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AI-based Attendance Tracking System using Real-Time Facial Recognition

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***Abstract* - A fundamental system necessary for monitoring student performance is attendance tracking. It is always a harder task to monitor the student consistently all through the learning period. A conventional based attendance system is not efficient enough, as it tracks the student's presence at the start or the end of the hour. This research work has proposed a facial recognition and artificial intelligence (AI)-based attendance tracking system. The proposed system includes a face recognition model to recognize real time images and upload the data to cloud server by using a deep learning TensorFlow framework. As a part of the proposed attendance tracking system, the face recognition system can also be utilized to maintain "punch card" records. It can be used to enhance recognition, authentication and security.**

Keywords: Face Detection, Face Recognition, OpenCV, Image Enhancement, Attendance System

I. INTRODUCTION

Attendance is critical in an academic context for both students and teachers. The fundamental components of the artificial intelligence-based student attendance system are facial detection, face recognition, and the student attendance monitoring system and apps. Every fundamental stage in assessing pupils' achievement depends on maintaining attendance. There is a distinct strategy for every organization like using ERP [1].

Since a person's face is considered to constitute their unique identity, it is seen to be a fundamentally important component of identification and communication with others all over the world [2].

It examines the distances between the colors on the ears, eyes, nose, and mouth as well as the overall contour of the face [3]. The concept of computer vision is considered since it is challenging to analyze data without a computer by using computer vision techniques to recognize human characteristics.

As a consequence, this method completely eliminates all problems with conventional systems and other biometric strategies [4, 5, 7] such as more time-consuming manual attendance [6]. This project is composed of two important supporting systems. C# was used to create both the administration module and the attendance receiver module, also referred to as a face scanner. For reading and updating attendance to the database, a Python face scanner or attendance receiver module was created.

II. LITERATURE REVIEW

The generation of the training dataset, its augmentation, face detection using Haar[19], the compilation of pictures and the training of CNNs[11,16],

and last but not least, integration into the current system to evaluate the recommended technique, are all critical elements in the development process[3]. This work is expected to provide insights and a working model of deep learning, which facilitates the accurate maintenance of the attendance system using face recognition. The full procedure for developing a face recognition component with state-of-the-art methods and deep learning innovations is described.

It demonstrates how a multicamera [9,12] installation lessens the effect of occlusion inside the face identification [17,18] technique since greater face detection would increase the accuracy of sophisticated class attendance surveillance. This paper provides a practical foundation for a system that uses face recognition to track students' attendance. Real-time face recognition and recurrent updates to the attendance data are used to assess whether or not students were present during the whole presentation [8].

The three tiers that make up the system are the Application Layer, the Communication Layer, and the Server Layer the creation of a filtering technique based on Eigenfaces[6,13], Fisher faces, and Euclidean distances obtained via LBP[7,10]. The suggested solution eliminates the expense of extra equipment, shortens the time needed to take attendance [6], and enables users to access the data whenever and wherever they choose.

The system consists of a camera that takes pictures of the classroom and sends them to the image-improving module, where the noise is greatly reduced [15] and the compression technique used produces greater efficiency [20].

The image is then improved before going via the Face Detection and Recognition modules [4], where the information/database server logs the attendance. The technique for collecting attendance in a classroom that is suggested in this paper is efficient and precise, and it has the potential to someday take the place of the more conventional manual approaches. Using this process is reliable, doable, and safe. The system may be installed within the classroom without the use of specialized equipment. It is essential to create a system that will handle this issue and give users a convenient environment. The most trustworthy kind of identifying evidence is considered to be a person's fingerprints [14] since they cannot be changed over time or even after a person has died.

III. ANALYSIS OF THE EXISTING MODELS

The two-step Region-based Convolutional Neural Network's results about the modified Haar classifiers, the pipeline of the training have various phases, they belong train themselves in joint training methods

The distribution of the convolutional layers during the different phases of the training is a drawback over the modified Haar classifiers

The skin segmentation technique utilizes the YCbCr color space and in the linear algebraic sense, the Gaussian mixture model for facial color has been adopted to classify the segments which are close to the human skin color. This model is convenient to manipulate leaving thus not applicable to the proposed Attendance system

The Biometric attendance management system making use of the employee's physical attributes iris, veins, or any other human body details is vulnerable to security breaches and the manual method of applying input is often a strenuous activity that affects the employee's mental state after a day's work.

