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Face Recognition Attendance Monitoring System Using Deep Learning Approach

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Abstract - Face Recognition Attendance Monitoring System offers a cutting-edge replacement for conventional techniques used in educational settings to track attendance. This solution provides a smooth and effective way to track student attendance by utilizing the latest developments in artificial intelligence and computer vision. Facial recognition technology replaces manual attendance taking by teachers by automatically recording students' attendance when they enter classes or other authorized areas. The architecture and implementation of the suggested system, which combines database administration, facial recognition, and detection modules, are described in this work. In order to reliably and precisely track student attendance, the system uses deep learning algorithms to precisely recognize and match faces against a pre-registered database of students. Installing such a system in academic environments has numerous advantages. It gives instructors less administrative work, expedites the attendance management procedure, and offers current information on student attendance trends. By producing thorough attendance reports for administrative needs, it also improves accountability and transparency. The efficacy and efficiency of the Face Recognition Attendance Monitoring System are proven through testing and assessment. The findings show that attendance records are accurately recorded, with few false positives and negatives. It provides an advanced, yet approachable, answer to the problems associated with university attendance tracking. The potential for revolutionizing existing attendance monitoring procedures through its adoption lies in its ability to develop a more efficient and data-driven approach to academic oversight and student involvement.

Keywords - Artificial intelligence, machine learning, deep learning, face recognition, attendance system.

Introduction

The integration of cutting-edge technologies into educational environments has sparked the creation of creative fixes meant to improve conventional procedures. Using computer vision and artificial intelligence (AI) capabilities, the Face Recognition Attendance Monitoring System for University Students marks a substantial development in attendance tracking approaches. Instructors no longer need to manually take attendance because this system uses facial recognition technology to automate the procedure.

This paper provides a thorough explanation of the suggested system's architecture, implementation, and assessment. With the use of cutting-edge deep learning algorithms, the system combines facial detection, recognition, and database management modules, building on the research of academics like [1, 2]. These algorithms allow for accurate face matching and recognition against a pre-registered student database, thanks to intensive training on big datasets. Additionally, the system adheres to strict regulations for data management and storage, prioritizing user privacy and data security as recommended by authors in [3].

Numerous advantages of using such a system in academic settings are demonstrated by research conducted by authors of [4, 5]. It provides real-time insights into student attendance trends, simplifies attendance management procedures, and lessens the administrative load on faculty members. It also improves openness and accountability by producing thorough attendance reports for administrative use.

The Face Recognition Attendance Monitoring System's effectiveness and efficiency are proven through extensive testing and assessment. The findings show that attendance records are accurately recorded, with few false positives and negatives. Moreover, user reviews and satisfaction surveys confirm the system's usefulness and suitability for usage in authentic learning environments. With its advanced yet approachable answer to the problems encountered by colleges, the Face Recognition Attendance Monitoring System marks a significant leap in attendance tracking methodology. By promoting a more effective and data-driven approach to student participation and academic oversight, its implementation has the potential to completely transform current attendance monitoring procedures.

In this paper, we introduce a novel approach for automating attendance management systems through the fusion of two

cutting-edge technologies: YOLOv8 for object detection and DeepFace for facial recognition. The system aims to streamline attendance tracking processes in various settings, including educational institutions, corporate offices, and events. By leveraging the robust detection capabilities of YOLOv8 and the high-accuracy facial recognition provided by DeepFace, the proposed system offers a reliable, efficient, and user-friendly solution for attendance management.

The remainder of this paper is organized as follows: Chapter two presents a summary of various automated attendance systems, chapter three presents the details of the proposed deep learning method in this work, chapter three presents the implementation details and the results obtained and lastly, chapter 5 concludes the work.

Literature Review

In [9], authors proposed a class face recognition attendance system based on eigenface values, Convolution Neural Network (CNN) and Principal Component Analysis (PCA). The author's uses two databases, one for storing the student's faces for face comparison during the attendance marking and the other for storing the student's attendance. The system consists of high definition camera installed outside the class rooms that captures the student's faces while entering the classroom. A second camera is installed inside the classroom that captures the faces of the students within the classroom. Both cameras uses face detection and recognition algorithms that are used to analyze the student's faces and mark their attendance.

In [10], authors improve the performance of the traditional AlexNet convolutional neural network using deep learning related approach and improves the AlexNet network training and test using webface dataset. The model is integrated with RFID card reading technology and applied in face recognition system for class attendance. The stability and accuracy of the proposed system efficiently reduced the cost of classroom attendance.

