Next-Gen Attendance System

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Abstract

The Next-Gen Attendance System is an automated advanced solution in the real-time tracking of attendance using deep learning models to streamline and enhance the process. With a wide capability of using YOLOv8 for very accurate face detection, this system offers three flexible modes for attendance capture: webcam live feeds, pre-recorded videos, or static images. These individual detected faces are uniquely labeled, and no same face gets recorded more than once in multiple sections. The system also makes use of CNN models to optimize facial feature and eye identification, even under dynamic environments. It significantly reduces the amount of manual effort and human error that is possible in attendance monitoring. The records are kept in secure easy to access excel sheets that uniquely identify each user. This solution has been designed for modern classrooms and pave the way for seamless integration of AI in attendance management systems within educational institutions.

Keywords: Webcam Attendance · Image Upload Attendance · Video Upload Attendance · Classroom Monitoring System · Student Attendance · Face detection · YOLOv8 · CNN

I. INTRODUCTION

This "Next-Gen Attendance System" breaks the mold in tracking attendance in educational spaces through automatic ways. Old methods like a traditional roll call or sign-in sheet for students tend to be time-consuming and inaccurate at times. This is a smart, web-based platform that employs deep learning algorithms to solve the problem of attendance monitoring with prompt and error-free processes intended for dynamic classroom settings. It is built with the YOLOv8 top-tier object detection framework for real-time face identification. Famous for its speed and accuracy, it can read faces at new angles, lighting, and conditions. It performs detection and classification in one pass with steady high-speed recognition that, of course is elemental in maintaining reliable records of attendance. Further, to increase the recognition precision, the system applies Convolutional Neural Networks(CNN) to dig out unique facial features. Such multi-layered networks have a strength towards capturing complex patterns in visual data. And thus they are increasingly needed for differentiating between individual faces[1]. Pre-trained CNN models enhance this ability and further increased reliability of the system in recording student attendance. The operating modes include live webcam feeds, as well as static images and pre-recorded videos, supported by the platform. Teachers can view an interactive interface for attendance tracking, where data is stored properly based on different Excel sheets for the corresponding sections[2]. This modular setup allows for easy scalability, thus tailored to diverse educational settings.

II. LITERATURE REVIEW

Hidayat et al., (2024)[1] (Alruvais and Zakarih[2] , Khwala Alhanai [3], Mitha Alhammadi, Nahla Almenhali, and Mad Shatnawi, Shailesh Arya, Hrithik Mesaria, and Vishal Parekh[4]) advance and review the current trends and practices that aim to enhance classroom management through technology. They recommend the provision of webcams in classrooms to detect movements and send alerts to staff concerning any detected motion. The report demonstrates the use of other approaches such as facial landmark tracking, facial segmentation, and prediction of gaze direction as among other activities undertaken to evaluate how the students behave. Also, they cover systems with the function of recognizing a face for attendance purposes. [1]Their approach is based on state-of-theart technologies that provide the framework for the development of a system for monitoring a classroom in real time through image analysis, improving the usability of classroom management tools. In other work, the author discusses automatic technologies used for controlling the location of pupils in e-learning environments and discusses in detail the application of deep learning such as Convolutional Neural Networks (CNNs) [2]. This work brings to light critical figures

in any research work, the students and most importantly their level of involvement using facial expression data, eye tracking, and head movements as examples. However, considerable achievements have been reached, advanced problems, particularly related to the requirement of huge volumes of information and enhancement in accuracy of tracking have come to light. On Knowledge-Based Intelligent Information Technology Systems conference, the researchers presented their work on a system for attendance based on face recognition. The main goal of utilizing transfer learning through pre-trained CNNs such as[3] SqueezeNet, GoogleNet, and AlexNet was to increase the accuracy of attendance management systems. Lastly, Shailesh Arya, Hrithik Mesaria, and Vishal Parekh from Pandit Deendayal Petroleum University[4] devised a Smart Attendance System through CNNs for real-time face recognition. Their system utilizes a Siamese network for enhancing accuracy and employs live camera feeds for detection and identification of students while automatically updating attendance in MongoDB database. This makes it more reliable and efficient than traditional forms of taking attendance. The article "Smart Attendance Management System Using Geo-Fencing and Machine Learning" by Sai Vasantha Lakshmi, Reddy Kumaraswamy, and Edwin Manhar [5] addresses the approach of an automated attendance system that merges geo-fencing with facial recognition using machine learning. The system uses GPS and API to create virtual fencing on diverse geographic locations based on student access, to record attendance only for students in some specific locations such as classrooms. It leverages models such as CNNs, VGGFace, or ResNet, for face identification and also uses liveness detection to prevent spoofing. This system automates attendance, cuts down on manual effort, and ensures high accuracy, making it valuable for schools and organizations. On the other side, the authors also suggest some future improvements.

Overall, this review marks advances in automated attendance and student monitoring, where the deep learning and the use of CNNs improve its accuracy, efficiency, and reliability.