IV. COMPONENTS OF THE SYSTEM

A. Embedded Device

An embedded device component with a photo sensor connects to the cloud server using IoT architecture, which saves and makes data analysis tools available to the user.

B. Face Recognition System

Two sorts of algorithms can be used to operate the facial recognition system. Algorithms for feature-based and comprehensive matching are also employed. While the feature-based technique divides the face based on facial qualities such as the eyes, skin tone, eyebrows, and other characteristics, the holistic matching approach uses the complete face as input data to identify a specific individual from the database.

In addition to the first two, a method known as three-dimensional face recognition makes use of sensors to gather 3D faces and accurately identify individuals in the real world. Face recognition in real time utilizing 3D sensor-based applications identifies a person using distinctive face images taken a variety of perspectives, with a variety of lighting, and in a variety of locations using different phrasing, increasing its effectiveness in all submissions.

C. Recognition Modules:

At the time of enrolment, templates of each student's face pictures are stored in the Face database's Training Set. Here, the algorithm finds every face in the supplied image and individually compares it to the face database (Testing Set). If a certain face is recognized, the attendance is recorded on the server, and accessible to the administrator for use in a variety of ways.

V. IMPLEMENTATION REQUIREMENT

A. Technical Requirement

Hardware Requirements

An individual Desktop computer and a high-quality camera must be installed in the classroom in order to take photographs. Secondary memory must be used to store the database and all the photos.

Software Requirements

- MATLAB 8.5.0(R2015a) or a later version
- Windows 8 and later

B. Functional Requirements

The functions and services that the system must provide are described by its functional requirements. User control over student records is necessary.

Only authorized users should be able to access the system. Both recognition and the system must be precisely associated with a webcam.

The system administrator or the user must first log in to the person who will receive access must log in.

The data must be entered and handled accurately.

C. Non-Functional Requirements

Non-functional Requirements are characteristics or elements of the system that may be used to gauge how well it performs. The following information clarifies them. Precision and accuracy are necessary for the system to function in order to avoid problems.

The GUI of the system will be easy to use. Users' data will be shown once it has been confirmed to be accurate and readily available. The system will be flexible enough to accommodate changes as well as the newest technological advancements. The efficacy and efficiency of the system will be ensured. The performance of the system will be ensured.

D. Flexibility:

Any flaws in the system should be fixed, and changes should be straightforward.

E. Security:

The program must safeguard student privacy and be reliable.

F. Usability:

The system ought to be easy to use and understand.

G. Maintainability:

The maintenance crew must be capable of handling any occasional issues.

H. Response time and speed:

Tasks should be completed swiftly.

VI. METHODOLOGY

This section provides a description of the system's software algorithm.

The algorithm is comprised of the following steps.

- Image capture
- Histogram Normalization
- Noise reduction
- Skin categorization
- Noise reduction
- Face detection
- Face recognition and attendance

The first step is using the photo-capturing device to take a photo.

The image that was produced has illumination effects that need to be eliminated before proceeding due to the varying lighting situations and some noise. The spatial domain implements Histogram normalization to enhance contrast. A median filter is handled to discriminate the noise from the picture. While FFT and low pass filters are two techniques for picture smoothing and noise reduction, the median filter yields good results.

A. Image capture

A high-definition camera attached above the whiteboard provides the image. The computer is linked to the camera. Every two minutes, it takes a picture and sends it to the computer to be processed

B. Histogram Normalization:

In order to acquire the best results, it is occasionally essential to remove brightness or darkness

from taken photographs. To enhance it, the RGB image is first converted to a grayscale version. Histogram normalization is a practical method for enhancing contrast in the spatial domain. This shows that the students in the rear rows can now be seen clearly, making it easy to recognize them. There are further ways to guarantee consistent lighting of a picture.

C. Noise Reduction

There might be several causes of noise in a picture when it is provided by the camera. There are several ways to eliminate noise. Although frequency domain low pass filtering may be an effective solution, the image is also deprived of some essential information. Our method uses median filtering to eliminate noise from the histogram-normalized picture.

D. Skin categorization

This is done to increase the efficiency of the face detection algorithm. The detection algorithm used by Voila and Jones works better when the skin is classified before scanning faces.

