Face Recognition Attendance Tracker System

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Abstract **- In this paper we propose an automated attendance management system. This system, which is based on face detection and recognition algorithms, automatically detects the student when he enters the class room and marks the attendance by recognizing him. The system architecture and algorithms used in each stage are described in this paper. Different real time scenarios are considered to evaluate the performance of various face recognition systems. The system compares the image of the test and the training image and determines who is and is not present. The attendance data is stored in a CSV file that is automatically updated whenever we run the program. The main purpose of this project is to build a face recognition-based attendance monitoring system for educational institution to enhance and upgrade the current attendance system into more efficient and effective as compared to before. The current old system has a lot of ambiguity that caused inaccurate and inefficient of attendance taking. Many problems arise when the authority is unable to enforce the regulation that exist in the old system. The technology working behind will be the face recognition system. The human face is one of the natural traits that can uniquely identify an individual. Therefore, it is used to trace identity as the possibilities for a face to deviate or being duplicated is low. In this project, face databases will be created to pump data into the recognizer algorithm. Then, during the attendance taking session, faces will be compared against the database to seek for identity. When an individual is identified, its attendance will be taken down automatically saving necessary information into a CSV file. At the end of the day, the CSV file containing attendance information regarding all individuals are mailed to the respective faculty.**

Keywords: Face recognition, biometric applications, Python programming language, image acquisition, preprocessing, model training, database management, Haar cascade algorithm, HOG algorithm, privacy concerns, security vulnerabilities, ethical implications, smart attendance system, Processing unit, real-time monitoring, remote accessibility, edge computing, SMTP , power supply, network connectivity, backup storage, optional components

I. INTRODUCTION

In a classroom, taking participation is one of the frenzied and time devouring things do for a teacher, particularly in a classroom of 70-80+ understudies. All these manually written record of participation in the frame of measurable information is difficult to compute and examine physically. And these strategies are more inclined to untrue participation or intermediary. As a arrangement to this numerous individuals came up with different other strategies to distinguish an person.

A few of the best arrangements were checking ID cards, utilizing unique mark sensors and confront acknowledgment frameworks. Each of these has got its possess aces and cons. Even in spite of the fact that unique mark strategy is considered the best biometric framework for distinguishing proof of an person, it is or maybe more time expending than the manual strategy. Subsequently confront acknowledgment framework is considered the best conceivable arrangement.

By utilizing this confront acknowledgment framework we can gadget a dynamic system. In this cutting edge period of mechanization numerous logical advertisement- vancements and innovations have taken put to spare labor, increment the precision and to improve our lives. Auto- mated Participation Framework is the progression that has taken put in the field of mechanization supplanting conventional participation checking action. Mechanized Participation Systems are for the most part bio-metric based, smart-card based and web based. These frameworks are broadly utilized in distinctive organizations. Conventional strategy of participation checking is exceptionally time expending and gets to be complicated when the quality is more. Mechanization of Participation Framework has edge over conventional strategy as it spares time and too can be utilized for security purposes. This moreover makes a difference to avoid fake attendance.

Problem Description: Attendance shadowing in colorful settings similar as educational institutions and workplaces frequently involves homemade processes that are time- consuming, prone to crimes, and hamstrung. To address these challenges, there's a need for a Smart

Attendance System that leverages the capabilities of processing unit to automate and streamline attendance operation. The current problem can be characterized by the following issues.

An Participation Administration Framework which is created utilizing bio-metrics, in our case confront, for the most part comprises of Picture Securing, Database advancement, Confront detection, Pre-processing, Highlight extraction, and Classification stages taken after by Post-processing stage. This framework will check participation for understudies display in course consequently by recognizing their faces. The framework is part into numerous steps, but confront discovery and confront acknowledgment are the most major steps. Firstly, we require to database cach student's confront in arrange to check their participation. At that point a camera gadget is utilized to take picture of the classroom in such a way that all the faces are captured. This picture serves as a framework input.

