendance marking, which saves time and reduces errors. Secondly, it ensures that attendance is marked accurately, as it is based on the employee's unique biometric information.Thirdly, it provides real-time attendance information, which allows for better decision-making by management.

However, the system also raises concerns like privacy and security. Implementing a facial recognition attendance management system can be costly, especially for small businesses or organizations with limited budgets. The costs can include hardware, software, training, maintenance, and support. It is important to ensure that employee data is protected and that the system is not used for any other purposes besides attendance management.

II. LITERATURE REVIEW

The are several existing systems closely related to the proposed idea of marking attendance in a class by making use of facial recognition techniques and algorithms. To analyze these systems a literature survey of the proposed systems was done.

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One of the key references used in this review is thework of Kawaguchi (2005), which proposed a lecture attendance system with a new method called continuous monitoring, and the student's attendance is marked automatically by the camera which captures the photo of a student in the class. The architecture of the system is simple since two cameras are equipped with the wall of the class. The first one is a capturing camera used to capture the image student in the class and the second camera is a sensor camera used to get the seat of a student inside the class and the camera capturing will snap the image of the student. The system compares the picture taking from a camera capturing images and faces in the database done much time to perfect the attendance.

Another relevant reference is the work of N. Kar. (2012), introduced an automated attendance management system using a face recognition technology that used the Principal Component Analysis To implement the system, use two libraries OpenCV a computer vision library, and FLTK(Light Tool Kit). Both of these libraries helped the development such as the OpenCV support algorithm and FLTK used to design the interface. In the system, there are Request Matching and Adding New facts to Database. In Request Matching, the first step is open the camera and snap the photo after the extraction of the frontal face. The next step is recognizing the face with the training data and projecting the extracted face onto the Principal Component Analysis. The final step displays the nearest face with the acquired images. Apart from that, adding a new face into the database is snapping the photo after that extract the frontal face images and then performing the Haar cascade Method to find the perform Principal Component Analysis Algorithm. The final step is storing the information inside the face XML file. The system is focused on the algorithm to improve face detection from acquired images or videos.

In addition, the work of Priyanka (2012), is alsorelevant,whichproposeda method using Eigenface and Principal Component Analysis which has the architecture as the following step. The camera needs to install in the front which can capture the entire face of the student inside the class. In the first phase after the camera has been captured; the captured image was transferred into the system as input. The image captured from the camera sometimes comes with darkness or brightness which needs to do an enhancement on it such as conversion to a gray image. The next step, Histogram Normalization is used in this system to remove the contrast of the image. It is easy to recognize when the student sits in the back row. The Median filter is used to remove noise from the image in case the camera is high definition camera, but sometimes it still contains the noise. The author also implements skin classification which changes all the pixels to black except the pixel that is close to the skin.

Overall, a literature review on attendance management systems using face recognition would provide an in-depth analysis of the current state of research in this area and help identify areas for future research and development.

III. EXISTING SYSTEM

Traditional attendance management systems rely on manual processes, such as signing in and out on a paper register. This process is time-consuming and can lead to errors, such as employees forgetting to sign in or out. Traditional attendance management systems can be prone to errors and inaccuracies. For example, paper registers or punch cards can be lost or stolen, leading to lost attendance data.These systems require significant manual labor to manage, including data entry and processing, which can be time-consuming and prone to errors. Also, they are susceptible to fraud and can be manipulated by employees. For example, employees can sign in and out for each other or use proxy attendance.

Overall, the drawbacks of traditional attendance management systems can lead to inaccurate attendance records, wasted time, and decreased productivity. Implementing a modern attendance management system using technologies such as face recognition can help overcome these drawbacks and improve the accuracy, efficiency, and security of attendance management.

