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Facial Recognition Attendance Monitoring System using Deep Learning Techniques

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A R T I C L E I N F O

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A B S T R A C T

The Facial Recognition Attendance Monitoring System employing Deep Learning Techniques represents a cutting-edge application of artificial intelligence in educational and corporate environments. The implementation of a Facial Recognition System can aid in identifying or verifying a person's identity from a digital image. Accurate attendance records ar vitaltoclassroom evaluation. However, manual attendance tracking can result in errors, missed students, or duplicate entries. The adoption of the Face Recognition-based attendance system could help eliminate these shortcomings. This innovative approach involves utilizing a camera to capture input images, detecting faces using algorithms such as Haarcascade, Eigen values, support vector machines, or the Fisher face algorithm, verifying the faces against a database of student profiles, and marking attendance in an Excel sheet. The use of OpenCV, an open-source computer vision library, ensures the efficien functioning of the system.

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INTRODUCTION

Over the past few years, facial recognition technology has gained significant attention due to its potential for various applications in law enforcement and other industries. It is a technology that can identify or verify a person from a digital image and has emerged as an attractive solution for identity verification. With the increased use of image-capturing devices such as smartphones and CCTV cameras, the need for computational analysis of multidimensional facial structures has become more important. The face recognition-based attendance system is an automated solution developed to address issues related to manual attendance-taking, which is time-consuming and prone to errors. In educational institutions, attendance is a critical part of daily classroom evaluation, but teachers may miss students or record multiple entries. This leads to data inconsistencies, which can be resolved with the face recognition-based attendance system. The objective of this paper is to offer a simple and automated system for recording and tracking student attendance using biometric technology. The system compares the face of the person with the images stored in the dataset to mark attendance. This paper aims to make the attendance process faster and more accurate. The documentation includes the definition, objective, design, implementation, testing and future enhancements of the paper. The manual attendance system is time consuming and requires lecturers to collect, verify and manage student records. In contrast, the automated system offers better benefits and reduces the workload of the lecturer.

LITERATURE REVIEW

Explain your methodologies in this chapter. You should explain your research instruments, data collection processes, data analysis processes or hypothesis testing processes, and data display processes.

The 3 techniques of face recognition in OpenCV library are:

a) Eigen faces algorithm
b) Fisher faces algorithm
c) Local Binary Pattern Histogram (LBPH) algorithm

The Eigen face method seeks to obtain facial features mathematically, rather than relying on physical features of the face, using mathematical transforms for recognition. The recognition process involves two phases, with a large group of individual faces serving as the training set to determine a set of Eigenvectors using Principal Component Analysis. However, this approach is susceptible to lighting conditions and head position, and the process of finding Eigen vectors and values is time-consuming.

In contrast, Fisher face is a similar approach to Eigen face, but with the added benefit of better classification of different classes of images, including facial expressions. However, the Fisher face approach is more intricate than Eigen face in finding the projection of the face space, and calculating ratios takes a considerable amount of processing time. This approach also results in larger face storage and more time-consuming recognition. The proposed system employs the Fisher face method for face recognition, which is superior and faster than other algorithms, and is also resilient to lighting conditions. Additionally, the Local Binary Pattern Histogram (LBPH) algorithm is a simple solution for face recognition that can detect both front and side faces.

