Face Recognition Attendance System using Open CV

Ajay Kumar, Anand, Anshika Yadav, Harshit Tiwari
Department of Computer Science and Engineering Axis Institute of Technology and Management, Kanpur

Abstract- Indeed, face recognition technology plays a crucial role in the contemporary digital era and has widespreadapplications across various industries. The unique characteristicsof an individual's face serve as a crucial biometric for developing face recognition systems. One particular challenge often encountered is efficiently managing attendance tracking. Traditional methods involve verbally calling out students' names and manually recording their presence or absence, which can be time-consuming and labour-intensive. However, this proposed model incorporates a camera that captures an image, utilizes face detection techniques, encodes and recognizes faces, records attendance in a spreadsheet format, and converts it into PDF files.The project introduces an OpenCV-based facial recognition approach. Examining OpenCV Real-Time Face recognition also determines the system's usability and suitability for use in any institution with a facial recognition system. By converting the manual approach into a system, an issue in this epidemicera can be solved.

Keywords: Biometric, OpenCV Python, camera, face recognition

I. INTRODUCTION

Within the last numerous years, numerous algorithms have been proposed for face detection. While lots of developmenthas been made in the direction of spotting faces below smallversions in lighting fixtures, facial expression and pose, dependable techniques for popularity beneath greater excessive variations have been established elusive. Face detection is essential to many face applications, together with face popularity and facial expression evaluation. But, the huge visible versions of faces, together with occlusions, massive pose variations, and excessive lighting, impose splendid demanding situations for those obligations in actual-world applications.

Cutting-edge deep gaining knowledge of structures is proved to be nearly perfect face detectors, which outperform humanabilities in this location [10]. The range of packages in these days' existence increases tremendously due to this reality. They would replace humans in regions wherein their accuracy is the most useful, as an instance, security. So given that their set of rules-driven selections may have critical results, the query of reliability and robustness towards malicious moves turns into critical. One in each of these undertakings is face detection that is widely used as a preparation operation for Face Id, which lets in tracing criminals or manage entrance policy.

Effective monitoring of student performance through attendance management is a critical responsibility of educational institutions. While various approaches areavailable, some facilities still rely on outdated paper or file systems, while others have adopted automated methods usingbiometrics. Among these biometric options, facial recognition systems have emerged as a prominent solution. These advanced computer systems can accurately identify or authenticate individuals by analyzing patterns based on theirunique facial features.

The management of facial recognition systems has seen significant progress in recent years, leading to their widespread adoption in security and business operations.Face recognition technology is a rapidly developing field within computer digital technology. One innovative application of this technology is its integration into attendance records, similar to other biometric techniques such as fingerprint or iris recognition systems commonly used in security settings. As educational institutions or organizations continue to expand, so does the complexity associated with attendance management, requiring more efficient solutions for instructors or administrators.

A mature face detecting system commonly consists of image acquisition, photo pre-processing, face detection, face tracking, face alignment, function extraction, and evaluation.Among the extra critical steps are face detection, tracking, and face

characteristic extraction. In recent years, face reputation structures were extensively used in channel bayonet structures which include clever access management and identity verification in high-pace railway stations. Thesechannel bayonet face recognition structures have all or maximum of the face picture series, face detection, face alignment, face high-quality detection, face function extraction, face tracking, and different steps. However, someof those structures require an excessive degree of cooperationfrom people, a few are complex to put in force, and a few have high necessities for hardware along with computing gadgets. On the only hand, the computing power of embedded systems isn't enough to support face detection, tracking, and face feature pairing-based totally on deep getting to know. Real-time requirements, a few channel bayonet face recognition systems require humans to intentionally approach the camera to cooperate with the device for verification, discarding the herbal and convenient benefits of face recognition. The specific goal situation studied in this paper is a single channel bayonet (unmarried face near range), and the aim is so one can quickly examine and recognize faces within 1-4 meters. The purpose of the research is to use a faster and higher overall performance algorithm to the channel bayonet face reputation machine with low computing energy and to enhance the running speed of the face popularity gadget through the progressed face detection algorithm. It can be established on low-stop gadgets with terrible computing overall performance even as preserving sure detection and reputation overall performance.

