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Face Recognition Based Smart Attendance System

Abha Sharma[1], Akshat Jain[2], Gaurav Shishodiya[3], Adarsh Raj Manjhi[4]
[1]Assistant Professor of ABESIT Institute of Technology, DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY GHAZIABAD (U.P.), India

[2,3,4] Student of ABES Institute of Technology, DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, GHAZIABAD (U.P.), India

Abstract- This project introduces a user-friendly Graphical User Interface (GUI) designed for optimal user convenience, imposing advanced artificial intelligence (AI) technology, specifically the YOLO V7 algorithm for real-time object detection. The focus of this application is on weapon detection within images or videos, allowing users to personalize the execution by selecting a targeted weapon category. The GUI facilitates the loading of media containing the desired category for detection, providing bounding boxes and classifying their face pixels or structures based on pre-trained object classes.

In response to the increased global impact of the Covid-19 pandemic, highlighten by refusal with social distancing and mask-wearing rules in crowded areas, this study presents an AI-based mask inspection system. Utilizing the YOLO V7 deep learning method, the system aims to enhance safety in densely populated public spaces by automating the detection of individuals not wearing masks. This proposed system employs advanced AI technology to address this critical challenge and contribute to the containment of the Covid-19 epidemic.

Furthermore, the project introduces an Automated Attendance Management System that employs face recognition technology for secure and efficient attendance marking. The system automatically identifies students upon entering the classroom, marking attendance by recognizing their faces. A predefined threshold ensures that only recognized faces stored in the database are accepted. The system incorporates global feature extraction using Principal Component Analysis (PCA) and employs feed-forward Artificial Neural Networks with the backpropagation algorithm for effective face recognition. This innovative approach offers a smarter, more secure, and time-efficient alternative to traditional attendance systems, contributing to streamlined classroom management processes.

I. INTRODUCTION

In educational settings, managing attendance remains a challenging and time-consuming task for lecturers, especially in large classrooms. Despite the importance of attendance tracking, many institutions still rely on manual or computerized spreadsheet methods, making it difficult for teachers to monitor students attendance and progress accurately. The introduction of an attendance management system aims to address these challenges, making it harder for students to skip classes without detection and providing a more efficient way for teachers to monitor attendance, ultimately enhancing the quality of education.

This project seeks to replace traditional attendance methods, reduce manipulation, and track students' arrival times. While user-friendly, the application has limitations, such as potential inaccuracies due to issues like image quality and limited datasets.

Within the realm of Deep Learning, algorithms like Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA) focus on selecting distinctive features for image analysis. Deep Learning encompasses Artificial Neural Networks (ANN) and Convolutional Neural Networks (CNN), which are especially effective for image classification and segmentation due to their feature extraction capabilities. Notably, the YOLO (You Only Look Once) algorithm, specifically YOLO V7, stands out for its high processing speed, achieving remarkable Frame per Second (FPS)

rates with high accuracy. This makes YOLO V7 particularly suitable for real-time automatic pandemic mask detection and warning systems in crowded areas.

II. LITERATURE REVIEW

The idea of finding human faces in referenced photographs or Videos is known as face detection.

The concept of face detection, identifying human faces in referenced photographs or videos, is integral to this research.

Face recognition systems, a technological advancement in this field,involve comparing face images from videos or photographs with a database of known and unknown faces.

Deep learning models, particularly convolutional neural networks (CNN), have become prevalent in recent years for face detection. Notably, the Faster R-CNN model has demonstrated remarkable results in object detection. This paper proposes a CNN-based architecture within the YOLOframework for face detection, eliminating reliance on hand-crafted features. The proposed architecture autonomously extracts features, facilitating faster real-time face detection during both training and testing phases on dual GPUs.Dr. Sabeenian R.S. developed the Face Recognition-based Attendance Management System, introducing an organized classroom attendance system through face recognition methods.

This system, using facial ID, captures attendance by identifying and recognizing faces through camera imaging. Through facial ID, the system can record involvement. Through a camera, it finds faces and then recognizes them. The system is split

into two parts: facial recognition and detection. Using the Local Binary Pattern Histogram (LBPH), the system will identify faces of students in the live-streamed video from the class and, if the recognized face is found in the database, will mark their attendance.

Salac's study inspired the development of a portable attendance system accessible from any location at any time. This innovative system allows lecturers to verify attendance using an Android smartphone, eliminating the need for traditional paper and PCs.

Students, in turn, can conveniently check their attendance information on their Android phones. The system utilizes SMS technology to \. enhance student safety and inform families about their child's attendance. Face recognition technology further contributes to accurate attendance records,with a student's face being detected and recorded as present in the database using the Android device's camera.

Additionally, the system allows for the generation of attendance reports when needed.

The complete region of face is seen as an input to the facial recognition system in a holistic way. The characteristic approach is the segmentation of facial features, such as the nose and eyes and the insertion in the face recognition method.

