

AI-Based Smart Office Entry and College Attendance System Using Face Recognition

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Abstract

The recognition of the face has been proven to be amongst the best biometrics for security improvement and automatic attendance system. Manual attendance register and RFID cards, which are the traditional methods of attendance recording, are time-consuming, error-prone and vulnerable to proxy attendance. In this respect this paper proposes an "AI Based Smart Office Entry and College Attendance System Using Face Recognition" which merges the access control and the attendance system automation. In particular, the proposed system utilizes a CNN face recognition system along with the YOLO object detector algorithm for fast and reliable face detection in real time. Once a face is matched to a user in the database, access is allowed and attendance is entered into a 'master' set of records.

Keywords: *Face Recognition, Artificial Intelligence, Convolutional Neural Network (CNN), YOLO, Smart Attendance System, Access Control, Computer Vision, Deep Learning.*

Introduction

Face recognition is emerging as one of the effective technologies for accessing the identity of a person in the field of identity verification and access control, thanks to the development of technologies like Artificial Intelligence and Computer Vision. Although traditional attendance systems (register, ID card, fingerprint biometric systems) are still employed in the educational institutions and organizations, they are time consuming, physical and at high risk of proxy attendance and security issues. Attendance system that is intelligent and automatic can resolve the problems above by identifying people with their facial features in no need of physical contact. The literatures recently have shown great advances in face recognition using deep learning techniques. The models derived from CNN shows more accuracy and robustness than the traditional approach like PCA, LDA, LBPH and Eigenface. Besides, the accurate and fast face detection models like real-time object detection models, YOLOv4 and YOLOv7 have very good results. Presently, attendance systems focus mainly on the classroom attendance issue and few integrate office access control and classroom attendance with a single system.

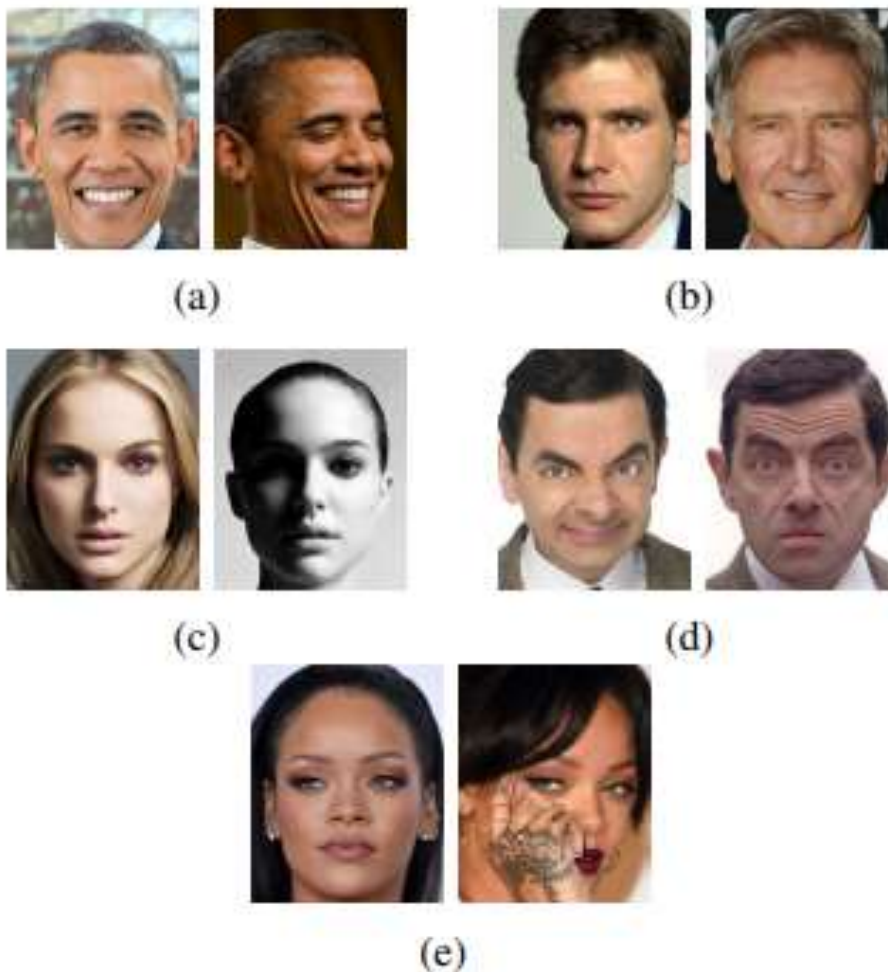


Figure 1. shows typical variations found in faces in-the-wild. (a) Head pose. (b) Age. (c) Illumination. (d) Facial expression. (e) Occlusion. (Trigueros, 2018)

To overcome these problems, in this paper, an AI-Based Smart Office Entry and College Attendance System Using Face Recognition is proposed. The proposed system includes face detection using YOLO method and face recognition on the basis of CNN which enable the secure entry to the office and the automatic attendance system. It provides an accurate, efficient, non-contact attendance solution, reduces the need for manual attendance and enhances security. The system is a real-time system and can be well applied in educational institutes or in office.

Literature Review

The literature was reviewed systematically to analyze the face recognition-based student attendance system, using 30 articles (Budiman, 2023). The review was done between the conventional algorithms (LBPH, Eigenface, Fisherface, PCA) and CNN deep learning model. The result demonstrated CNN model resulted in the highest accuracy (99%) for recognition and LBPH obtained the accuracy (92%). The results of this study indicate that CNNs used for face recognition have a higher accuracy, robustness and reliability in attendance systems. This is applicable to the proposed AI-Based Smart Office Entry and College Attendance System Using Face Recognition, where the CNN based face recognition system would be utilised to enhance the security of offices and automate the attendance system in different scenarios.

