ATTENDANCE MANAGEMENT SYSTEM USING HAARCASCADE CLASSIFIER

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Abstract - academic *monitoring and accountability are directly impacted by attendance management, which is a crucial part of administrative operations in educational institutions. Conventional techniques, such biometric systems or human roll calls, frequently have problems with inaccuracies, inefficiencies, and restricted scalability.This project made use of an high resolution webcam.The program uses OpenCV and the Haar-Cascade Classifier to identify faces in real time, making it possible to identify people with ease and precision.This guarantees an automatic attendance recording procedure that drastically lowers the requirement for human involvement. Detailed student profiles and attendance logs are stored in the integrated MongoDB database management system.Scalability, security, and accessibility are given top priority in the system's design, which allows it to be tailored to different institutional requirements. Automatically generated attendance summaries are sent to parents by SMS and email. This strengthens student accountability by increasing openness and promoting better communication between guardians and institutions. The suggested system has many benefits beyond its operational effectiveness, such as error reduction, real-time data accessibility, and intuitive user interfaces.*

***Key Words*: Haar-cascade classifier, MongoDB, OpenCV , Fosters , NVIDIA Jetson Nano.**

1. INTRODUCTION

Since attendance has a direct impact on academic monitoring and responsibility, it is crucial for both teachers and students in educational institutions. Upholding precise attendance records is essential, but conventional approaches to tracking attendance—such as calling names or roll numbers—take a lot of time and effort. The necessity of an automated attendance management system is highlighted by these inefficiencies. Even while some organizations have implemented automated systems, such as RFID-based approaches and biometric procedures, these solutions still have drawbacks, especially when it comes to time efficiency. In order to mark their attendance, students frequently have to wait in lines, which might interfere with the flow of class activity. A face recognition-based attendance system that automates and updates the attendance monitoring process was developed to overcome these constraints.

The suggested solution makes use of cutting-edge technologies to guarantee precision and effectiveness. The system stores and trains student data, including name, roll number, class, section, and photos. The hardware components for picture capture and processing include an high resolution webcam, while OpenCV is used for image extraction. Additionally, the haar cascade classifier performs the facial recognition. Attendance is automatically entered as "present" or "absent" in a secure MongoDB database once the identified faces are compared to a pre-existing dataset.

The ability to deliver notifications automatically is one of its most notable characteristics. To ensure openness and promote better communication between the institution and guardians, attendance records are emailed and texted to parents at the conclusion of each day. This strategy not only overcomes the drawbacks of conventional techniques but also serves as an example of how AI-powered solutions may revolutionize administrative procedures in educational environments, offering a dependable, effective, and cutting-edge approach to attendance management.

2.BACKGROUND THEORY

Face recognition is essential to daily life since it makes it easy for people to recognize friends, relatives, and strangers. Even though it can seem simple, recognizing human faces requires a number of intricate stages. During recognition, human intelligence makes it easier to receive and comprehend visual information. This starts when an item reflects light, which is a type of electromagnetic wave, and projects it onto the retina of the human eye. Humans understand information by analyzing characteristics including shape, size, contour, and texture through complex visual processing. To identify a face, this analysis is then contrasted with representations that have been stored in memory.

Even though human recognition is effective, it might be difficult to replicate in automated systems. Due to memory constraints and the possibility of errors, humans are unable to do large-scale recognition tasks, such as identifying people in different locations like universities. Computers overcome these obstacles and provide the basis for facial recognition systems because of their large memory capacity and fast processing speed.

The human face is a powerful biometric for identification due to its uniqueness. To verify identity, face recognition technologies compare photos taken in real time with pictures saved in a database. In the 1960s, researchers developed the first systems that recognized facial characteristics such the mouth, nose, eyes, and ears and calculated their ratios and distances. This marked the beginning of the development of face recognition technology. Features such as lip thickness and hair color were included in the 1970s, but a major breakthrough was made In 1988 the famous author introduced Principal Component Analysis (PCA). The field of facial recognition research has advanced significantly in recent years.

3.PROBLEM STATEMENT

Management of attendance is an essential part of academic monitoring and accountability in educational institutions. Conventional techniques, such human roll calls or paper-based record keeping, are labor-intensive, error-prone, and inefficient. These antiquated procedures interrupt the flow of the classroom and take important time and effort away from instructional activities.

Although some of these issues have been addressed by the introduction of contemporary automated technologies, such as biometric and RFID-based systems, these solutions are not without drawbacks. These methods frequently force students to wait in line for attendance, which causes delays and impedes the efficient flow of instruction. Additionally, current approaches lack the real-time communication and integration required to give stakeholders—like parents—immediate updates.

