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Face Recognition System using OpenCV

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Abstract - *The face recognition system using OpenCV is a system which recognizes know faces and store it with time stamp. Then recognize the unknown faces and store it in another dataset with time stamp. The versatile face recognition system utilizing OpenCV, designed to streamline attendance tracking in online classes, meetings, and residential security applications. Leveraging advanced image processing techniques, the system identifies and verifies participants' faces in real-time. Its adaptable nature allows easy customization of recognized individuals, facilitating efficient management of attendance lists. This technology proves beneficial for remote learning scenarios, virtual meetings, and enhancing security protocols in residential settings. By seamlessly integrating with existing platforms, the system offers a user-friendly and efficient solution to automate attendance management, thereby improving overall convenience and security in various contexts.*

Key Words: face recognition, OpenCV, dataset, time stamp, real time recognition.

1.INTRODUCTION

Face recognition is important because it not only allows us to use our faces as keys, but it also allows face recognition systems to read our expressions in real time. Face recognition is rapidly improving as the Internet of Things grows and new gadgets are developed. Everyone's first concern in the current world is security. People are harassed at home, and the antiquated security mechanisms designed to keep people safe have failed. Various electronic devices, such as mobile phones, laptops, and ATMs, use biometric authentication or passcodes, however these can be easily accessed by thieves through any methods, making them insecure. Every face is unique because it can be recognised, which is essential for determining a person's identity. Facial recognition is a novel biometric technology for criminal identification that offers high accuracy with low intrusion. It is a technique that uses facial recognition to automatically identify and validate people in video or image frames. This study describes a face recognition system that incorporates the best face detection, feature extraction, and classification approaches currently in use. MTCNN and Face Net are two advanced deep learning systems that have received widespread acclaim for their sophistication and modernity. Our video streaming layer provides a continuous and stable experience with no abrupt transitions between consecutive frames.

1.1 SCOPE

The suggested system aims to create and deploy a reliable and effective system for facial recognition technology-based automated attendance tracking. In order to effectively detect and identify people in photos or videos, the project will use facial recognition algorithms and techniques, which will replace the need for manual attendance procedures. The scope most likely includes activities like image preprocessing and enhancement, face detection and recognition techniques implementation, facial feature extraction, and creation and management of a face database. Creating an intuitive user interface, connecting the system with current attendance management systems, and assessing the system's performance in terms of accuracy, speed, scalability, and usability are all potential components of the project.

1.2 FACE DETECTION

Changes in an object's position in respect to its surroundings are monitored using face detection. One of the most important security elements in recent years is face detection software. It is used to enhance security equipment that has already been installed, such as the motion sensor illumination on indoor and outdoor security cameras. An advanced facial identification system like this might be automated to detect criminals by using CCTV cameras positioned at numerous locations. The goal of the project is to create an automated system that effectively and reliably tracks attendance using facial recognition technology.

Fig -1: Face detection

The goal of the project is to recognise people in pictures or videos, extract their face traits, and compare them to a database already in existence. The main goal is to substitute a dependable and practical solution for manual attendance methods in order to lighten the administrative burden and increase accuracy. The project's overall goal is to provide a seamless, user-friendly system that enhances attendance management and provides a dependable, effective, and secure way to record and track attendance.

1.3 LITERATURE REVIEW

Despite notable recent developments in the field of face recognition [DeepFace, DeepId2], scaling up face verification and recognition effectively poses substantial obstacles to existing methodologies.

1) The [1] FaceNet system, which we introduce in this study, directly learns a mapping from face images to a condensed Euclidean space where distances directly correlate to a measure of face similarity.[5] Eigenfaces: This method captures major facial changes for recognition by using primary Component Analysis (PCA) to represent faces as a collection of primary components.

2) Local Binary Patterns (LBP): A texture-based method for encoding local pixel patterns, LBP captures spatial relationships and adapts to changes in lighting.

3) Fisherfaces: Also referred to as Linear Discriminant Analysis (LDA), this method derives distinguishing characteristics from the faces of various people.

4) Deep Convolutional Neural Networks (CNN): By extracting intricate patterns and features from facial photos, CNNs, a subset of deep learning techniques, have achieved astounding success in face recognition.

5) 3D Face Recognition: This method uses depth data from 3D face scans or specialized sensors to enable accurate identification even when position, lighting, and expression variations are present.