FLOWCHART

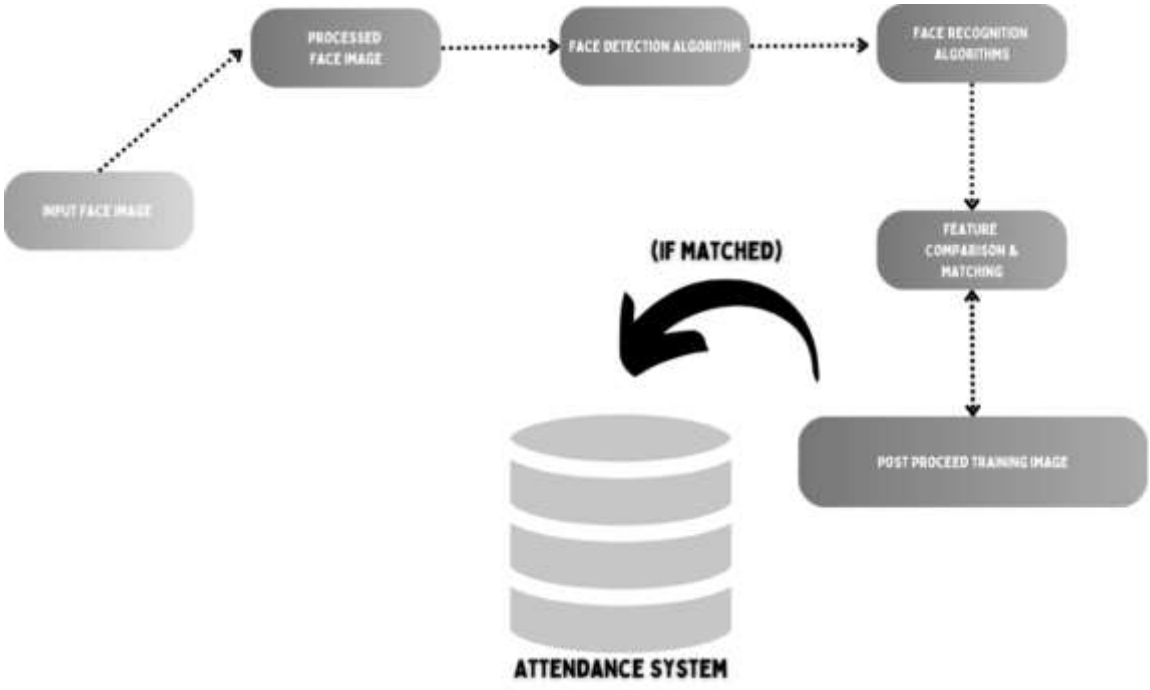


Figure 1. Flowchart

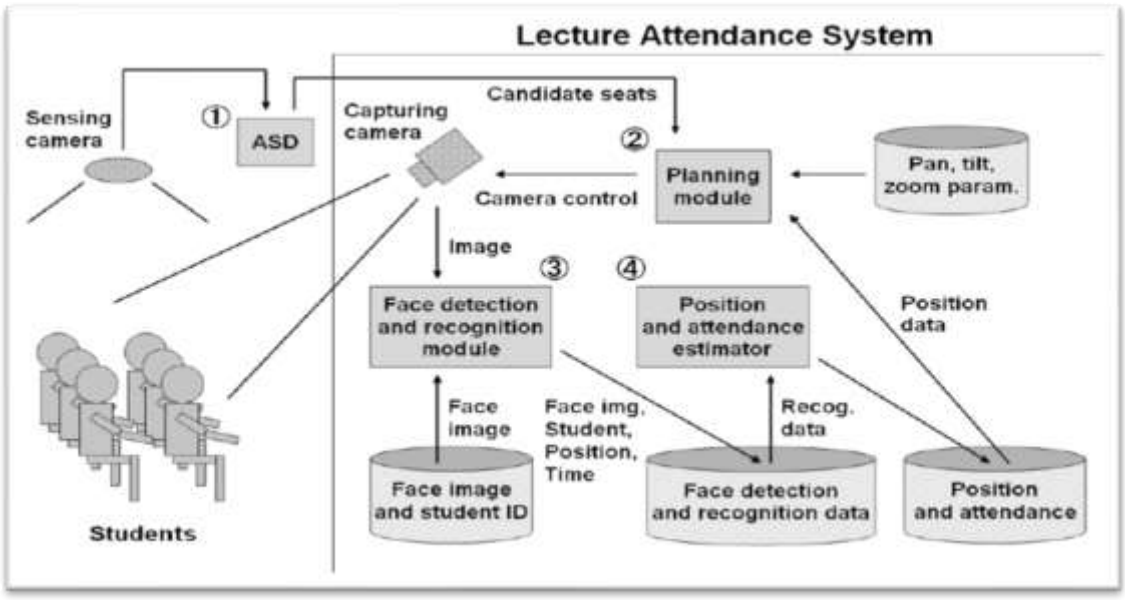
METHODOLOGY

The Software Requirement Specification (SRS) is aimed at defining the necessary functionalities and Uniform Resource Locator (URL) for the Intelligent Network Backup Tool. It intends to establish a clear understanding of the final product's features and specifications as envisioned by both the development team and the client. The requirement statements are prioritized and detailed in this document. It targets project developers, managers, users, testers, and documentation writers, providing them with information on design and

implementation constraints, external interface requirements, system features, non-functional requirements, and dependencies. Identifying needs is crucial for businesses and organizations to evaluate their market performance and maintain a competitive edge.

a) Architecture of the proposed system

The proposed system seeks to automate the existing manual attendance system by utilizing face recognition technology. Its main objective is to capture and store each student's face for attendance purposes. Accurate detection of all facial features during the image capture process is vital. With facial recognition steps applied to the captured image, teachers no longer have to take attendance manually during class. This paper tackles the challenges commonly associated with manual attendance systems. To detect faces, Haar Cascade classifiers are utilized, while the Local Binary Pattern Histogram (LBPH) algorithm is used to recognize student faces. Fig 3.1: System Architecture The proposed system for Face Recognition based Classroom attendance system. The system requires a camera installed in the classroom at a position where it could capture all the students in the classroom and thus capture their images effectively. This image is processed to get the desired results