For face detection we should search for the algorithms like LBPH. LBPH face recognizer is an enhancement to defeat this inadequacy.

SE No.	Paper Title	Authors	Year	Name of Publisher	Technology	Method
1.	Face recognition with symmetric local graph	Mohd Fikri Azli Abdullah, Housam Khalifa Bashier, Afizan Azman	2021	Elsevier	Python	In this approach, the graph structure of a pixel in an image has better representation with its neighbour's pixel.
2.	Human face recognition using PCA based genetic algorithm	Firoz Mahmud, Md Enamul Haque, Biprodi Pal	2020	IEEE	Machine Learning	In this paper, tried to explain basic concept of face recognition using PCA based genetic algorithm Reduces the computational time.
3.	Face recognition with liveness detection using eye and mouth movement	Avinash Kumar Singh, Piyush Joshi, G.C. Nandi	2022	IEEE	Image Processing	The system has shown a good accuracy ratio. Highly Secured.
4.	A deep learning approach for face detection using YOLO	Dweepna Garg, Parth Goel, Sharnil Pandya, Amit Ganatra	2018	IEEE	Deep Learning	This paper focuses on improving the accuracy of detecting the face using the model of deep learning. The paper compares the accuracy of detecting the face in an efficient manner with respect to the traditional approach.
5.	Facial Image encryption for secure face recognition system	Eimad Abusham, Basim Ibrahim, Kashif Zia, Muhammad Rehman	2023	MDPI	Image encryption recognition process	This paper proposes an image encryption scheme to counter spoofing attacks by integrating it into the pipeline of Linear Discriminant Analysis (LDA) based face recognition.
6.	Facial recognition is the plutonium of AI	Luke Stark	2019	ACM	Artificial Intelligence	This study shows that recognizing facial recognition as plutonium-like in its hazardous effects only underscores the need to build on calls for regulation like Smith's, paying close attention to how the government regulates a hazardous substance like

						plutonium.
7.	Enhancement of patient facial recognition through deep learning algortithm: Convnet	Edeh Michael Onyema, Piyush Kumar Shukla, Surjeet Dalal, Mayuri Neeraj Mathur, Mohammed Zakariah, Basant Tiwari	2021	Hindawi	Deep Learning Algorithm(CNN)	In this study, we provide a strategy for facial expression recognition based on deep learning and CNN to overcome difficulties that commonly occur, such as low recognition accuracy and weak generalisation capacity of traditional face expression recognition algorithms. This method demonstrates the CNN model's capacity to recognise patient facial expressions more accurately
8.	The ethical application of biometric facial recognition technology	Marcus Smith, Seumas Miller	2021	Springer	AI biometrics	This article examines the rise of biometric facial recognition, current applications and legal developments, and conducts an ethical analysis of the issues that arise.

III. LITERATURE SURVEY

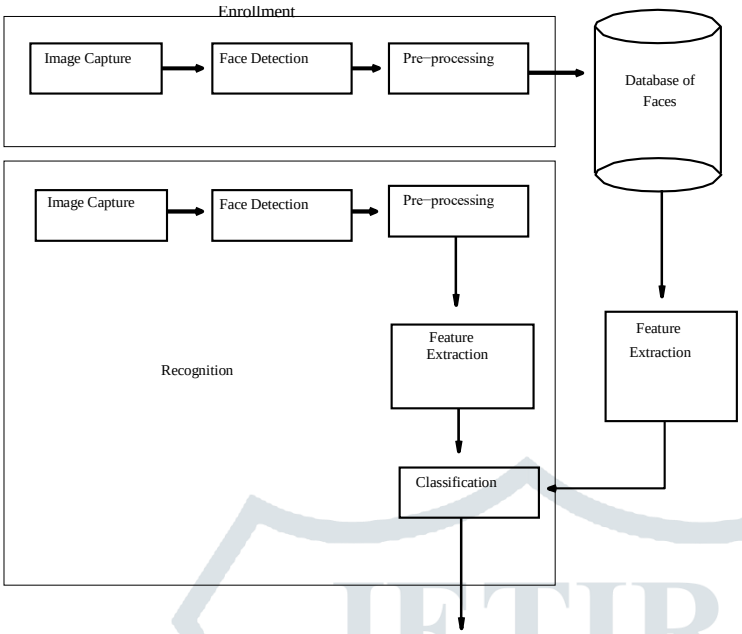
9.	YOLO V7 and Computer vision-based mask wearing system for congested public areas	Yunus Egi	2023	Journal of the Institute of Science and Technology	Artificial Intelligence	This study aims to create an Artificial Intelligence (AI) based mask inspection system with the YOLO V7 deep learning method to ensure that overcrowded public areas are protected from the Covid-19 epidemic.
10.	Real time face recognition system based on YOLO and InsightFace	Anjeana N, K.Anusudha	2023	Springer	YOLO V7 & InsightFace	This paper reveals a new real time unique face recognition network called YOLO-InsightFace that combines YOLO-V7, a cutting edge deep learning model and InsightFace, one-of-a-kind 2D & 3D face analysis python module.