2. METHODOLOGY

The suggested method seeks to create a reliable face recognition attendance system that can detect and subtract unknown faces while reliably identifying recognized faces. Unknown faces will be found in the collected photos or video frames using object detection methods. Unknown people will have their faces and a timestamp recorded by the system, which will serve as a record of their existence. The system would require input from photos and videos in order to distinguish faces and compare them to a database of recognizable individuals. CCTV cameras, mobile cameras, and other sources could all provide this data. To precisely identify registered users, the system will use face recognition algorithms. Here, faces are found and recognized using the Haar Cascade method.

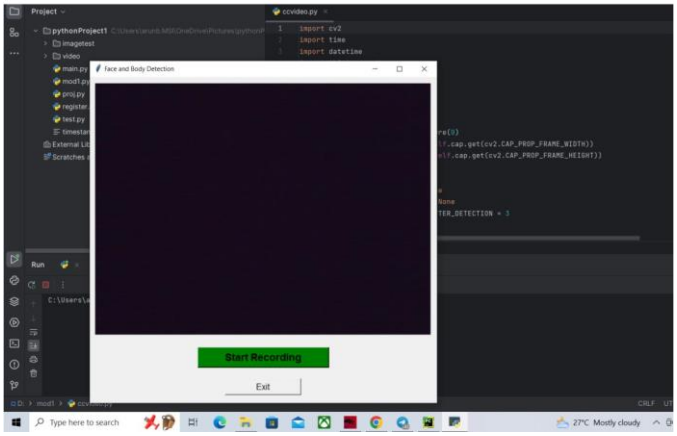

Fig -2: motion detection window

The technique of identifying and recognizing faces of people who are not yet known or registered in a database is known as "unknown face detection." It entails examining the patterns and features of the face to identify whether a face resembles any recognized individuals or if it is completely unidentified. The use of object detection algorithms will be used to identify and remove unidentified faces from attendance records. Applying various algorithms and approaches to analyses, alter, and extract valuable information from visual data is the process of processing images and videos. The suggested system will analyses facial features, conduct face recognition, and find unidentified faces using image and video processing techniques. The practice of monitoring and documenting people's presence or absence in a certain setting is known as attendance management. The suggested system's attendance management process includes organizing the attendance records, storing timestamped photos of unidentified faces, and maintaining a database of recognized people. Attendance management is the process of keeping track of and recording people's presence or absence in a certain location. A database of recognized people is kept, timestamped photographs of unidentifiable faces are stored, and attendance records are organized as part of the suggested system's attendance management procedure.

2.1 DATASET

We'll build a database of every person, their unique ID, and the quantity of grayscale photos needed for face recognition. A dataset is created using the photographs of the specific person, and the images are then stored in an XML file. For each person's ID, we used 1000 samples because this increased the accuracy of the image of the individual. The authorized individuals' created dataset is kept in a YML file.

The images are trained using the Local Binary Pattern Histogram (LBPH) approach.

Chi-Square: This formula is used to characterizes a person's expression. In our project, it is employed to assess the character of a certain individual whose database is recorded in an XML file.

$$D = \sum_{i=1}^{n} \left(\frac{h_i st_1 i - h_i st^2 i}{h_i st^1 i} \right)^2 \quad (1)$$

D = chi square obtained
$\sum$ = the sum of
hist1 = observed score
hist2 = expected score.

Euclidean Distance: To calculate the separation between two straight lines, use this equation. It is employed to calculate the dimensions of images that are stored in datasets.

$$D = \sqrt{\sum_{i=1}^{n} (hist1i - hist2i)^2} \quad (2)$$

Where:
D = chi square obtained
$\sum$ = the sum of
(hist1, hist2) are two vectors.

Normalized Euclidean Distance: The length of the line segment connecting points hist1 and hist2 (hist1, hist2) equals the Euclidean distance between them. A Euclidean vector is a representation of a point's location in Euclidean n-space. This formula scaled the image's length and created a square box around it.

$$D = \sqrt{\sum_{i=1}^{n} \left(\frac{hist1i - hist2i}{n} \right)^2} \quad (3)$$

Absolute Value: After being acquired by the camera, the image is trained using both positive and negative images using the Haar Cascade Classifier. It is employed to change grayscale photographs into colored ones.

$$D = \sum_{i=1}^{n} |hist1i - hist2i| \quad (4)$$

2.2 DESIGN

The technology uses a camera or webcam to record facial photos or video frames. These images are used as raw material for later processing. Preprocessing techniques are applied to the collected images or frames to improve quality and lower noise. This might entail filters, normalization, and resizing actions.