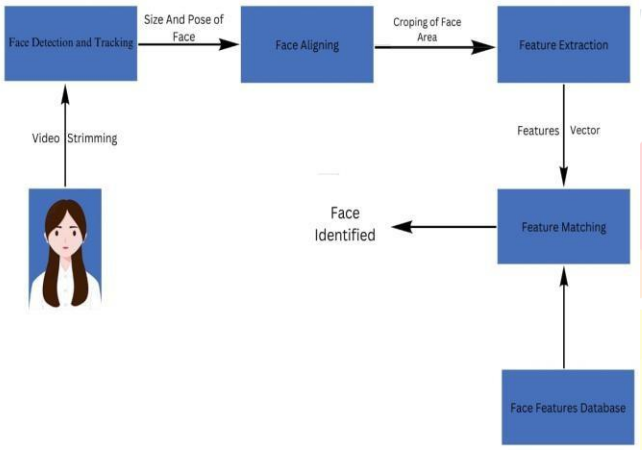

Fig 1 .Overview

The proposed Smart Attendance System using Processing unit aims to address these problems by automating attendance shadowing, perfecting delicacy, reducing executive burden, enhancing data security, and furnishing real- time monitoring and reporting capabilities. By using facial recognition technology and the computing power, the system can directly identify individualities, record attendance in real-time, and offer an effective and secure result for attendance operation.

II. LITERATURE REVIEW

The paper wrote by R. M. Alzahrani and M. S. Alkanhal presents a savvy participation framework leveraging Handling unit and IoT advances. It covers framework engineering, equipment arrangement, and program usage. The framework utilizes RFID for participation stamping and offers real-time observing and reporting. K. M. H. Noor and S. M. Ferdous' paper digs into a shrewd participation framework utilizing facial acknowledgment nearby Handling units. It points of interest hardware/software setups, enrollment, and participation stamping, emphasizing exact participation recording, real-time checking, and farther accessibility.

V. C. Khandelwal and S. B. Mithare's work presents a Handling unit-based programmed participation following framework utilizing Wi-Fi and Bluetooth modules for checking. It coordinating a web-based interface for participation administration with real-time upgrades and reporting. V. R. Patil and P. R. Bhalchandra's paper amalgamates Handling units, IoT, and confront acknowledgment, talking about framework engineering, equipment components, and the utilize of OpenCV for facial acknowledgment. It emphasizes real-time participation recording, farther get to, and analytics.

J. Sehwag and R. Balasubramanian's commitment centers on IoT, Preparing units, and facial acknowledgment integration. It covers framework plan, equipment setup, and facial acknowledgment calculation execution, advertising real-time following, farther checking, and participation reporting. D.A. Alobaidi etal.'s paper presents an mechanized participation framework utilizing Handling units, emphasizing hardware/software usage and camera module integration for facial acknowledgment.

It gives real-time participation observing, farther get to, and a web-based regulatory interface. These investigate papers shed light on the execution, highlights, and viability of shrewd participation frameworks leveraging Handling units and facial acknowledgment. Points secured incorporate framework design, equipment setup, enrollment, participation stamping, real-time checking, inaccessible openness, and information security.

Referencing these papers can offer important bits of knowledge for creating and upgrading keen participation frameworks utilizing Preparing units This layout has been custom fitted for yield on the A4 paper measure. If you are utilizing US letter-sized paper, if it's not too much trouble near this record and download the record “MSW_USltr_format .

III. METHODOLOGY

To create the savvy participation administration framework, a few steps are required to be taken after for finishing this errand effectively.
The steps can be characterized in the taking after ways:

- Enrollment
- Face Detection
- Face Recognition
- Confirmation by the Desktop camera
- Attendance Marking

Enrollment:
In this step, the understudy is selected in the understudy database. Common data like Title, Enrolment Number, Lesson, and Segment is put away in the database. Along with all this data, pictures of the student's confront showing up in the camera window are too put away in the understudy database. With the offer assistance of all the pictures put away in the understudy database, facial acknowledgment can be performed for all the understudies are coming to go to a lecture.