1.1. OVERVIEW

Facial recognition as a biometric technique involves the task of determining whether a particular facial image matches oneof the facial images stored in a database. However, this task presents challenges due to various factors that can affect the image, such as facial expression, aging, and lighting conditions. Despite potential accuracy limitations, facial recognition offers several advantages over other biometric techniques. It is a straightforward and convenient method that works independently. In the proposed system, facial recognition technology is used to automatically monitor the attendance of employees or students, eliminating the need fortheir active participation. The system uses a camera to capture images of individuals, detects their faces in the captured images, compares them to the images in the database, and marks their attendance accordingly.

1.2. AIMS AND OBJECTIVES

The goal of this project is to create an automated student attendance system based on facial recognition. The following achievements are expected to achieve this goal:

- Face detection: The system will be able to identify and locate a face segment within the video.
- Feature extraction: Once a face is detected, the system extracts relevant and useful features from the detected face.
- Face recognition: The extracted features will be classified and compared with the existing data to recognize the detectedface.
- Attendance record: After successfully recognizing the student's face, the system records his attendance and associates it with his identity.

By meeting these goals, the project aims to develop a robustand efficient automated student attendance system based on facial recognition technology.

II. IMAGE PROCESSING

The face recognition process can actually be divided into twoprimary phases: processing and recognition. The processing phase occurs before face detection and includes various pre-processing steps to prepare the image for accurate detection and recognition. Some of the common processes at this stage include:

1. Face Alignment: This process involves aligning detected facial regions in an image to a standardized position or orientation. It helps to normalize the position, scale and rotation of the face and ensures consistency in subsequent recognition steps.
2. Face detection: In this step, algorithms or models are used to find and identify areas of the image that contain faces. Facedetection techniques use pattern recognition and machine learning algorithms to identify facial features such as eyes, nose, and mouth.

The recognition phase follows the processing phase

and involves extracting meaningful features from the detected facial regions and comparing them to stored facial data. Key actions in this phase include:

1. Feature Extraction: This step focuses on extracting unique facial features from pre-processed facial regions. Various methods, such as principal component analysis (PCA), local binary patterns (LBP), or convolutional neural networks (CNN), can be used to extract discriminative features that represent the underlying facial characteristics.
2. Matching: Once the features are extracted, they are compared to stored face data or templates in the database. The aim of this comparison is to find the closest match between the extracted features and the data of the reference surfaces. Comparison algorithms such as Euclidean distance, cosine similarity or support vector machines (SVM) can be used forthis purpose.

By dividing the face recognition process into these two phases, processing and recognition, it will be easier to understand the basic steps involved in achieving accurate andreliable face recognition.

A. Face detection

The main purpose of this step is to determine if any human faces are present in the given image and to identify thelocation of those faces. The desired result of this step is to obtain the individual fields or parts that contain each detected face in the original input image. To increase the robustness and flexibility of the face recognition system design, face alignment is performed. This includes adjusting the scale andorientation of the face fields to make them standardized and consistent. Aligning faces makes it easier to compare and analyze facial features for subsequent steps in the face recognition process.

B. FEATURE EXTRACTION

After the initial face detection step, the next stage involves extracting human face patches from the images. Once these face patches are obtained, the subsequent step is to convert them into a vector representation with fixed coordinates or aset of landmark points. The conversion process involves mapping the facial features within the face patch to a specific set of predefined coordinates or landmarks. These landmarksrepresent key points on the face, such as the corners of the eyes, the tip of the nose, or the corners of the mouth. By capturing the spatial arrangement of these landmarks, a vector representation or a set of landmark points is created. This conversion allows for a more compact and structured representation of the face, which is easier to process and compare for subsequent tasks such as face recognition or analysis. The vector or landmark points capture the distinctive features of the face and provide a foundation for further analysis and classification.