The Haar Cascade algorithm employs a series of classifiers that are staged in a cascade. Each stage consists of a number of weak classifiers that analyses various areas of the image in turn. In order to lessen computing effort, the cascade is made to swiftly dismiss regions that are unlikely to contain faces. A region is processed further for face recognition or additional analysis if it successfully navigates through every stage of the cascade and is deemed to have made a positive detection. After face detection, further methods for face recognition can be applied. In order to identify the person, these algorithms examine the identified face region, extract facial characteristics like landmarks or descriptors, and contrast them with a database of recognized faces.

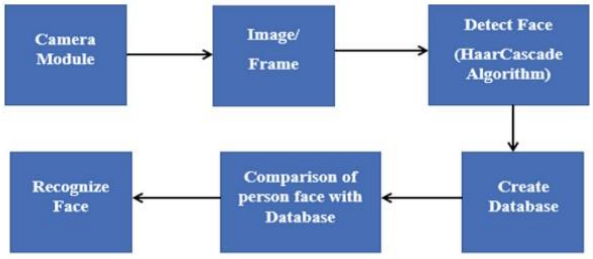

Fig -3: Block diagram of face recognition system

Due of its effectiveness and precision, the Haar Cascade method is frequently used for face detection tasks. It is appropriate for use in real-world applications due to its capacity to manage changes in lighting conditions, facial angles, and partial occlusions. In complex circumstances with extreme position fluctuations or low-resolution photos, it might, nevertheless, be limited. However, for face detection and recognition in computer vision, the Haar Cascade method continues to be a key tool.

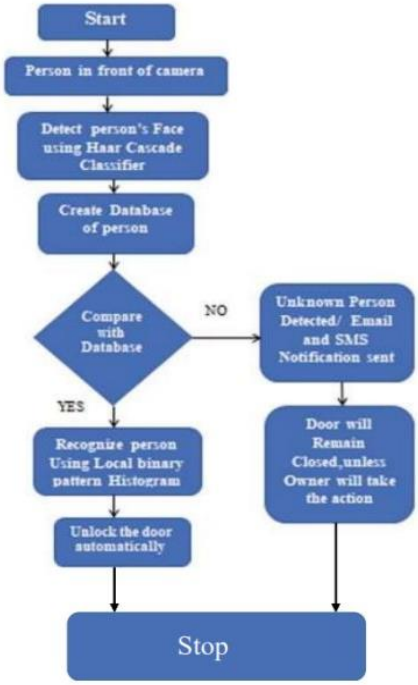

Fig -4: Flow chart of face recognition system

2.3 IMPLEMENTATION

The software configuration is the setting where the project was developed. It is important to choose a language that is suited for the project. Additionally, the right operating system for the project needs to be chosen. These choices have a significant impact on how well the created tool works. Therefore, these should only be chosen after a thorough examination.

The experiment was conducted on a computer running Windows 11 that featured an Intel i7 4 GHz processor, 8 GB of memory, and a webcam (HP TrueVision HD camera with 0.31 MP and 640x480 resolution).

2.4 RESULT

Numerous strengths and shortcomings of the project system were discovered during the development and testing phase. In order to increase the usability of the system, other enhancements and requirements were also listed. Here is an overview: System Strengths: a) High Accuracy: The project system's facial recognition algorithm often displays high accuracy. This shows that the system does a good job of accurately recognizing faces. b) No Prior Training Is Necessary: The facial recognition algorithm employed in this project system does not require pre-training, in contrast to several others. This suggests that the system doesn't require substantial training to quickly adjust to new faces. Systems' shortcomings a) Camera orientation Dependency: Aspects like camera orientation have an impact on face recognition accuracy.

