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Integrated Student Database and Attendance Management System with Face Recognition

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"Integrated Student Database and Attendance Management System with Face Recognition"

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Abstract

The Integrated Student Database and Attendance Management System with Face Recognition is an innovative solution designed to streamline and enhance attendance tracking and management processes within educational institutions. This system leverages the power of face recognition technology to accurately and efficiently monitor student attendance, eliminating the need for manual methods such as roll call or barcode scanning. The primary objective of this system is to create a comprehensive and centralized student database that seamlessly integrates with attendance management. By using face recognition technology, the system can reliably identify and authenticate students, ensuring accurate attendance records. The system captures facial images of students during registration, which are then stored securely in the database. During class sessions, the system utilizes video feeds from camera used in the system to continuously analyze and match faces with the stored images in real-time. This process enables instant identification of students present in the classroom, automating the attendance marking process. Furthermore, the system can generate attendance reports for the class and for the entire institute. The integrated database component of the system provides a centralized repository for storing student information, including personal details and attendance history. This allows administrators and teachers to access up-to-date and accurate data, promoting effective communication and informed decision-making. By implementing the Integrated Student Database and Attendance Management System with Face Recognition, educational institutions can streamline attendance management processes, save administrative time, reduce errors, and enhance overall efficiency. This system offers a reliable and scalable solution to optimize student attendance tracking, promote accountability, and improve communication among stakeholders in the educational ecosystem.

Keywords- Face Detection, Face Recognition, Image Processing, LBPH

1. Introduction

The objective of implementing a face recognition-based attendance monitoring system is to streamline the attendance procedure, thereby minimizing the time and effort expended by the instructor, enabling them to allocate more resources towards teaching. This technology offers a user-friendly and efficient solution for students as well. The system operates by capturing images of students present within the classroom environment, utilizing a face recognition algorithm to automatically record attendance. This approach eliminates the need for time-consuming roll calls, which often result in inaccuracies due to proxy attendance. The system caters to various user roles, including lecturers, administrators, and students. Lecturers have the ability to control the attendance process by determining when the image capture process begins. Administrators possess the authority to update the system's database whenever new students enroll. For students, this system facilitates the monitoring of their attendance, allowing them to view their attendance records without the ability to modify or manipulate the system's database. The system administrator holds the privilege of managing, uploading, and updating the database.

Following are the functionality of the lecturer

- Start the attendance of the students
- View the attendance
- Retrieve the queries
- Control over the system
- Manual attendance marking
- Time

Following are the functionality of the students

- View attendance

Following are the functionality of the administrator

- View attendance of students
- Retrieve queries
- Control over the entire system
- Update the database of the students

The teacher devotes significant time to manually mark attendance, resulting in inefficient utilization of time that could have been allocated to more constructive activities such as teaching and solving doubts. Consequently, this system offers substantial benefits to the education industry and other sectors like IT firms, offices, banks, airports, and places where security and identity are of utmost importance. The system comprises an algorithm that specifically identifies the face of the student, distinguishing it from the surrounding space and other body parts. This recognized image is then matched with pre-fed data, which is obtained when students enroll in college or a particular class. The system operates in three distinct stages. Firstly, it requires the collection of images of students who will be attending the classes, as it is crucial to capture images of all students. The second phase involves dynamically detecting faces using the attendance monitoring system through face recognition. The camera captures images of faces exclusively, and with the aid of the pre-fed data, these captured images are recognized. The final phase of the system involves updating the attendance sheet. Recognized faces are marked as present, while the remaining students are marked as absent. Over the past two decades, numerous face detection methods have emerged. While classical methods have been highly successful, their main drawback lies in their reliance on 2D facial photographs. Such representations are sensitive to variations in expression, lighting, and poses. Additionally, the computational and storage complexities, as well as the intricacies involved in generating examples, make these methods cumbersome. The requirements of modern face detection systems may necessitate the incorporation of machine learning capabilities, enabling machines to evolve through a learning process and perform tasks that are challenging or even impossible to accomplish using traditional algorithmic approaches. These novel

methods are primarily rooted in the concept of learning, which has been a focal point of artificial intelligence research for many years. Given that face detection can be considered a two-class model identification problem, these advancements in machine learning prove to be particularly relevant.