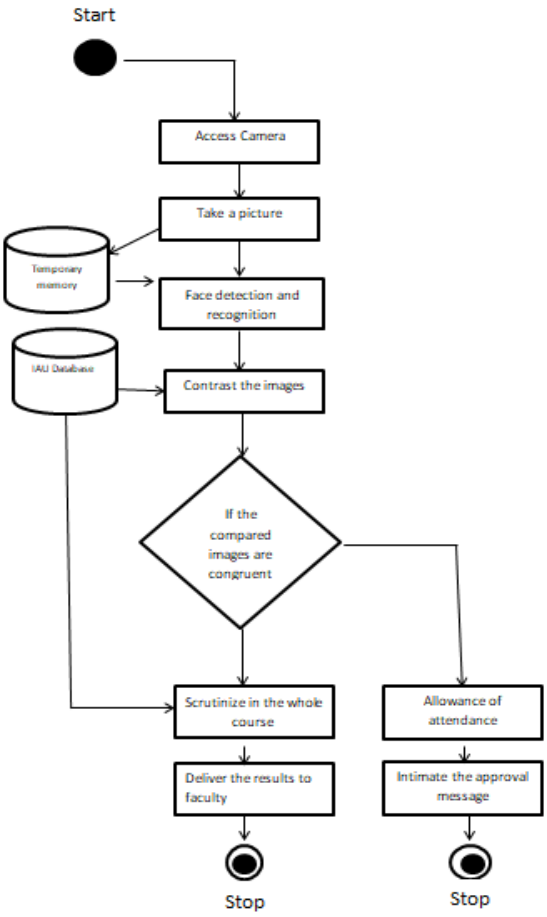
E. Face detection

Circles are drawn on the faces of the students to identify them in this section. Following the skin categorization procedure, the algorithm's detection rate increased.

Haar classifiers have been used for detection. The face identification method was tested on various photographs before being used to recognize faces in real-time video. In order to detect several faces in an image, an algorithm is trained on face images before being applied to a classroom image. A face under a veil is also recognized by the system. After face detection, the following step is to cut each face that has been recognized from the images. The algorithm accelerates itself by using the threading mechanism. Each cropped image is allocated to a distinct thread for identification purposes.

F. Face Recognition and Attendance

Face detection follows the facial recognition phase. This is accomplished by cropping the picture so that just the first identified face is visible, and afterward, comparing it with the database. Consequently, each student's face is compared using the Eigenface approach to the server keeps track of attendance and the face database.



G. Performance analysis

The implementation of Summed area tables referred to as integral integers can be detailed as two-dimensional lookup tables, they share the authentic size of the image. With respect to the element's position the summation of the collection of pixels positioned on the top-left region in the initial photographic data, this approach trims down the noise of the given dataset and the formulation that the sum of initial positions of the integral image frames the histogram normalization influenced by the lookups of the rectangle features such as the six lookups for 2 rectangle features and 3 rectangle feature requires 8 lookups, thus ameliorating in facilitating the convenience for histogram normalization highly impacting the corollary of the machine learning model.

VII. COMPARITIVE ANALYSIS OF THE EXISTING MODELS AND PROPOSED METHOD

Existing face detection systems	Face detection acute rate for the sample size of 5000
Modified Haar cascade	96.9
Neural Network	72.3
Matching modified Haar cascade	63.46
Skin segmentation (YCbCr color approach)	51.6
Higher Order Statistics	73
Two step R-CNN Method	93.86

Modified Haar cascade with the sample set of 5000 in conditions with ordinary scenarios proved to be efficient with 96.9 percent of precise indication of certainty.

The feature crosses employment in deep learning is subjected to curtail and the citified implementation of feature crosses, Neural networks making use of the dataset gives an accuracy of 72.3 % and this model has less convenient histogram normalization with respect to Haar classifiers

The region-based convolutional neural network when implemented through the two-step algorithm for the given dataset its accuracy is influenced with the outcome of 93.86%, the most abutting to the Modified Haar classifiers. The two-step convolutional sieves the noise with its intersection over the union approach closely resulting in the modified Haar implementation.

VIII. CONCLUSION

The traditional approach of maintaining the attendance percentage of manual entry is being proposed to switch to Automation. Students are more likely to retain their attention if implemented.

If the attendance is maintained by machines capable of intelligence and marking their attendance, faculty and students will be structured to maintain the decorum of staying put as the system will record and assess their presence accordingly now it's not possible because if the faculty left the college, the system automatically marks as absent so everyone else. The artificial intelligence-powered system for tracking staff and student attendance is extremely safe, accurate, and simple to use.

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