In [11], authors proposed a face recognition attendance system that uses raspberry pi module to collected data from camera. To achieve the face recognition, the authors collected the students face database that also consists of their roll numbers, and names. The raspberry pi is installed in the class such that the entire class could be viewed. The student's faces are then captured and their attendance updated. The system significantly saves the time consumed in taking the manual student attendance.

In [12], authors proposed a face recognition system for students attendance marking that automatically detect the students while entering their respective classes and mark their attendance by recognizing their faces. The proposed system employs the viola face recognition algorithm to detect student faces, Principal Component Analysis (PCA) for feature selection and Support Vector Machine (SVM) for classification. The proposed system significantly saves time and assists in monitoring the students.

In [13], authors proposed an automated face recognition attendance system for classroom. The suggested system uses Gabor filters, generative adversarial networks, CNN, SVM, KNN, and Haar classifiers. Attendance reports will be generated and saved in Excel format following face recognition. The system is tested in a variety of settings, including changes in lighting, head motions, and the spacing between the student and the cameras. Following extensive testing, the total complexity and accuracy are determined. The suggested technique turned out to be a reliable and effective tool for recording attendance in a classroom without requiring any manual labour or time commitment.

The authors of [14] propose a face recognition technique-based approach for a student attendance system in the classroom. They execute this by first extracting the features of the student's face using Discrete Wavelet Transforms (DWT) and Discrete Cosine Transforms (DCT), and then classifying the facial objects using the Radial Basis Function (RBF). 121 out of 148 students in a classroom environment successfully detected faces in the experiments.

In [15], authors proposed a comprehensive embedded class attendance system using face recognition with door control access. In the proposed system, a camera and a 5 inch screen are integrated with raspberry pi. The camera captures the students faces while they approach the door and the captured images are passed to the raspberry pi. Each student face is matched with the face database and the door is opened when the student face is found in the students face database and the attendance is marked.

In [16], authors present a way to link face recognition technology with the Personal Component Analysis (PCA) technique for a student attendance system. With the use of an automated clock-in and clock-out log, the system allows professors to conveniently access information about students while also automatically recording participation in a classroom setting.

In [17], authors suggested an automatic attendance system that uses a live video stream to record attendance. Prior to extracting and storing the features, the suggested system gathers the

student database. A mechanical setup intended to capture the class image in two directions is used to take pictures of every student in the room, enhancing the quality of the image and detecting the number of faces in the image. Cropped are the faces that were identified from the input image. A feature extraction process is used to compare the clipped faces' features to the database. Should the pupil be identified, that specific pupil's attendance record will be indicated as present. Identified faces from the input image are cropped and a feature extraction process is used to compare the clipped faces' features to the database. Should the pupil be identified, that specific pupil's attendance record will be indicated as present. The attendance report is uploaded to the webpage created specifically for this purpose after the full recognition process is finished. Only those who have been authenticated can view the webpage.

In [18], an attendance system for facial recognition was created. The proposed approach comprised extracting human faces from a webcam using the Viola-Jones methodology, scaling the extracted face to the target size, and interpreting the resized face with a simple Local Binary Patterns Histogram algorithm. Immediately upon the completion of recognition, the attendance will be updated with the pertinent data in a SQLite database.

Background

In this section, the YOLO, Deep Face and OpenCV library are explained. These technologies form the basis for the development of our face recognition attendance system.

YOLO

The cutting-edge object identification system YOLO (You Only Look Once) is renowned for its speed and precision [6]. In 2016, Ross Girshick, Santosh Divvala, Joseph Redmon, and Ali Farhadi presented it for the first time. YOLO's core idea is to identify objects using a neural network in a single pass, which makes it incredibly quick in comparison to conventional two-stage detection techniques [7]. YOLO uses a convolutional neural network (CNN) to process the full image at once and forecasts bounding boxes and class probabilities concurrently. It creates a grid out of the input image and uses that grid to estimate bounding boxes and object probabilities. Multiple bounding boxes and corresponding class probabilities are predicted for each grid cell [7]. The following are the key components of YOLO:

- Feature Extraction Backbone: Typically, YOLO bases its feature extraction on a deep CNN. A customized CNN architecture called DarkNet is used in the original YOLO model.
- Detection Layers: YOLO contains multiple detection layer at different network scales that enable it to detect objects of different sizes.
- Anchor Boxes: Anchor boxes are used by YOLO to forecast boundary boxes. These anchor boxes aid in the prediction of objects with varying sizes and shapes because they are pre-defined shapes with various aspect ratios and scales.
- Non-Maximum Suppression (NMS): Following bounding box prediction, YOLO uses NMS to eliminate duplicate and overlapping boxes, retaining just the most certain ones.
- Feature Pyramid: To improve its ability to recognize objects of varied sizes, YOLO uses a feature pyramid to extract features at multiple scales from the input image.