A dependable, effective, and transparent system that avoids errors, promotes better communication, and minimizes disruptions is desperately needed to address these issues. The challenge is creating an attendance management system that satisfies the need for precision, timeliness, and updated administrative procedures in addition to automating the procedure.

4.Processing Digital Images

Digital image processing is the process of analyzing and altering digitally stored photographs using a computer. Among the many applications of this technology are the following primary objectives:

- Increasing visual clarity to aid in human comprehension of the image.
- Image processing for machines, such as robotics or automated systems.

4.1.Digital Computer Image Representation

The mathematical explanation of a digital image is :

F(X,Y) = r(x, y). i(x, y) , where

r(x,y):denotes the surface's characteristics at a particular place.
In electronic format:

1. Images are organized in a grid pattern using pixels, which are tiny squares.
2.Every pixel in the image represents a point, and its brightness or color is indicated by a value.
3.A matrix is used to store these pixel values, making the picture prepared for processing by a computer.

4.2 Image Processing Steps(Digital)

image processing involves important tasks:

1.**Image acquisition**:-The initial stage, known as image acquisition, involves taking pictures with cameras or sensors and converting them into a digital format that a computer can process.

2Preprocessing:-In Preprocessing is the process of improving an image's quality by lowering noise and modifying contrast or brightness, which makes the image easier to interpret and manipulate.

3.**Segmentation:-** To facilitate the analysis of particular areas, the image is segmented into smaller segments, such as objects or regions.

4Feature Extraction and Description :- This stage looks for crucial information in the picture, such as edges, forms, or textures, that aid in item identification.

5. Acknowledgment and Interpretation: The regions or items recognized in the picture are named or categorized, and useful information is gleaned from them.

6.**Knowledge Base**: This entails utilizing already-existing information or expertise to improve the efficiency of image processing.

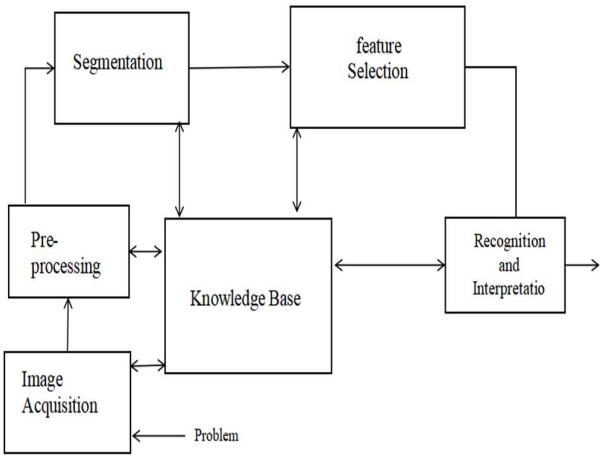


Figure 1: Steps for digital image processing

5.Face Detection Using Haar Cascade

One popular and effective face identification technology is the Haar Cascade approach. It has become well-known since it can correctly recognize faces in photos or videos, which makes it ideal for uses such as intelligent voting systems. There are multiple crucial steps in the face detection process when employing this technique.

I) Conversion to Grayscale :- The input image must first be converted to grayscale. By emphasizing intensity changes over color information, this streamlines the image and lowers computational complexity**.**

II) Identifying Haar Features :- The technique then computes the difference in pixel intensity summation between neighboring rectangular regions to identify certain square-shaped features, or Haar features. Patterns found in facial structures, such as edges and textures, are captured by these features.

III) Using Integral Images to Improve Speed :-

Integral pictures are utilized to improve feature computation performance. The approach may quickly compute Haar features by using an integral image, which is a two-dimensional representation that retains cumulative pixel intensity sums for rectangular areas.

IV) Using Adaboost for Classifier Training :- The Adaboost algorithm is used to train a classifier in the following step. The most important characteristics that can successfully distinguish faces from non-faces are found by this method. By combining several weak classifiers into one strong classifier, it ensures accurate output and raises accuracy.