2. Motivation

The rise of technology like image processing is what inspired this proposed effort. The manufacturers of smartphones provide features like face unlock, AI, and machine learning. The classroom frequently has a large number of students, which makes it time-consuming. Therefore, developing a system that can automatically detect the present students and then mark the students appropriately will be very helpful. It will be similar to staff ID scanning, but much simpler. Additionally, this technique will lessen student tampering with attendance records.

3. Related Work

Hajar Philaliet. Aluminum. [1] compared four machine learning-based methods that allow the machine to evolve through a learning process and perform rather difficult tasks using more conventional algorithms (Haar-AdaBoost, LBP-AdaBoost, GF-SVM, GFNN). The first two methods “Haar-AdaBoost, LBP-AdaBoost” are based on a boost algorithm used for both selection and training of a strong classifier with waterfall classification. The last two classification methods "GF-SVM, GF-NN" use a Gabor filter to extract the features from the image. Based on this study, we found that the detection time varies depending on the method. In terms of response rate, the AdaBoost hair method remains the best of the four methods. We will then use Hair AdaBoost.

In [2] the authors proposed a system to avoid the disadvantages of the traditional manual attendance system. This article describes how real-time face detection and recognition can help you verify student attendance. The article demonstrates an automated attendance system consisting of a camera installed in the classroom that takes pictures and then recognizes multiple faces. This system includes many steps such as creating student face database, HOG functions, face and eye recognition, SVM classifier, comparison/recognition, attendance assessment. Algorithms such as the Viola-Jones and HOG functions and the SVM classifier are used to achieve the desired results.The card had some glitches that allowed the system to be sensitive to light. The proposed system can overcome this disadvantage by using algorithms that may not be sensitive to illumination and using advanced high-resolution cameras.

Shireesha Chintalapati, MV Raghunad et al. [4] have described various techniques for implementing an attendance monitoring system using face recognition. The process is divided into two main parts. The first is face recognition technique and the second is face recognition technique. Face detection can be implemented using the Viola-Jones face detection algorithm, which consists of four main components, namely, hair properties, integral image, adaboost algorithm, and cascade function. Face recognition can be implemented using LBP (Local Binary Patterns). LBP helps convert the image into machine-understandable formats, such as binary. Before face detection and detection, the captured image needs to be converted to grayscale for easier calculation. The face recognition technique first captures the image (student record) and detects faces in the images. The detected faces are saved for future reference. The face recognition technique captures images of the class and attempts to recognize them by comparing them to previously recognized faces.

4. Proposed System

Fig 4.1 Flow chart for Integrated Student Database and Attendance Management System with Face Recognition

Multiple student images are collected for the training data set. This dataset is used to match the real-time images captured in the classroom and flag the presence of matching data. These recorded images go through a pre-processing phase. The purpose of image pre-processing is to improve the image data either by removing unwanted distortions or by improving some important image properties for further processing. Image pre-processing includes background subtraction and conversion of the image to grayscale. The background of the image does not move i.e., it stays silent. Thus, the background is subtracted from the image set. The image is converted to grayscale before the background is stripped away. This allows for good accuracy in face recognition. Features are extracted from the detected faces and cropped face images are saved for comparison. Feature extraction is a type of dimensionality reduction that efficiently represents the parts of an image of interest as a compact feature vector. This approach is useful when the image size is large and a small feature representation is needed to quickly perform tasks such as image matching and image retrieval. Photographs of students in Class are then taken to signal the presence of students present in the classroom. These images also go through a pre-processing and face recognition process. Faces detected in class images are compared to images in the original data set. If a match is found, the student number and name are added to the current student list. Face recognition technology is used for the comparison.

4.1.Face Detection

The aim is to find faces (position and size) in an image and optionally extract them for use by the face detection algorithm.

4.1.1. Face Recognition

Because facial images have already been extracted, cropped, resized, and usually converted to grayscale, the face recognition algorithm is responsible for finding the features that best describe the image.