DeepFace

DeepFace is a facial recognition system developed by Facebook's AI research team. When it was first released in 2014, it attracted notice for its remarkable accuracy in facial recognition. DeepFace uses convolutional neural networks (CNNs), a type of deep learning technique, to recognize faces. Using a CNN-based face detector, the program first finds faces in a picture. Next, in order to guarantee consistent representation across various images and positions, it aligns the faces that have been recognized to a canonical stance. Using a deep CNN architecture, DeepFace retrieves deep characteristics from the aligned faces. These deep features are then utilized to match and identify faces by comparing similarity scores amongst face representations [8].

DeepFace can automatically extract complicated patterns and representations from data because it is built on deep learning algorithms. It works well in real-world situations because it is made to withstand changes in lighting, posture, and facial emotions. DeepFace can handle big datasets with millions of faces and photos and is very scalable. It has proven to be effective in correctly detecting faces by achieving state-of-the-art accuracy on benchmark face recognition datasets. Facebook has made extensive use of DeepFace for a number of uses, such as photo tagging, content moderation, and security functions. Although facial recognition technology has shown a surprising degree of accuracy, privacy and surveillance concerns have also been raised by this technology, sparking discussions regarding the moral application and regulation of this field.

OpenCV

OpenCV, or Open Source Computer Vision Library, is an open-source computer vision and machine learning software library.

Since Intel created it in 1999, a group of developers has updated and enhanced it on a regular basis. C++ code makes up OpenCV, whose development is now supported by a number of companies, including Sony, Google, Intel, and others. The image processing (filtering, transformations, etc.), object detection and recognition, feature extraction and matching, camera calibration and 3D reconstruction, motion analysis and object tracking, and machine learning algorithms for classification, regression, and clustering are just a few of the many algorithms for image and video analysis that OpenCV offers.

Materials and Methods

The proposed student's attendance system consists of student capture module, attendance capture module, and attendance update module and attendance view module as depicted in figure 1. The student capture module uses OpenCV to capture the faces of the students and store the captured faces in the face database for face analysis. In the attendance capture module, the faces of students are captured from real-time video stream captured on camera using OpenCV is processed and compared with the faces in the face database generated by the face capture. An attendance list consisting of recognized faces is generated and updated in the attendance database during the attendance upload phase. The detail implementation of each component of the system is described in the subsequent sections below.

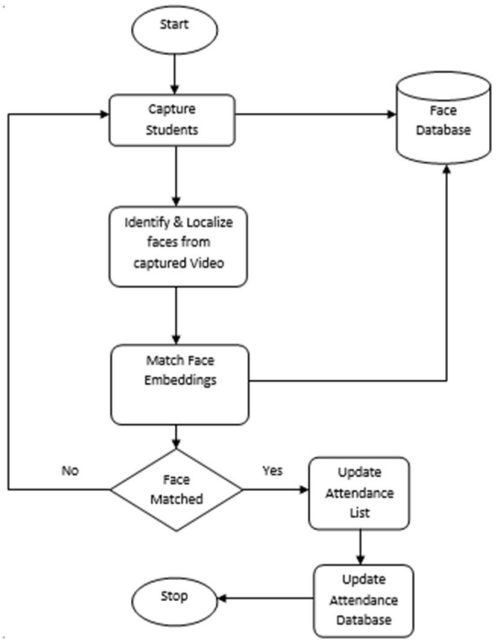

Figure 1 Flowchart of the proposed attendance system

Students Face Capture Module

In this module, the openCV computer vision library is used to capture student's faces and stored in the face database. During this process, the student registration number is used as the name attribute of the student captured face and the files are saved to the image database in .jpg format. Other attributes of the students are stored in the attendance database, which are used during the attendance marking phase.