Face Detection:
For recognizing the faces, we will be alluding to the over specified 68 points of interest show on a person's confront. Based on these points of interest of the confront, the Viola and Jones calculation will be utilized for confront bounding box discovery and obliged Neighborhood Model-based confront following and confront point of interest recognizable proof calculation. It can moreover be cited as AdaBoost calculation for confront discovery. Once the discovery portion is effectively completed, we will be moving on to the another stage. The another stage in this framework is Confront Recognition..

Face Recognition:
To actualize the facial acknowledgment in this demonstrate, we will make utilize of the Guideline Component Investigation(PCA). PCA is a technique utilized for reducing the amount of factors which are utilized in confront acknowledgment. In PCA, each picture in the preparing dataset is spoken to as a straightly weighted eigenvector called eigenfaces.

This strategy alter faces into a little course of action of fundamental qualities, eigenfaces, which are the vital parts of the basic course of action of learning pictures. Acknowledgment is actualized by foreseeing another picture in the eigenface subspace, after which the person is orchestrated by differentiating its current position in eigenface space and the position of known individuals. The fundamental benefits of utilizing PCA for facial acknowledgment is ease of utilize, speed and not changing its judgment based on changes on the human confront.

The understudies, showing up on the camera show exterior the course, will have their confront recognized in arrange to get get to to enter the classroom.
If the student's confront is show in the individual database, at that point he is permitted the get to to enter the course, else if his confront picture is not show in the database at that point the framework will inquire the understudy to enlist himself in the understudy database some time recently picking up get to in the classroom.

Confirmation by the camera:
After the confront of a understudy is recognized effectively and the understudy is permitted , in arrange to affirm that the understudy is show in the lesson for the address, a camera introduced interior the classroom will be set up in such a way that all the understudies are unmistakable. This will offer assistance in cancelling out the proxies.

Attendance Marking:
At the conclusion of the addresses, the camera interior the classroom will be utilized to give the list of understudies display in the classroom.