4.2.Haar Cascade Algorithm

Haar-like features are the fundamental basis for object recognition in the Haar classifier. Instead of using pixel intensity values, these functions use a change in contrast value between groups of adjacent rectangular pixels. The contrast differences between pixel groups are used to determine relative light and dark areas. Two or three adjacent clusters with relative contrast variance form a hair-like feature. Hair-like features are used for image recognition, as shown in the figure. Haar features can easily be scaled by increasing or decreasing the size of the group of pixels under study. This allows you to use the feature to detect objects of different

sizes. With the waterfall classifier, you can analyze only the partial images with the highest probability for all hair features that distinguish the object. You can also change the accuracy of the classifier. You can increase both the false positive rate and hit rate by reducing the number of steps. The opposite is also the case. Viola and Jones managed to achieve a 90% cure rate by recognizing a human face with just 100 simple functions. To recognize human facial features such as the mouth, eyes, and nose, the cascades of the hair classifier must first be learned. To train classifiers, you need to implement this harmless AdaBoost algorithm and the Haar feature algorithms. Fortunately, Intel has developed an open-source library called the Open Computer Vision Library (OpenCV) dedicated to simplifying the implementation of vision-related computer programs. The OpenCV library is designed to be used in conjunction with applications related to HMI, robotics, biometrics, machine vision, and other areas where visualization is important and includes implementation of Haar classifier detection and training. The system then uses this algorithm to recognize the face of the person in the video. A green square appears on the person's face as an indication of the recognition process. Once the face is recognized, the user can stop the video and enter the details of the recognized person, such as name, address, etc. B. Name, address, occupation, and any previous convictions. If a discovered person is punished, they can be identified as a suspect. The system provides a checkbox option that allows the user to indicate whether a specific person is suspicious or not. Here's how the first form works, showing a sample video and detecting a face

4.2. Local Binary Pattern Histogram *(LBPH)***:**

Local Binary Pattern (LBP) is a simple but very efficient texture operator that labels an image pixel by thresholding the neighborhood of each pixel and treating the result as a binary number.
The first step in calculating LBPH is to create an intermediate image that better describes the original image by emphasizing facial features. To do this, the algorithm uses the sliding window concept based on the parameter radius and neighborhood.
Steps involved in LBPH

- Parameters**:** Radius, Neighbors, Grid X, Grid Y
- Training the algorithm
- Applying the LBP operation
- Extracting the histogram
- Performing the face recognition

5. Result and Discussion

For the Integrated Student Database and Attendance Management System with Face Recognition, the following results were obtained

5.1.Login System and Application menu

Login system is used for authentication before entering into the application menu. The application menu contains list of menu items such as students details, photo, face detection, attendance etc.

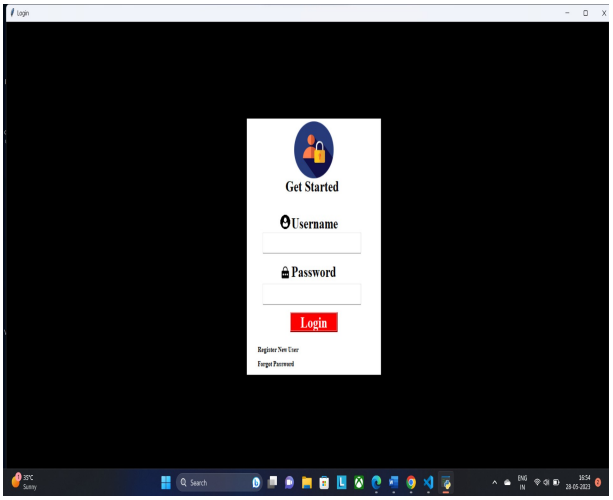

Fig 5.1(a) Login system

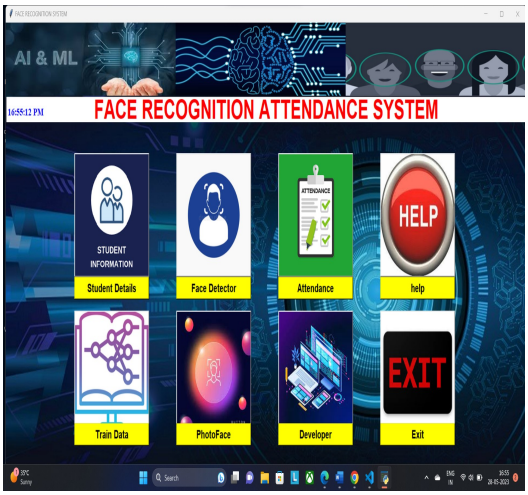

Fig 5.1(b) Application Menu

5.2 Face detection details management and training the dataset

Student information can be registered in the student details management system and the 100 images are captured of a single student for face recognition purposes. The captured images of the students are stored in a local database. The stored images are trained using a classifier and are assigned corresponding labels such as Id, name, and department.