Attendance Capture Module

In this module, the student's attendance is captured for attendance update. The capture phase consists of two modules, the face detection module and the face recognition module. The face detection module detects and identifies human faces within the digital video frames captured using opencv library. The face recognition module match the face embedding obtained from the face detection module with the face databases and returned all identified faces. The face detection process in this work employs the conventional YOLOV8 model to obtain the localization information. The obtained information is then forwarded to DeepFace model for face recognition.

Attendance Update Module

In this module, a list is generated and populated with the registration number of the students identified by the system. The list of the identified students is considered to be present at that particular session and is updated in the system database.

View Attendance Module

This module queries the attendance database and displays the student's names, student registration number, the percentage attendance of the students, and total number of class's present, total classes conducted in the session. The information about the students and their respective attendance percentage is displayed in table, which allows them to easily identify their respective information row.

Implementation and Results

The front end of the system is implemented using TKinter python GUI framework. TKinter is a standard python library interface to the Tk GUI toolkit shipped with python. TKinter toolkit makes the development of GUI easier and faster and can be used on both UNIX and windows operation systems. The backend of the developed face attendance system is built using MySQL database management system. The face recognition model was built and trained on a windows machine with core i7 10th Gen processor system. The system

has a RAM of 16Gb and 512GB SSD with nvidia integrated GPU. The ultralytics library used to develop and train the YOLOV8 for the face detection model and the Deep Face library used for the face recognition. The face dataset for the model training consists of 1000 images of students with each student having upto 10 images.

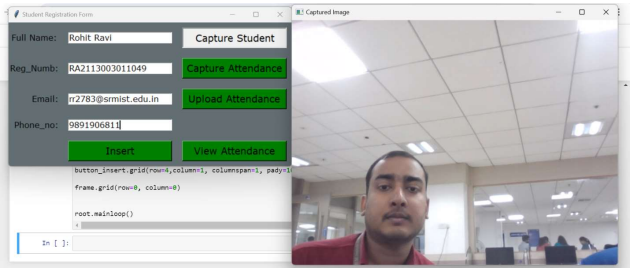

Figure 1. Students Face Capture Page

Figure 1 show the student capture page which allows for capturing of the students faces and their information for attendance marking. The details about the students are stored in the attendance database and the faces of the students are stored in the face database.

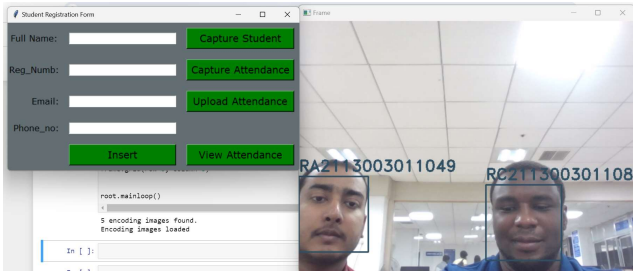

Figure 2 Attendance capture page

Figure 2 shows the attendance capture face, where tl student's attendance is captured. A camera is used to captu the student's faces and the recognized students are mark present in the attendance database.

Name	Reg Number	Email ID	Phone_No	Present	Total_Class	Percent
Rohit Ravi	RA2113003011049	rr2783@srmist.edu.in	9891906811	0	3	
Ismail Zahraddeen Yakubu	RC2113003011082	iy1242@srmist.edu.in	9940424170	3	3	

Figure 3 Attendance Database

Figure 3 shows the students attendance recorded by the syste The table shows the total number of classes attended by ea student, the overall classes conducted by the professor and t percentage attendance of each student.

Conclusion

In conclusion, a major development in the fields of biometric authentication and workforce management has been made with the combination of YOLOv8 and DeepFace technologies in the creation of a face recognition attendance system. This technology provides unmatched precision and efficiency in detecting people and documenting their attendance by utilizing deep learning algorithms. Because YOLOv8 is used, the system has strong object detection skills and can discover and extract faces from busy, complex surroundings with accuracy. Furthermore, accurate identification and verification of people is made possible by Deep Face's cutting-edge face recognition algorithms, even in situations with changing lighting and facial expressions. The YOLOv8 and Deep Face-powered face recognition attendance system, in short, marks the beginning of a new era in workforce management that is efficient, accurate, and secure. Organizations may maximize resources, improve productivity, and cultivate a more open and accountable work culture by utilizing state-of-the-art technology. Future developments in the fields of computer vision and artificial intelligence should bring about even more revolutionary changes to the way we handle attendance tracking and other related tasks.

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