V) Classifier Cascade :- Lastly, the system analyzes the input image using a haar-cascade classifier. There are several phases in this cascade, with multiple classifiers in each stage. An picture is instantly removed if it fails at any point, minimizing false

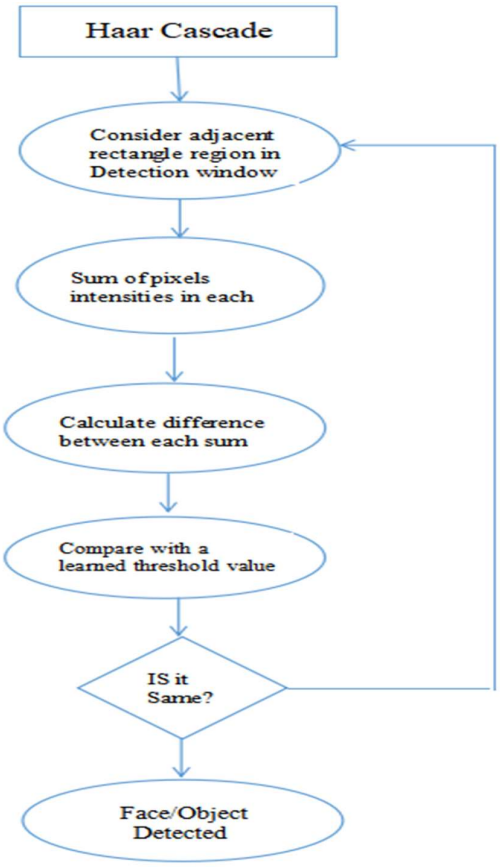


Figure 2: Haar Cascade Algorithm Flowchart

6.WORK FLOW

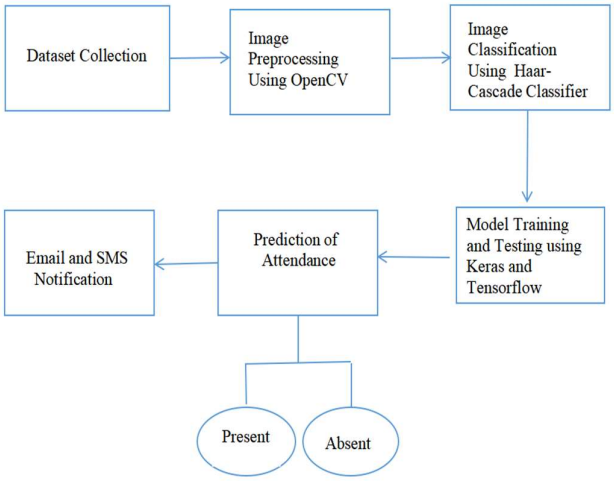


Figure 3:- Block Diagram for Attendance management System

1. **Information Gathering**

The initial phase entails dynamically collecting student facial data using a webcam or comparable image. capture apparatus. To increase recognition accuracy, several facial image captures under various lighting and angle situations are used to register each student in the system. To guarantee accurate identification during the recognition process, distinct identifiers such as student names, roll numbers, or IDs are connected to their profiles in addition to the facial photos.

2. **Recognition of Faces**

The technology records still photos or live video streams from the input device during attendance sessions and recognizes facial features. Following that, these facial traits are contrasted with the database's training data. Patterns specific to human faces, like edges and textures, are recognized by the Haar Cascade algorithm. The student's identity is verified after a match is made, allowing for precise and easy attendance recording.

3. Attendance by Subject

` The system is made to facilitate subject-wise attendance tracking in order to improve functionality. Attendance is tracked for particular classes or disciplines. Without requiring any manual input, the system automatically records a student's attendance for the chosen topic after correctly identifying them. This guarantees a precise and effective attendance management procedure catered to each subject.

4.Storing Data In Databases

The attendance of the student is securely stored in the Data base. We use the efficient and saleable data base called MongoDB. In this we stoore in the form of:

>**Stu_ID**: A distinct identification number for every student.

>**Stu_Name**: The student's entire name.

>**Subject**: The subject or session for which attendance is logged.

>Date and Time: A time stamp that shows the exact moment the attendance was taken.

6.Automated SMS and Email Alerts

An automated email notification tool is incorporated into the system to enhance communication between parents or guardians, as well as educational institutions. An email with the following information is sent to the guardian once attendance is recorded:

- The student's name and ID.
- The subject or session attended.
- The date and time of attendance

This tool promotes greater participation and responsibility by increasing transparency and guaranteeing that parents are promptly notified about their child's attendance.