IV. METHODOLOGY

4.1 Dataset Preparation

The high-resolution camera is used to take frontal images of the students. The images are converted from RGB to Grayscale The faces detected in images are stored in the database after pre-processing and detection. A minimum of 100 images are captured per individual student along with a unique ID. The dimensions of these stored images are of a maximum resolution of 200×200 pixels. These images are later used to train the recognizer

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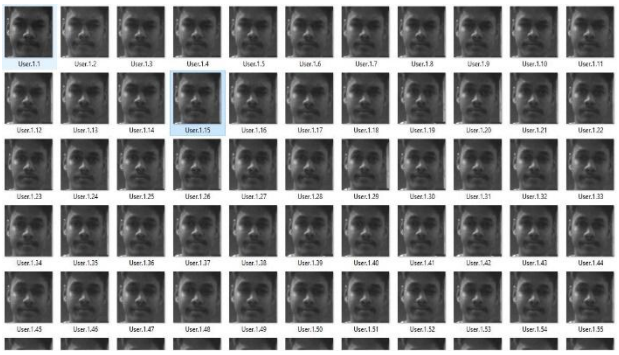

Figure 4. (a): Preprocessed Images stored in the database

4.2 Face Detection

A proper and efficient face detection algorithm always increases the performance of face recognition systems. Various algorithms are proposed for face detection. Once the camera starts capturing, simultaneously the Haar Cascade algorithm is applied to the video to get the individual faces of the students and obtain the distinct features of their faces such as eyes, nose, and lips. The Haar cascade algorithm works by providing us with the parts of the face that are needed most for the detection

4.3 Face Recognition

In this third and most crucial phase of recognizing the student, that is comparing captured image against the stored images in the database, this method is done by making use of the LBPH algorithm(Local Binary Pattern Histogram), each image stored in the database has its histogram value calculated and is cross-checked against the calculated Histogram value of the images extracted from the captured video

4.4 Attendance Marking

In this phase the attendance is marked, if the detected face matches with the images stored in the database, then the attendance is marked as present and an email is sent to the student mentioning that his/her attendance has been marked for the day and if the face doesn't match with the dataset then also the student will receive an email that their attendance was marked as absent. To successfully mark the attendance the accuracy needs to be at least 50 percent.

4.5 Hardware and Software

The system requirements for an attendance management system using face recognition depend on several factors, including the software used, the size of the organization, and the number of employees. However, here are some general system requirements that are typically needed for a basic attendance management system using face recognition: a computer with an Intel Core i5 processor and 8GB of RAM. We used Python as the programming language and the OpenCV library with the TensorFlow back end for implementing the system.

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4.6 Algorithms Used

A. Haar Cascade

Haar Cascade is a machine learning-based object detection algorithm used to detect objects in images or videos. It was proposed by Viola and Jones in 2001 and is based on the concept of features and classifiers. In the context of face detection for attendance management using face recognition, a Haar Cascade can be used to detect faces in images or video frames. The algorithm works by training a classifier with a set of positive and negative images. Positive images contain the object to be detected (in this case, faces) while negative images do not contain the object.

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Figure 4.1: Haar Cascade classifier view

During training, the algorithm extracts thousands of features from the images and calculates the Haar-like features which are simple rectangular areas with defined sizes, positions, and thresholds that capture important information about the face like edges,
lines, or textures. Then, the algorithm uses a machine learning algorithm called AdaBoost to select the most relevant features and create a classifier to distinguish between positive and negative images.
After training, the classifier can be applied to new images or video frames to detect the presence of the object (face) in real time. The algorithm then uses a technique called non-maximum suppression to eliminate false positives and retain only the most likely face detections.

B. Local Binary Pattern Histograms (LBPH):

Local Binary Pattern Histograms (LBPH) are a popular machine learning-based algorithm used for face recognition. LBPH works by dividing an image into small, overlapping regions and computing a binary code for each region based on the intensity values of its pixels relative to its neighboring pixels. The binary codes are then concatenated to form a histogram that represents the texture information of the image. To perform face recognition using LBPH, the algorithm first extracts the LBPH histogram for each face in the database during enrollment. When a new face is detected, the LBPH histogram is computed for the face and compared with the histograms in the database using a distance metric such as Euclidean distance or cosine distance. The face with the closest histogram is considered a match, and the attendance is recorded.