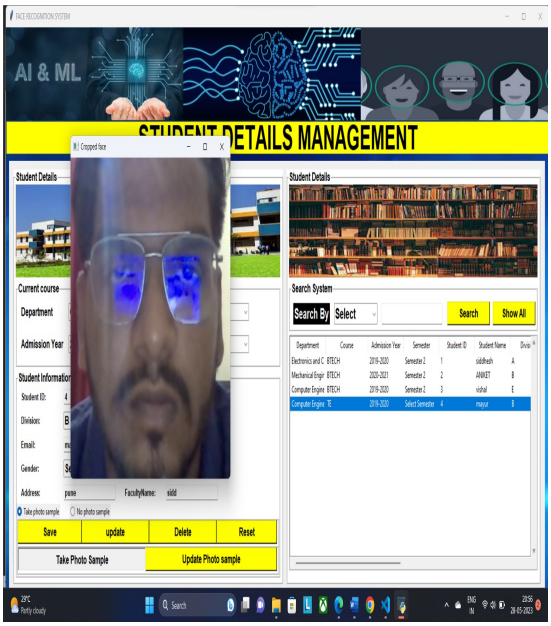

Fig 5.2(a) Students details management and face detection process

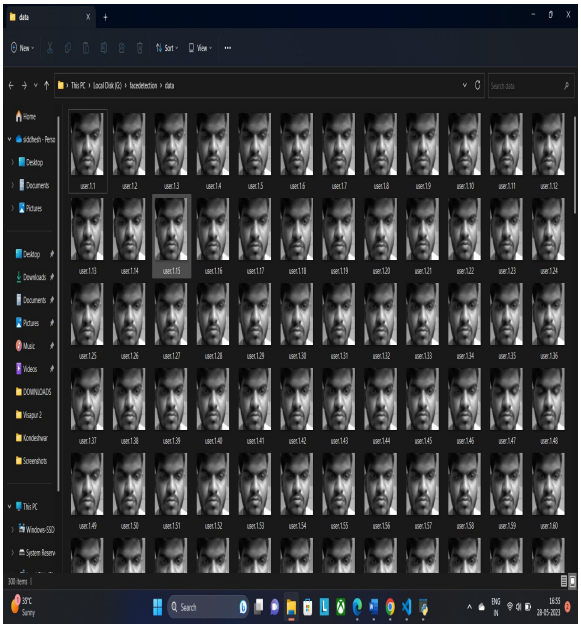

Fig 5.2(b) Datasets of images

5.3 Face Recognition and Attendance Result stored in an excel sheet

During the Face recognition process, the features comparison takes place with respect to the features stored in the database. After recognition of the face from the defined datasets the face is displayed along with the corresponding ID, Name, and Department of the student which is used for marking the attendance. The corresponding attendance of the students is stored in an Excel sheet. The file is stored as a .csv file whose data can be exported and imported with buttons given in the attendance menu.