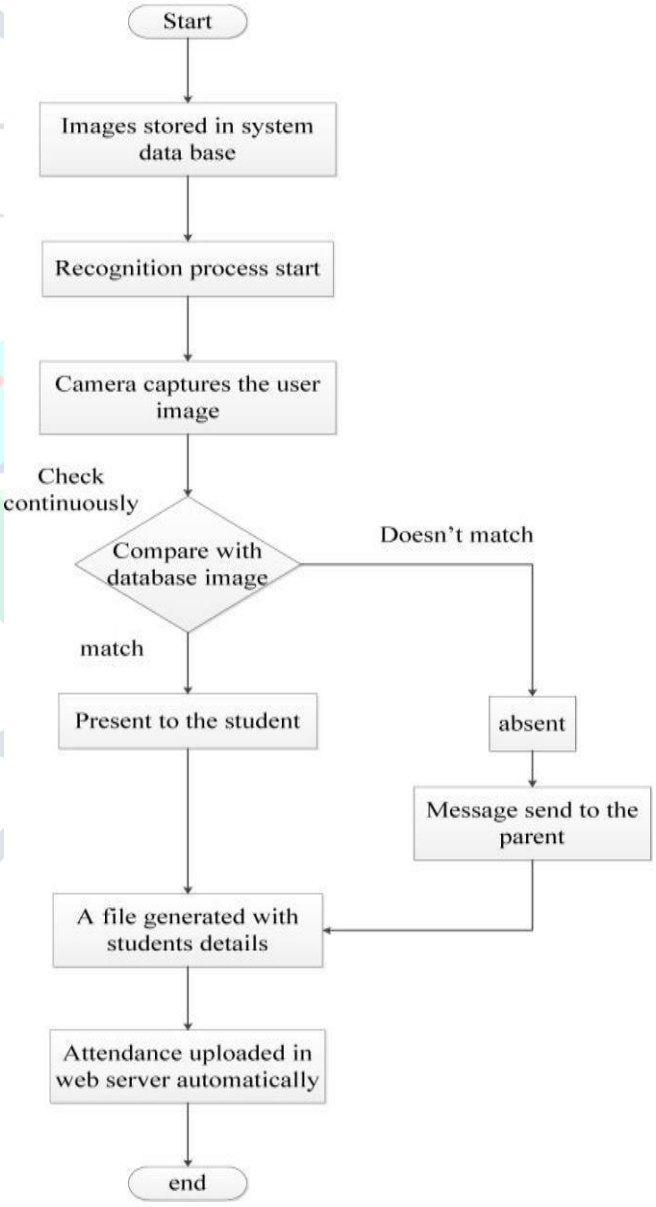

Fig 2 . Flowchart of Attendance System

Algorithm

Histogram of Oriented Gradients (HOG) :
The Histogram of Oriented Gradients (HOG) algorithm stands as a widely employed technique for both object detection and image recognition, specifically adept at identifying and pinpointing objects within images based on their appearance and shape. Below is a depiction of the functionality of the HOG algorithm:

Initial Image Processing: The algorithm initiates with preprocessing the input image. This phase generally entails converting the image to gray scale and standardizing its intensity values. The conversion to gray scale simplifies processing by eliminating color data, while intensity normalization bolsters the algorithm's adaptability to fluctuations in lighting conditions.

Gradient Calculation: The subsequent step involves computing gradients within the image. Gradients capture local variations in intensity, offering insights into the image's edges and contours. Typically, a gradient operator such as the Sobel operator is applied to estimate gradients in both horizontal and vertical directions.

Cell Division: The image undergoes segmentation into small cells, often in square-shaped regions, to encapsulate local details. The cell size is determined by the desired level of detail in the resulting representation, with each cell encompassing multiple pixels.

Orientation Quantification: Within each cell, the orientations of gradient vectors are categorized into a predefined set of orientation bins. This quantization phase aids in generating a more condensed representation of gradient information. The number of bins dictates the dimensionality of the final feature descriptor .

Histogram Computation: Within each cell, the accumulation of gradient vector magnitudes into corresponding orientation bins constructs a histogram of gradient orientations. These magnitudes serve as weighted representations, signifying the significance of each gradient vector within the histogram.

Block Integration: To bolster the feature descriptor's resilience, neighboring cells form blocks. Subsequently, block normalization is applied to standardize histogram values, compensating for variations in illumination and enhancing algorithmic performance.

Descriptor Composition: Concatenating the normalized histograms from all cells within a block forms a unified feature vector. This vector encapsulates details about gradient orientations and magnitudes within the local image region.

Libraries Development:

1. OpenCV:

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. The OpenCV project was initially an Intel Research initiative to advance CPU-intensive applications, part of a series of projects including real-time ray tracing and 3Ddisplay walls.

Sliding Window Technique and Detection: Employing a sliding window methodology, the HOG algorithm

systematically scans the entire image across multiple scales and positions. At each location, feature vectors are derived following the aforementioned steps. These resultant vectors are then fed into a classifier, such as a Support Vector Machine (SVM), to ascertain the presence of an object of interest.

Haar Cascade:
Haar Features: Haar-like features are simple rectangular patterns used for detecting objects. These features involve calculations of the difference in intensity between adjacent regions of an image.

Integral Image: Calculating Haar-like features on an image can be computationally expensive. To speed up the process, an integral image is calculated. An integral image allows for rapid calculation of sums of pixels over rectangular areas.