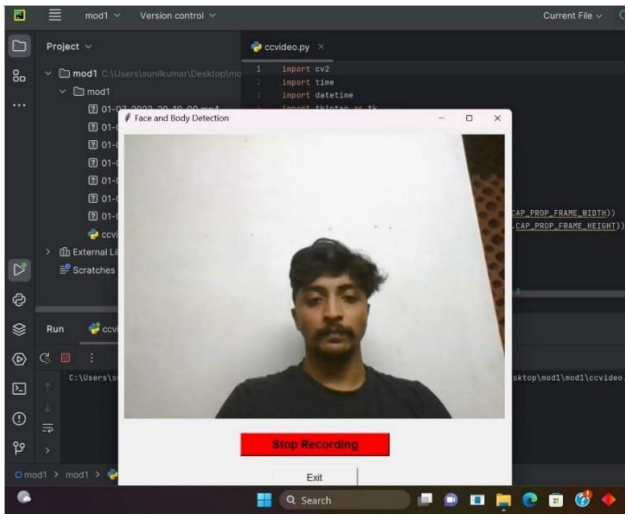

Fig -5: Records automatically when an unknown person is detected

However, particular information about these elements is not given. Future Needs and Improvements: a) Improved Accuracy from Different Camera orientations: Future research should concentrate on improving facial recognition accuracy, particularly from various camera orientations. This would strengthen the system and enable it to recognize faces taken from different perspectives. b) GPS Location Recording: By including GPS location recording as a feature, the system's actions would be given more context and information, which could be valuable for tracking and monitoring. c) other Features: The report refers to the need for other features, but it does not list them. To make the system more usable, additional requirements and desirable functionalities should be determined.

Fig -6: face detection of an known person

We want to create a reliable and effective system to identify faces in pictures and videos with this face detection project. Modern deep learning techniques, particularly Convolutional Neural Networks (CNNs), which have demonstrated outstanding performance in image identification tests, will be used. A variety of photos with faces in various stances, lighting settings, and backgrounds will make up the dataset for training and validation.

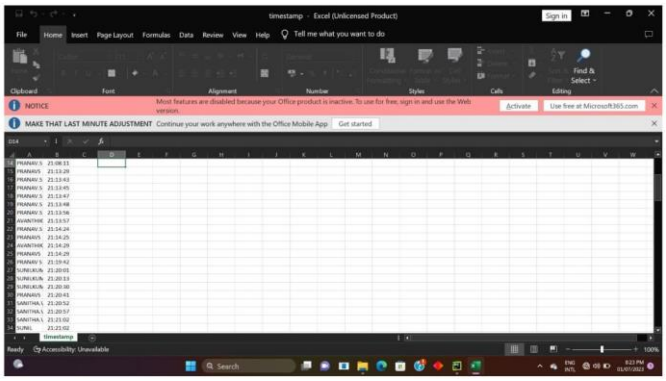

Fig -7: attendance details

To improve the data's generalizability, we will preprocess it by shrinking, normalizing, and augmenting it. The dataset will be used to fine-tune the CNN architecture we have chosen, such as the well-known Faster R-CNN or Single Shot MultiBox Detector (SSD). For implementation, Python and deep learning frameworks like TensorFlow or PyTorch will be used. Metrics will be used for evaluation.

3. CONCLUSIONS

The results of the face detection and face recognition systems show that they are both quite successful and precise. Many different difficulties in daily life can be solved using techniques comparable to face recognition technology, which has many applications. In the system we've suggested, accuracy is roughly 85%.High accuracy in recognizing people is one of the main benefits of a face recognition attendance system. The method enables accurate identification by examining distinctive facial patterns and traits, which leaves no room for fraudulent activities like proxy attendance. A fair and open environment is fostered by this, which encourages accountability and integrity in attendance tracking. This method involves locating and detecting faces in live videos or still photos. In order to ensure that, this calls for the adoption of technology and speedier algorithms. To ensure that the system can handle the data quickly, quicker algorithms and technology must be implemented. For use in the future, every single database entry is updated. Any advancement can be implemented into this system because it has a modular architecture. The system may also include changes to the environment. This system efficiently completes daily chores using contemporary, in-demand technology. To sum up, a face recognition attendance system has the power to revolutionise attendance monitoring by offering precise, secure, and effective solutions. Adopting it can improve security, expedite administrative procedures, and foster an environment of openness and accountability. This technology can considerably improve attendance management in numerous sectors with careful implementation and privacy controls in place, leading to overall operational efficiency and productivity

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