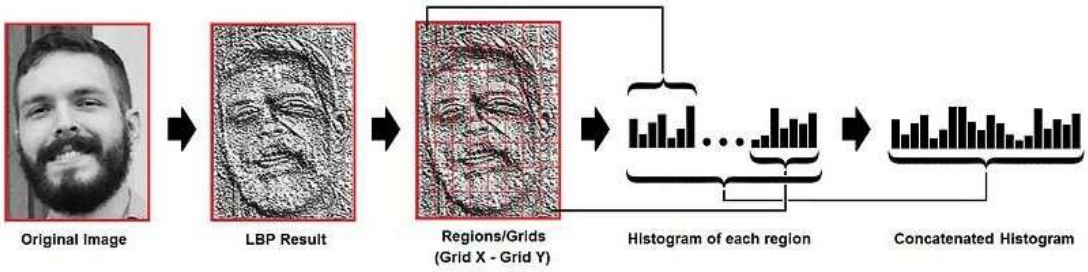


b) Algorithms and Flow Diagrams

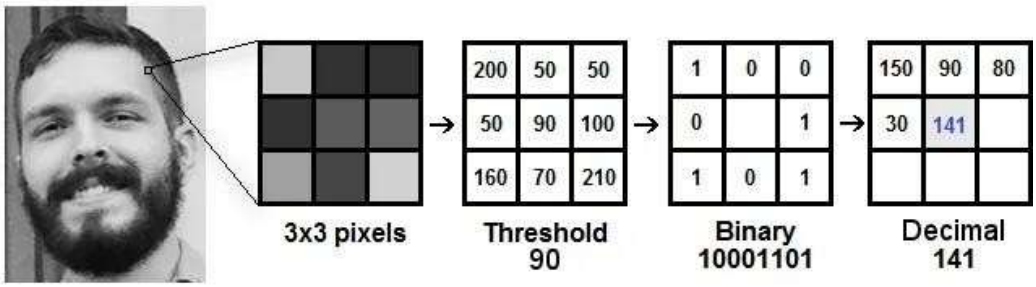
Face detection uses classifiers, which are algorithms that detect what is either a face (1) or not a face (0) in an image. It is a machine learning based approach where a cascade function is trained from a lot of positive (images of faces) and negative images (images without faces. In feature extraction, the algorithm uses training data to best identity features that it can consider a face.

c) Local Binary Pattern Histogram (LBPH) Algorithm

The Local Binary Pattern (LBP) was initially introduced in 1994 and has proven to be an influential character in texture classification. Studies have shown that the combination of LBP with histograms of oriented gradients (HOG) descriptor significantly enhances detection accuracy for certain datasets. By utilizing LBP in



combination with histograms, we can create a straightforward data vector to represent facial images. Fig 3.3: General Face Recognition Structure The provided flow diagram depicts the image captured by the camera as the input, which is then subjected to the face detection algorithm to convert the original image into a grayscale image for feature extraction. Next, the input image undergoes a comparison process with the current image, utilizing verification and identification techniques to ensure a dependable recognition outcome



Performing the Face Recognition

In this stage, the algorithm has completed its training process. Each histogram generated during training represents an image in the training dataset. To recognize a new input image, we repeat the same steps as before, creating a histogram that represents its features. We can then compare this histogram to the histograms in the training dataset to

$$d(x, y) = \sqrt{\sum_{i=1}^{n}(y_i - x_i)^2}$$

Find the closest match. Several approaches can be used to compare histograms and calculate the distance between them, such as Euclidean distance, chi-square, absolute value, and others. In this case, we can use the Euclidean distance formula, which is a commonly used method.

Comparison Subject	**Eigenface**	**Fisher face**	**LBPH**
Value prediction when testing with the same face	4633.81	318.59	29.32
Smallest value prediction when testing with different faces	2004.2	61.42	71.88
Biggest value prediction when testing with different faces	8360.78	2805.77	367.5
FPS Range	0.67	1.23	6.58

CONCLUSIONS AND RECOMENDATIONS

The proposed system is designed to provide an automated attendance system for lectures, sections, and laboratories, allowing lecturers or teaching assistants to easily record student attendance. By utilizing face detection and recognition algorithms, this system saves time and effort, especially in classes with a large number of students. This automated system can improve an institution's goodwill by reducing drawbacks in the traditional manual system. Through thorough testing of the face detection and recognition algorithms, student attendance is marked by recognizing their face and storing the data in an attendance sheet. The system was developed from requirements to a complete

system, including evaluation and testing, and achieved its objectives to the satisfaction of the client.

Although some challenges were encountered during implementation, they were addressed and resolved. Strategies for future work and improvements to the system are discussed in this section.

FURTHER WORKS

The attendance marking system we have developed is successful in automatically recording attendance and generating an excel sheet in real-time. However, in order to create a dedicated system for educational institutions, a highly efficient algorithm that is not affected by varying lighting conditions in classrooms is necessary. Additionally, the system must utilize a camera with an optimal resolution. Another area for improvement is creating an online attendance database with automatic updates. This can be accomplished by installing a standalone module in the classroom with wireless internet access. Implementing these improvements would greatly enhance the functionality and usefulness of the paper.

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