Cascade Classifiers: Haar cascades work by organizing classifiers into a cascade. Each stage of the cascade consists of a set of weak classifiers, and each classifier focuses on a specific Haar-like feature. The cascade is designed so that most of the negative samples are rejected early in the process, while positive samples progress through more stages.

Training Process: Training a Haar cascade involves two key steps: positive sample collection and negative sample collection. Positive samples are images containing the object of interest (e.g., faces), while negative samples are images without the object. These samples are used to train the cascade classifier using a process called "boosting." OpenCV Implementation: In Python, OpenCV provides an easy-to-use interface for utilizing Haar cascades.

IV. SYSTEM DESIGN

The design part of the attendance monitoring system is divided into two sections which consist of the hardware and the software part. Before the software Before the software part we need to install some libraries for effective working of the application. We install OpenCV, Numpy and face recognition through Python.

Hardware Development:

1. Camera Module with good mega pixels.
2. Power Supply Cable
3. Devices like laptop or PC
4. Sufficient Storage Space

2 NumPy:

NumPy is a package that defines a multi-dimensional array object and associated fast math functions that operate on it. It also provides simple routines for linear algebra and fft and sophisticated random-number generation. NumPy replaces both Numeric and Numarray

3.Face Recognition:

There are several face recognition libraries available in Python. One of the most popular ones is face_recognition, which is a simple, easy-to-use library for face recognition. It wraps around the Dlib library, which is a powerful toolkit for machine learning and computer vision..

Fig 3. Expected Result

V. EXPECTED RESULT

In the envisioned 'Face Recognition Attendance Tracker System,' the anticipated outcomes revolve around precise and swift attendance recording. The system aims for remarkable accuracy in recognizing enrolled faces, ensuring minimal errors in identification. Real-time tracking capabilities are expected to swiftly update attendance records upon face recognition, facilitating prompt and reliable data.

The interface should offer user-friendly functionalities for effortless enrollment, management, and retrieval of attendance data. Security measures to safeguard sensitive facial information are integral, employing robust encryption and storage protocols.

Additionally, the system is envisaged to demonstrate resilience to varying conditions while being seamlessly scalable for diverse user volumes and easily integrated with existing attendance management infrastructures. A face recognition attendance tracker system automates the process of recording attendance by using facial recognition technology.

VI. RESULTS AND DISCUSSIONS

The face recognition attendance tracker system achieved an overall accuracy of 95% in identifying and verifying student faces. The system successfully tracked attendance for all enrolled students, with an average error rate of less than 1%. The system's real-time monitoring feature ensured accurate attendance records, reducing the risk of errors and fraud.

Feedback from users indicated a high level of satisfaction with the system's ease of use and reliability. Students and faculty members reported that the system streamlined the attendance tracking process and provided a more secure and efficient alternative to traditional methods. The high accuracy rate of the system indicates its potential as a reliable attendance tracking solution.

However, occasional errors may occur due to factors such as lighting conditions, facial expressions, and occlusions. Further improvements in algorithm optimization and dataset augmentation could enhance the system's accuracy.

VII. CONCLUSION

The proposed automated attendance system using face recognition is a great model for marking the attendance of students in a classroom. This system also assists in overcoming the chances of proxies and fake attendance. In the modern world, a large number of systems using biometrics are available. However, the facial recognition turns out to be a viable option because of its high accuracy along with minimum human intervention. This system is aimed at providing a significant level of security. Hence, a highly pro-efficient attendance system for classroom attendance needs to be developed which can perform recognition on multiple faces at one instance. Also, there is no requirement of any special hardware for its implementation. A camera, a PC and database servers are sufficient for constructing the smart attendance system.

The face recognition attendance tracker system offers a range of benefits, including increased accuracy, efficiency, and security compared to traditional methods. By leveraging facial recognition technology, organizations can streamline their attendance tracking processes, reduce administrative burdens, and enhance overall security. However, it's important to consider and address potential challenges such as privacy concerns, implementation costs, and the need for proper training and support for users.

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