C. FACE RECOGNITION

The last step in the face recognition process is face identification. In order to achieve automatic recognition, a database of faces must be created. This involves capturing multiple images of each individual and extracting their facialfeatures, which are then stored in a database. When an input image is provided, the first step is face detection, where the system identifies and locates the face in the image. Next, feature extraction is performed on the detected face to obtain its unique set of facial features. These extracted features are then compared with the features stored in the face database for each person. The comparison is performed by calculating the similarity or distance between the features of the input image and the features of each individual in the database. This comparison allows the system to determine the closest match or matches. Finally, the identified face is linked to thecorresponding person in the database, providing a recognition or identification result. By creating a comprehensive database of faces and performing accurate facial feature comparisons,the system can automatically recognize and identify individuals based on their facial characteristics.

D. Local Binary Pattern Histogram

Local Binary Pattern (LBP) is a simple but very powerful texture operator which marks the pixels of an image bythresholding the neighborhood of each one pixel and treats the result as a binary number.

It was first described in 1994 (LBP) and has since been found to be powerful texture classification function. Furthermore, itwas found that when LBP in combination with the descriptororiented gradients histograms improves detection performance on some datasets. Using the LBP combination with histograms we can represent face images with a

simple data vector.

Working with the LBPH algorithm step by step: The LBPH algorithm works in 5 steps.

1. Parameters: LBPH uses 4 parameters:

- Radius: the radius is used to create a circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.
- Neighbors: number of sample points to build a circular local binary pattern. Keep in mind: the more sample points you include, the higher computational costs. It is usually set to 8.
- Grid X: the number of cells in the horizontal direction. The more cells the finer the grid, the higher the dimensionality ofthe resulting element vector. It is usually set to 8.
- Grid Y: the number of cells in the vertical direction. The more cells the finer the grid, the higher the dimensionality of the result feature vector. It is usually set to 8.

2. Training the algorithm: First we need to train the algorithm.Do so we need to use a dataset with face images of the peoplewe want know. We also need to set an ID (it can be a numberor a name person) for each image, so the algorithm uses this information recognize the input image and give you theoutput. Images of the same the person must have the same ID. With a training set already constructed let's look at the computational steps of LBPH.

3. Using the LBP operation: The first computational step of LBPH is create an intermediate image that better describes the original image way, highlighting facial features. It uses an algorithm to do this the sliding window concept, based on the parameters radius and neighbors.

III. LITERATURE SURVEY

The paper titled "Individual Stable Space" highlights that most face recognition systems have specific requirements for the input faces. These requirements typically include controlled illumination, specific facial positions, particular view angles, and the absence of any obstacles.

Controlled Illumination: Face recognition systems often perform better when the lighting conditions are controlled and consistent. In ideal scenarios, the illumination should be even across the face, without any harsh shadows or extreme brightness.

Facial Positions: Face recognition algorithms typically workbest when the face is positioned in a specific manner within the image. This usually involves facing the camera directly, with the face centered and aligned properly. Deviations fromthese preferred positions can potentially impact the accuracyof the recognition process.

View Angles: Certain face recognition systems are designed to work optimally within specific view angles. This means that capturing faces from different perspectives or extreme angles may pose challenges for accurate recognition. The performance of the system may vary based on the specific range of view angles it is trained and optimized for.

Obstacle-Free Environment: In order to achieve reliable face recognition, it is preferred to capture faces in an environment without any obstacles obstructing the view of the face. This includes factors like occlusions, such as objects partially covering the face, or heavy makeup or accessories that significantly alter the facial appearance.

While these constraints exist in many face recognition systems, it is worth noting that advancements in the field have led to the development of more robust algorithms that can handle variations in lighting, pose, and occlusions to some extent. However, adhering to the recommended guidelines still generally improves the performance and accuracy of face recognition systems. In the paper titled "Enhancing Face Recognition in Uncontrolled Environments" authored by Xin Geng, the primary focus lies in improving face recognition accuracy when faced with unpredictable conditions. Although facial recognition systems are extensively utilized in regulated settings, their effectiveness is restricted in real-time applications. Suchlimitations include the necessity for controlled environments and the requirement of single-person images as input. This research introduces a novel system that tackles these constraints. However, it is important to note that this systemis not suitable for attendance systems in real-time scenarios due to its reliance on static images. [1]