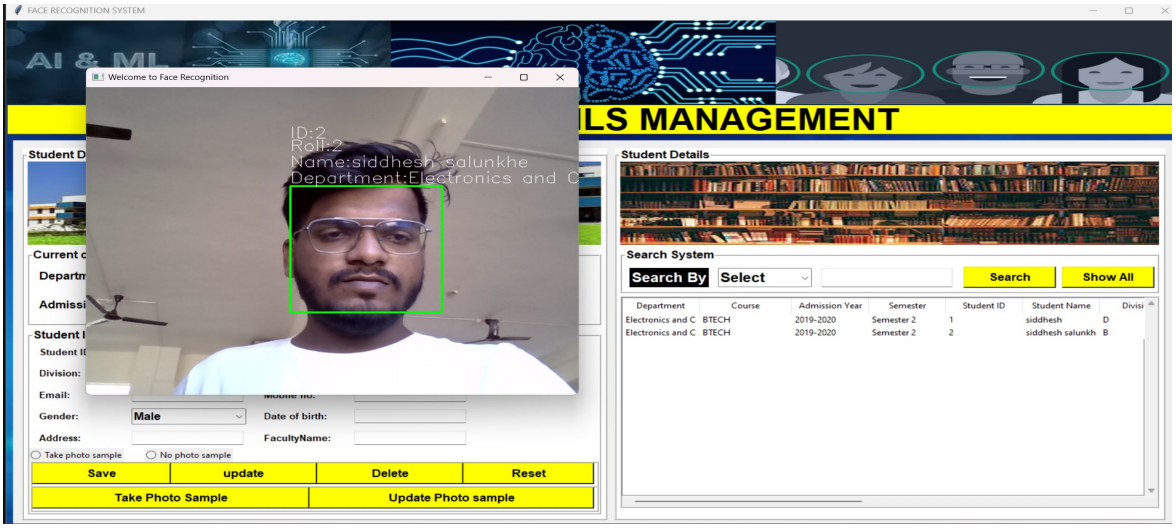

Fig 5.3(a) Face Recognition system

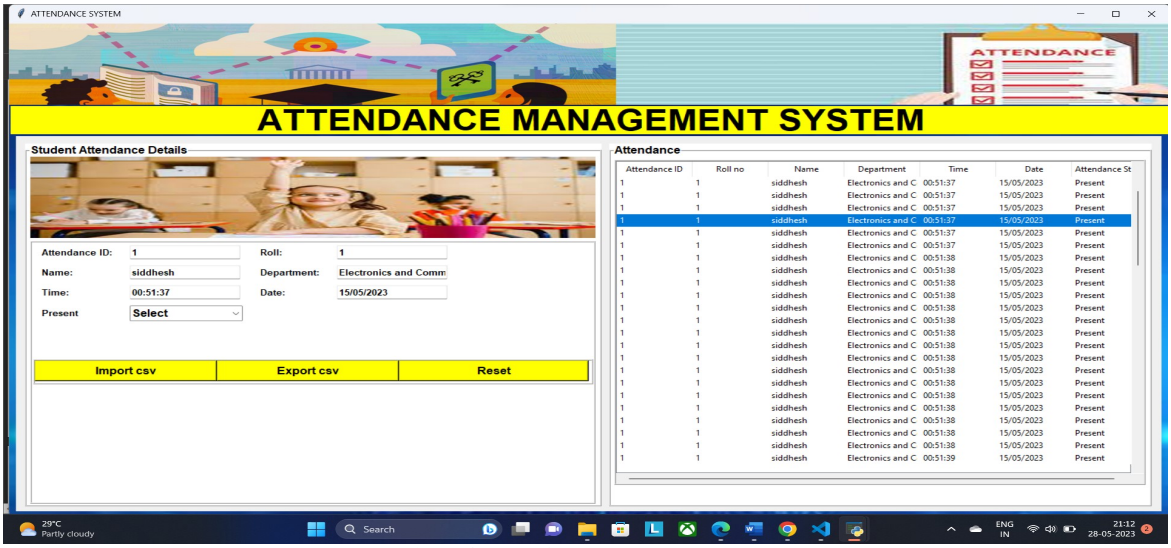

Fig 5.3(b) Attendance management system

6. Future Scope

Almost all academic institutions require student attendance records, and tracking attendance manually can be a cumbersome and time-consuming task. Therefore, maintaining automatic attendance using facial recognition is very beneficial and less error-prone than a manual process. This also reduces the manipulation of the attendance list by the students and saves time. The future purpose of the proposed work could be to take many detailed photos of students and use any cloud technology to store these images. The system can be configured and used in ATMs for fraud detection.The system can also be used in elections where the voter can be identified using facial recognition.

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8.Conclusion

The article introduces an effective method of attendance management system in a classroom environment that can replace the old manual methods. This method is sufficiently safe, reliable, accurate, and effective. No special equipment is required to install the system in the classroom. It can be built with a camera and a computer. There is a need for algorithms that detect faces in curtains to improve system performance.

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