III. METHODOLOGY

Next-Gen Attendance System is one that will use deep learning and computer vision for automatic attendance at educational institutes through facial recognition. It is necessary a webcam, face detection, recognition algorithms, and a structured database to record attendance [6] .Here's how it all comes together and is developed and implemented.

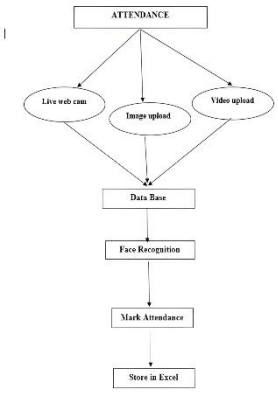

Fig.1. Flowchart of a Deep Learning-Based System for Student Monitoring and Recognition in Online Classes

Fig 1 illustrates a flowchart for automated attendance via face recognition, processing input from webcam, image, or video to enhance face detection and identification. Recognized faces are marked for attendance and logged in an Excel file for efficient tracking[13][14].

3.1 Data collection

The face recognition system needs a database of known faces, and in order for this to be structured, follows:

- A folder holds labelled facial images for each section, for example, 'sectionC/database-C'. They also take shots of the face of each individual from all angles, like 15 different directions, to extend the recognition precision.
- Images pre-processed [7] and stored using names as identifiers in a structured folder system as: '5L0-10', '5E5-2'.

3.2 Face Detection and Recognition

The system utilizes YOLOv8 for the detection of faces in real-time and a face recognition library to carry out encodings and matching. This is how it works:

- Captures live video frames through webcam, resized them and transferred them from BGR to RGB for use in the face recognition model.
- *Face Detection:* YOLOv8 detects the bounding boxes around faces in the video frame.
- *Face Encoding:* The face recognition model encodes a detected face into a 128-dimensional

encoding, and then it compares this with known face encodings in the database.

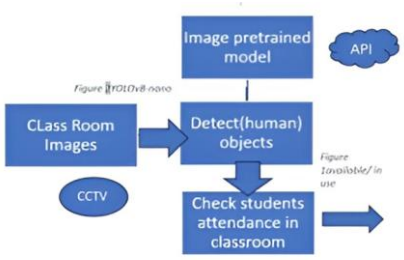

Fig.2. YOLOv8-Nano-Based System for Detecting Students and Checking Attendance in the Classroom

Fig 2 is the Student attendance system using a pre-trained YOLOv8[8] nano model captures classroom images, preprocesses them with a people detection model, and automatically identifies present students, reducing the need for manual attendance tracking[8].

3.3 Face Encoding and Matching

- *Encoding Known Faces:* Each face of the database is encoded to obtain unique features and hence retained for future reference.
- *A face matching:* if the face is detected in the video feed, then its encoding is matched against the stored encodings. If distance between the detected face and one of the stored face encodings is lower than the specified threshold, for example, 0.55, then this is classified as a match.

3.4 Attendance Marking

The system marks attendance by successful face recognition through the following steps:

- System checks whether attendance is already marked for a person whose face is detected on the same day.
- Attendance details are saved into an Excel file for each section, and the date name is something like ‘Attendance-2024-07-13.xlsx‘.
- For every record, the data includes name, date, and time. No further entry is done if a person has already recorded for that day.

3.5 Storage of Data

- Excel Files: Using pandas and ‘openpyxl‘, attendance data are stored in Excel files. Every section has a folder, and inside the folder, the attendance sheet is saved; one example can be the ‘section-C‘ folder.
- Daily Sheets: Files dated. Every day the system will produce new file, such as, section C will have its attendance file called ‘Attendance-2024-07-13.xlsx‘.
- Every individual attendee’s attendance is captured just once in a day to avoid duplication.

3.6 Real-time System Interaction

- The webcam was used for displaying live feed in the system. It draws bounding boxes around the detected faces, [9] recognized face using green box and carry name while the face could not be captured gets red box inside the bound.
- *Keyboard Input:* One may press the Ëscbutton to quit or ’R’ to enroll a new person. New captures are processed for encoding and added to the database in real time.

3.7 System Flow and Re-encoding

- Captured new faces, encoded, and saved to appropriate folder. Re-capture the face encodings to refresh the data. It puts the system under current updates.

3.8 Challenges Addressed

- Frame Stuttering: Improve performance by cropping frames to process on a lower resolution or 0.25x scale.
- Duplicate Attendance: Prevents the registration of multiple instances of the same individual for attending on the same date using Excel saved files.
- Dynamic Updates: Ability to capture and recognize new faces in real-time without having to turn off the system.

This methodology outlines the workflow and core technical components of your Next-Gen Attendance System, providing an overview of how the system was built, from face detection to attendance storage.

3.9 Model Evaluation

For model evaluation, accuracy can be determined based on the success rate of the face recognition process, while performance metrics could include the speed of processing and error rates in misidentifying or missing students. Evaluation could also involve testing different input methods [12](webcam, image, video) to ensure robustness across data formats. Additionally, storing the output in Excel provides an organized way to verify the model’s efficiency in maintaining attendance records.