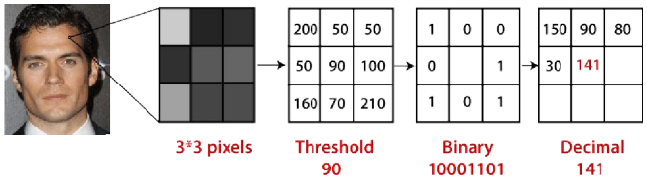

Figure 6.2: Face Recognition of LBPH Algorithm.

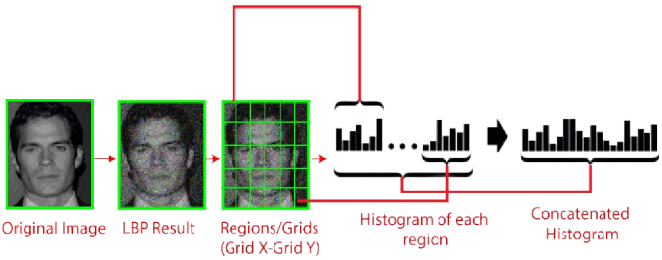

Figure 6.2.2: Extracting the Histograms from the image.

V. BENEFITS OF THE SYSTEM

- **Cost-effective:** Real-time face recognition systems reduce labor costs associated with manual attendance tracking, and also reduce the costs associated with paper-based attendance systems.

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- **Time-saving:** Real-time face recognition systems can automate the attendance management process, eliminating the need for manual attendance tracking, reducing administrative workloads, and saving time.
- **Security:** Real-time face recognition systems can provide enhanced security by verifying the identity of individuals, preventing impersonation, and reducing the risk of fraud.
- **Real-time reporting:** Real-time face recognition systems can provide real-time reports on attendance data, allowing managers to monitor attendance trends, identify attendance issues, and take corrective action

VI. LIMITATIONS

- **Privacy concerns:** Real-time face recognition attendance management systems raise significant privacy concerns, as they involve collecting and storing biometric data. Employees or students may feel uncomfortable with their bio-metric data being collected and used for attendance tracking.
- **Poor Image Quality:** The effectiveness of facial-recognition algorithms is influenced by the image quality which can sometimes lead to errors in detection of the face if the image quality is poor.
- **Different environmental conditions:** The relative angle of the target's face significantly impacts the recognition score. But, it can be affected by environmental factors such as lighting, and facial obstructions.

VII. RESULTS AND DISCUSSION

When the users interact with the system, The users are provided with three different options such as, add data to the dataset, Train with the new dataset, and mark attendance. During the creation of the dataset, after clicking on Add data to dataset button, the webcam starts automatically and a window pops up and starts detecting the faces in the frame. Then it automatically starts clicking photos until 100 samples are collected. These images then will be pre-processed and stored in the training images folder. Later the data is trained, For marking the attendance the student needs to click on the mark attendance button and then enter the user id that was given to them during the registration. After successful detection, The attendance will be marked. Also, a person can mark attendance only once on a particular day.

VIII. CONCLUSION

The implementation of an attendance management system using face recognition technology can bring many benefits to an organization. It can automate the attendance marking process, reduce the time and effort required for manual attendance tracking, and eliminate errors associated with manual methods. Thus, the system aims to capture the images of the students, relate them to the database to ensure their presence or absence, and mark attendance to the particular student to maintain the record.

In future work, we plan to collect more data for each user to create a bigger dataset to get higher accuracy for our model. Also, we can use better camera configuration to capture high-resolution images and use cloud databases such as GCloud, AWS, etc. The accuracy of real-time face recognition systems can be affected by environmental factors such as lighting, camera quality, and facial obstructions. Future developments should address these factors to ensure consistent and reliable performance.

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