IV. PROPOSED METHODOLOGY

A. ARCHITECTURE

The system architecture is as shown in Figure 1. The proposed automated attendance management system is based on face recognition algorithm. When a person enters the classroom his image is captured by the camera at the entrance. Face region is then extracted and pre-processed for further processing. As not more than two persons can enter the classroom at a time face detection algorithm has less work. Face Recognition proves to be advantageous than other systems as discussed in the Table I. When the student's face is recognized it is fed to post-processing. The System algorithm is discussed.The stages in the proposed Automated Attendance Management System are as shown in the Figure 1. Technical details of implementation of each stage are discussed in the next sections.

A. METHODOLOGY



A. Image Capture

The high resolution camera is used to capture the frontal images of the students. The Camera is mounted at a distance where the image capturing is working fine without any blurredness. The captured image is preferred to be of the size 640x480 to avoid resizing of the image in the back-end as we observed resizing may sometimes results in poor performance.

B. Face Detection

The aim is to locate and probably extract the faces from the picture to be used with the facial recognition algorithm and it also aims to reduce the pixels of the image to find the features values.

Face Recognition: The algorithm for face recognition is used to find the characteristics of a picture which best describe with face images that are already extracted, cut, scaled down and usually converted into grayscale.

Face Recognition is a biometric method for the identification of a person through a comparison digital image data and the record stored for him.

C. Pre-processing

The detected face is extracted and subjected to preprocessing. This preprocessing step involves with histogram equalization of the extracted face image and is resized to 100x100. Histogram Equalization is the most common Histogram Normalization technique. This improves the contrast of the image as it stretches the range of the intensities in an image by making it more clear.

D. Database Development

The faces detected in images are stored in the database after preprocessing and detection. As we chose biometric based system, enrollment of every individual is required. This database development process consists of image capture of every individual and extracting the bio-metric feature and later it is enhanced using pre-processing techniques and stored in the database. The dimensions of these stored images are 212* 212 pixels. In our project we have taken the images of individuals in different angles, different expressions and also in different lighting conditions. A database of 40 individuals with 10 images of each has been collected for this project.

E. Feature Extraction and Classification

The effectiveness of a Face Recognition system depends on how well it extracts features and classifies them to provide accurate results.

Feature extraction can be done using different techniques, such as feature-based or holistic techniques. These are like algorithms in machine learning that aim to recognize and categorize content.

One commonly used method for feature extraction is Principal Component Analysis (PCA). PCA reduces the dimensions of face images using eigenfaces and their corresponding projections. Instead of using all dimensions of an image, only meaningful dimensions are considered to represent the image. Mathematically, an image using PCA is represented as $\chi = WY + \mu$, where χ is the face vector, Y is the vector of eigenfaces, W is the feature vector, and μ is the average face vector. These projections are then used as features in face recognition.

Later, Fisher's Linear Discriminant Analysis (LDA) was introduced, which maximizes the ratio of between-class scatter to within-class scatter. While PCA doesn't consider discriminative information, LDA focuses on preserving discriminative details. However, LDA may struggle in poorly illuminated conditions.

Another algorithm, Local Binary Pattern Histogram (LBPH), has been proposed for face feature extraction. It emphasizes face properties to create an intermediate image, using the theory of sliding windows based on radius and neighboring parameters.

In general, features extracted from PCA and LDA are often subjected to distance classifiers. The system calculates the distance between the features of a probe image and the features of trained images. If the distance is less than a threshold, the probe image is recognized. This is usually done using the Euclidean distance as a classifier to find the best match from the input test images.

To enhance classification, machine learning algorithms can be employed instead of relying solely on the Euclidean distance. This approach

can lead to better and more accurate recognition results.

F. Post-processing

In this proposed system, after recognizing the faces of the Students , the names are updated into an excel sheet. The system is also equipped with the facility of sending a notification mail to the absentees when that facility is enabled.

V.CONCLUSION

The proposed automated attendance system using face recognition is an excellent system for recording student attendance in a classroom. This system also helps to eliminate the possibility of proxies and phoney attendance. A great number of biometric systems are available in today's society. However, because of its great accuracy and low human intervention, facial recognition proves to be a viable solution. This system is intended to provide a high level of security. As a result, a very efficient attendance system for classroom attendance must be designed, one that can recognize faces at once.
This project addresses crucial aspects of security, safety during the pandemic, and efficient attendance management through the integration of advanced AI technologies. The combination of real time object detection, mask inspection, and automated attendance systems contributes to a comprehensive and impactful solution for various domains.This method is fast and convenient in identifying a person.

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