7.RESULT

Figure 4. Home Page

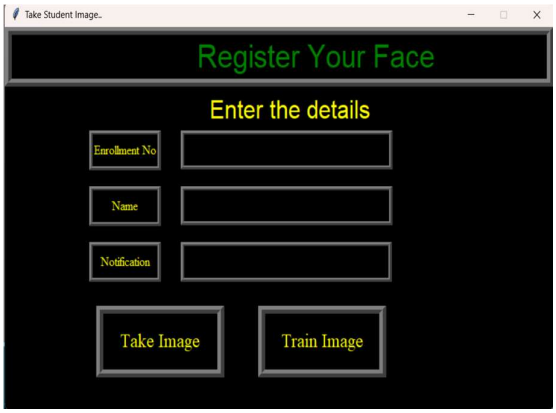


Figure 5 :-Registering New Students and Training the Image

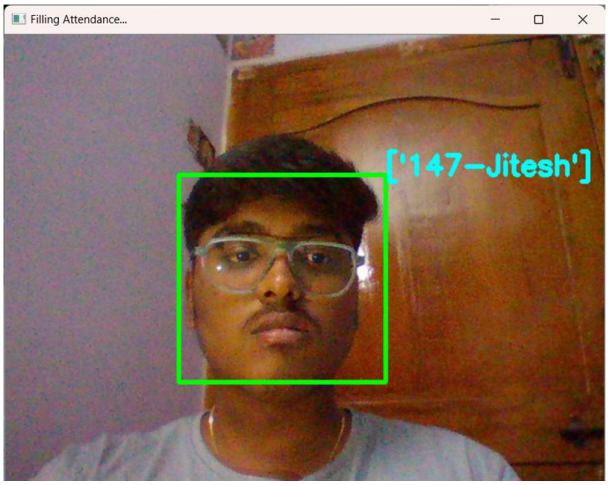
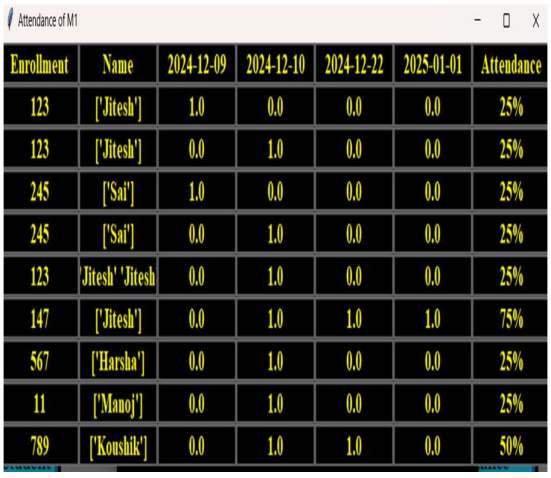


Figure 6: Detecting the face and marking the attendance



Enrollment	Name	2024-12-09	2024-12-10	2024-12-22	2025-01-01	Attendance
123	['Jitesh']	1.0	0.0	0.0	0.0	25%
123	['Jitesh']	0.0	1.0	0.0	0.0	25%
245	['Sai']	1.0	0.0	0.0	0.0	25%
245	['Sai']	0.0	1.0	0.0	0.0	25%
123	Jitesh' 'Jitesh	0.0	1.0	0.0	0.0	25%
147	['Jitesh']	0.0	1.0	1.0	1.0	75%
567	['Harsha']	0.0	1.0	0.0	0.0	25%
11	['Manoj']	0.0	1.0	0.0	0.0	25%
789	['Koushik']	0.0	1.0	1.0	0.0	50%

Figure 7: Viewing the attendance in local CSV formate

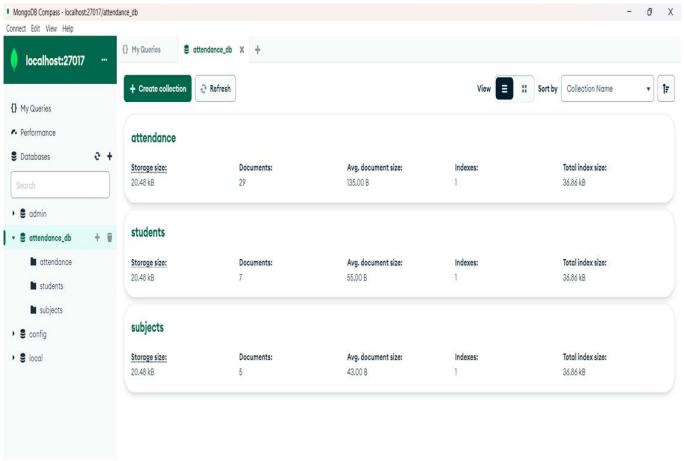


Figure 8: Storing the Attendance in MongoDB DataBase

8.CONCLUSIONS

Face recognition systems are becoming increasingly significant in the field of image processing due to their wide-ranging applications. These systems are commonly utilized in areas such as crime prevention, video surveillance and other security-related activities. One potential application of face recognition technology is within educational institutions, where it can be employed to streamline and enhance attendance management.The implementation of a Face Recognition-Based Attendance System is designed to address the challenges and inaccuracies associated with traditional, manual attendance-taking methods. By automating the process, this system not only reduces errors but also provides a more efficient and reliable solution for organizations, particularly in academic environments.

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