In the paper titled "Detecting Cheating in Facial Recognition Systems Using 3WPCA-Dual Vision

Face Recognition," Edy Winarno proposed a system that aims to predict instances of cheating within facial recognition-based systems. This system accomplishes this by identifying instances where an authorized person's photograph or a similar image is used instead of the actual authorized person. To achieve this, the system leverages dual vision cameras, also referred to as stereo vision cameras, which capture two separate images using two lenses and produce an output consisting of both images. After obtaining the two photos, they combined the person's left and right halves into a singleimage such that the 3WPCA approach could be used to extract the person from the image. Using this approach, 98%of cheating is detected.[2]

There are multiple methods available for tracking attendance, ranging from traditional data collection approaches to advanced biometric-based solutions. While traditional methods have their limitations and can be difficultto implement, biometric-based solutions offer a more sophisticated and reliable approach. However, these methodsmay face issues such as insufficient personnel and errors, such as failed fingerprint scans due to moist or dirty fingers. Considering these challenges, the author suggests a potential solution that involves integrating a mobile presence system, incorporating NFC safety features, and utilizing Raspberry Pi devices to store data in the cloud. This proposed approach aims to address the limitations of traditional attendance tracking methods by leveraging mobile technology, enhancing security with NFC features, and utilizing the cloudfor efficient data storage.

The suggested approach aims to address the limitations of traditional methods by incorporating mobile technology, NFC (Near Field Communication) for secure interactions, cloud storage for data management, and the utilization of Raspberry Pi devices. The author's paper reviews relevant works in the field, focusing on NFC, face recognition, cloud computing, microcomputers, and attendance managementsystems.

Building upon this review, the author introduces a new method along with a system design and implementation plan. The outcome is a mobile-based attendance system that reduces reliance on paper-based processes and eliminates thetime and effort traditionally required for attendance tracking. By leveraging mobile technology and integrating various components, the proposed system offers a more efficient and streamlined approach to managing attendance. [3]

The authors of this study “Design and implementation of a student attendance system using iris biometric recognition”

[4] have developed and put into operation an iris biometric attendance system. The participants were initially required to register their personal information and distinctive iris template. The technology took attendance for the class automatically by taking a picture of each student's eye, identifying their iris, and looking for a match in the built-in database. The prototype was hosted on the web.

In the facial recognition-based attendance system proposed by the authors [5], they utilized support vector machine (SVM) classifiers and algorithms such as Viola-Jones and Histogram of Oriented Gradients (HOG) features. The aim was to develop a system that could effectively handle real- time scenarios, considering factors such as scaling, illumination variations, occlusions, and facial position.

The authors incorporated SVM classifiers, a popular machine learning technique, to train the system for face recognition. They likely used labeled training data to train the SVM model to distinguish between different individualsbased on their facial features. Additionally, the authors employed algorithms like Viola-Jones and HOG features to enhance the face detection and recognition process. The Viola-Jones algorithm is known for its robustness and efficiency in detecting faces in images, while the HOGfeature descriptor is useful for capturing the shape and appearance information of faces.

To evaluate the performance of their system, the authors used quantitative analysis based on Peak Signal to Noise Ratio (PSNR) measurements. PSNR is a commonly used metric toassess the quality of reconstructed images by comparing them to the original images

Fig. 1. Face and Facial Points Detection using MTCNN

After using my dataset for the Haar cascade approach, I determined the face at 68%. "Giant. 5", shows some images from my dataset where the face was effectively determined using the Haar cascade method.

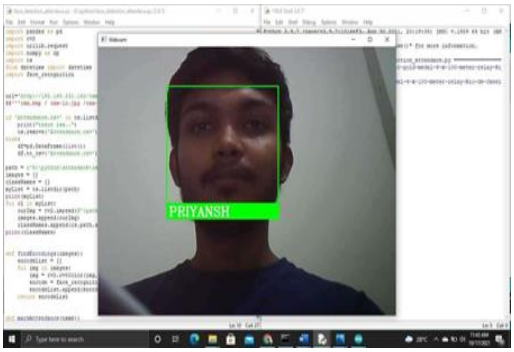

Fig. 2. Face Detection using Haar Cascade

IV. RESULT ANALYSIS

The facial recognition attendance system includes a developed interface that makes it easy to take and save photos of individual students. This interface enables seamless integration with the system's training dataset. After each student's photo is captured, it is stored in a training dataset, ensuring that their facial data is included for future recognition and identification purposes.