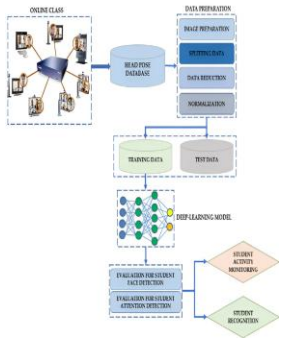

Fig.3. Attendance Management System Flowchart.

Fig 3 is the Flowchart of a deep learning setup to track student focus in online classes. Videos from students are processed, stored, and prepped, then split for training and testing. A model detects faces and tracks focus, checking accuracy in identifying faces and engagement.

IV. RESULT

4.1 System Features

Modes of Attendance Marking

- *Live Images:* Teachers can take pictures with a webcam for marking attendance.
- *Pre-recorded Videos:* Teachers can upload videos to record attendance. – *Static Images:* Teachers can mark attendance using still photos.

Face Detection Features

- *Real-time Detection:* It detects and labels faces within real-time webcam sessions using a green box around the face and ID.
- *Video-based Detection:* This is a system that reads through recorded videos to automatically recognize and tag all the faces in a classroom.

Fig.4. Student Information Form shows the interface used to collect and manage student data, ensuring streamlined attendance tracking and database management

Fig 4 Student Information Form created with Python Tkinter. This interface collects key student details—year, semester, branch, and section—streamlining attendance recording and storing data in a database for future use. Overall, using CNNs in the smart attendance system has shown to improve accuracy, reliability, speed, and the ability to handle larger data effectively.

Fig.5. Attendance can be taken through webcam, image and video options

Fig 5 is the Main interface of the Smart Attendance System offers flexible attendance options, including adding pictures to the database, using a live webcam for real-time tracking, and importing images or video. Captured data can be accessed in the attendance sheet, enabling efficient attendance management.

Visual Examples

Once the teacher selects the year and section then a marking attendance menu screen appears. They can then capture live images of the students via webcam, upload an existing video, or use a static image. And once one of the options is selected, the system utilizes it to mark attendance for the students in that section allowing the teacher flexibility to choose the method which is best suited to their needs. This project represents a face detection system that can identify and tag faces in real-time using a webcam, or from video files. In Fig 6:

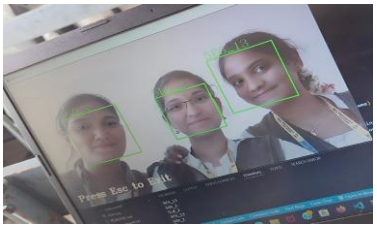

Fig.6. Face Detection System for Real-time and Webcam-based Input

Fig.7. Face Detection System for Real-time and Video-based Input

- Fig 6 shows the system detecting faces live through a webcam[15]. Every face appears highlighted by a green box and with a unique label, proving its real time ability of recognition.
- Fig 7 is the working version of the system using the pre-recorded video. In the given instance, it detects and labels several faces in the class. The system is given evidence of how well it could be used in other environments.

It further maintains attendance details. It captures face images through a webcam or video and identifies the captured faces through internal algorithms. The face is matched with particular registers and automatically records attendance along with roll number and time attended. Such details are saved in an Excel sheet for easier and error-free tracking and record without manual inputting.

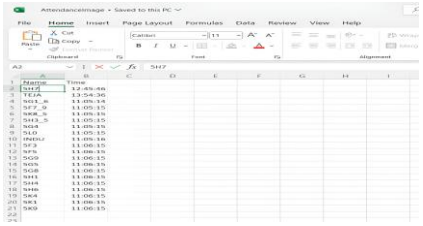

Fig.8. Attendance is stored in excel sheet as per date along with the timestamp and roll number

The image Fig 8 shows an Excel sheet for tracking attendance, with each student's roll number in the "Name" column and the recorded time in the "Time" column[15]. Attendance data is captured via a live webcam from images or video, organizing clear records of each student's attendance and time of capture.

V. CONCLUSION

The Next-Gen Attendance System is a high-tech solution developed with deep learning-based automation of attendance through facial recognition. It utilizes YOLOv8 models for in real time on face detection and facial recognition algorithms for encoding, enabling an efficient and precise identification of individuals. Its simplicity brings it in unison with the usual hardware devices like webcams, hence making it accessible and affordable. The system eliminates such manual attendance tasks, minimizes the error and fraud such as proxy attendance, and can update its database in real time, providing easy provision to accommodate new users without interrupting operations. Attendance records are kept in daily Excel sheets for each section, that enable easy access to historical data and eventual linkage with even larger data management systems. The system also prevents any form of duplication, hence accuracy is guaranteed.

This paper merely showcases how deep learning and computer vision can transform ordinary work, such as tracking attendance, into something so much different. It is lovely, helpful for schools and offices and many other organizations to have this sort of thing, and it is pretty accurate. Security could be enhanced in the future and scalability in terms of systems and massive environments and datasets.

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