At the same time, the relevant data of the student, such as hisname and unique identifier, are stored in the system database. This ensures that student information is linked to their respective photograph, allowing for accurate identification and tracking.

With the successful capture and saving of student photos, theface recognition system is now capable of recognizing and identifying the students based on their stored facial data. Thisfunctionality enables efficient and accurate attendance tracking and management within educational institutions or any other context where the system is implemented.

Fig.3 Face Attendance System

Firstly interface has been developed for student managementsystem to store student details using SQL. A student management system is a piece of software that assists colleges, universities, and institutions in effectively managing tasks linked to students. Administrative tasks are made easier, and student data is centralised. It maintains a central database where all student data is kept, including names, addresses, phone numbers, and enrollment history. This makes it simple to update and retrieve student records asneeded.

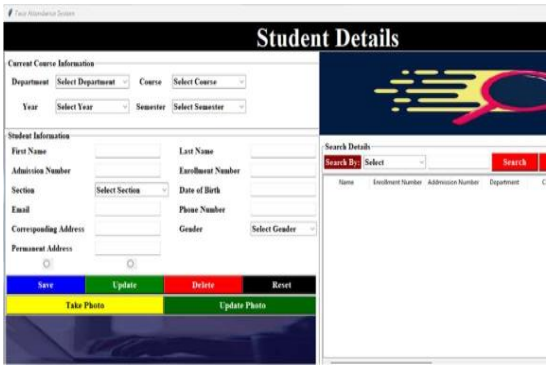

Fig.4 Student Management System

Captured images are trained using OpenCV, a popular computer vision library, and stored in a database. As part of the training process, the faces in the images are cropped and extracted, and these extracted faces are used for further comparison and identification.

To get the attendance using the facial recognition system, thefaces detected in real time are compared with the faces storedin the database. If a match is found between the detected faceand the face in the database, it means that a matching individual is present.

After a successful match, the system marks the corresponding name in the database with the status "PRESENT" along withthe current date and time. This action serves as a record of the individual's attendance at a given time.

The facial recognition system enables automated and efficient attendance recording through face matching and database operations, streamlining the process and reducing manual effort.

Fig. 5 train dataset

Fig.6 Face recognition

V. CONCLUSION

The OpenCV Real-time face recognition attendancesystem prototype offers several notable advantages:

1. Efficient Attendance Taking: The system enables the seamless capturing of attendance during active class periods,making it convenient for both students and instructors. It eliminates the need for manual attendance processes, saving time and reducing administrative burden.
2. Improved Monitoring: Professors can effectively monitor and track the presence of students in real-time during class sessions. This feature promotes better engagement and ensures that students are actively participating in the learningprocess.
3. Accurate Student Registration: The system simplifies the process of registering student names by leveraging face recognition technology. This eliminates potential spelling errors or data entry mistakes, ensuring accurate attendance records.
4. Cost Savings for Remote Work: The system proves particularly beneficial for teachers or users working remotely or from home. By automating attendance procedures, it reduces the need for physical infrastructure or additional resources, leading to cost savings.
5. Time and Effort Savings: The automated nature of the system saves valuable time and effort for both teachers and users. It eliminates manual attendance tracking, allowing instructors to focus more on teaching and enhancing the learning experience.
6. Recommended for Long Commutes: Individuals facing long commutes to work or educational institutions can benefitfrom this system. By streamlining attendance procedures, it helps alleviate the burden of travel, providing a convenient solution for remote attendance management.

In summary, the OpenCV Real-time face recognition attendance system prototype offers advantages such as efficient attendance management, improved monitoring capabilities, accurate student registration, cost savings for remote work, time and effort savings, and suitability for individuals with long commutes.

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