In the work (Trigueros, 2018), the author discussed the advancement of face recognition technologies from the conventional algorithms such as PCA, LDA and LBP to more recent algorithms like CNN, DeepFace and ResNet. The results show that CNN-based algorithm has a higher accuracy and robustness in different lighting environments, facial expressions, and head pose angles compared to the traditional algorithm. This is also supported as evidenced by the case study of proposed AI-Based Smart Office Entry and College Attendance System Using Face Recognition algorithm for office entry, attendance and face recognition in the college.

Face recognition system, called AttenFace, was proposed by (Rao, 2022) which can be used for automating the process of student attendance. This system is based on taking images at a 10-minute interval instead of watching the videos continuously to reduce the amount of calculation without losing the students' attention in the classroom. YOLO, Haar Cascade, FaceNet and VGGFace2 are used to detect and recognize faces in this system. In addition, AttenFace provides an online portal that can be accessed by students, teachers and administration to track attendance information. This paper can also be applied to the recommended face recognition based smart office entry & college attendance system, which will enhance the security level of the smart office by combining the functions of office entry verification & automated attendance because of deep learning.

Shriwastav (2016) explained about the face recognition based attendance system that tries to automate attendance of students in classrooms. To make attendance checking more efficient by eliminating the need for manual attendance taking, the authors proposed using face detection and recognition and continuous monitoring. This system has been designed on MATLAB software and its advantages are; better security, lesser proxy attendance and effective attendance checking. However, the authors did note that there could be differences in results for recognition due to various lighting conditions, facial poses, and image qualities used. As a result, further improvements of the recognition algorithms are needed. As proposed in the introduction of this paper, AI-Based Smart Office Entry and College Attendance System Using Face Recognition is an addition to the existing face recognition system and adopts deep learning technology it is compatible with this article.

A new object detection model, namely YOLOv7 (Wang, 2023) has been proposed, which has improved detection accuracy and real-time speed. Various modifications of the structure in this model have been brought about which aid in the better and speedier detection of objects, without increasing the amount of computation. The model has achieved an AP of 56.8% on MS COCO dataset and outperforms the previous models such as YOLOv5, YOLOX, and DETR. Since the speed and accuracy of YOLOv7 are excellent, it is suitable for the computer vision system. This study provides a backing to the proposed AI-Based Smart Office Entry and College Attendance System Using Face Recognition because of the ability of YOLOv7 to perform efficient face detection.

To achieve reasonable accuracy and speed, (Bochkovskiy, 2020) proposed a real-time object detection model, named YOLOv4. The model involves several kinds of optimization methods and improvements in architecture to improve the detection performance while still operating real-time. When tested on the MS COCO dataset, the YOLOv4 model can detect 43.5% Average Precision (AP) with an average of 65 images per second (IPS) on the x86_64 architecture. The research showed that YOLOv4 can be applied to the objects of fast and accurate detection. The results validate the proposed AI-Based Smart Office Entry and College Attendance System Using Face Recognition, where YOLOv4 can be applied to detect faces efficiently for real-time face recognition, which would ensure the secure entry to the office room and automated attendance system.

Table 1: - shows the comparison of previous studies.

Ref. No.	Dataset	Techniques	Algorithms	Accuracy
1	Review of 30 face recognition studies	Automated Face Recognition for Student Attendance	LBPH, CNN (ResNet-50), Eigenface, Fisherface, PCA	92%
2	Multiple public face recognition datasets (review paper; no single dataset)	Face Recognition	PCA, LDA, LBP, CNN, DeepFace, ResNet	-
3	Student face images captured from classroom cameras (custom dataset)	Real-time Face Recognition and Automated Attendance System	YOLO (Object Detection), Haar Cascade (Face Detection), FaceNet (Face Recognition), VGGFace2 (Training Dataset)	-

Ref. No.	Dataset	Techniques	Algorithms	Accuracy
4	Classroom face images (captured using camera;	Face Recognition- based Attendance System	Face Detection and Face Recognition (MATLAB-based Biometric System)	-
5	MS COCO	Real-Time Object Detection	YOLOv7	56.8%
6	MS COCO	Real-Time Object Detection	YOLOv7	43.5%

Proposed System Architecture

The proposed system will be comprised of various modules such as:

- **Face Detection:** This module is used as the 'eyes' of the system. The module is composed of an intelligent AI model called YOLO which will identify faces from the real-time video feeds of cameras. Its goal is to find the exact position of faces in the feed.
- **Face Recognition:** After the detection of face, this module works. The module consists of a sophisticated AI model which is CNN (such as ResNet-50). It examines the special characteristics of the faces detected. Then it compares the features, to determine if the face is one of the pre-recorded individuals.
- **Database:** This is the 'memory' of the system that holds the records of all the registered persons as well as their facial images, names, ids and level of permissions. Most importantly, it keeps a history of all occurrences of at the office.
- **Access Control:** This module acts as the gatekeeper. It will decide on access based on the output of the facial recognition component.
- **Attendance Recording Module:** This component will run automatically. Any person identified is automatically recorded with timings of entry/exit.

Methodology

The research methodology that is used in conducting research is as follows:

1. **Data Collection:** The images of the faces were taken from students and staff members in the office. The data set was pre-processed to increase the robustness by changing lighting conditions, poses, expressions, and occlusions in the data set.
2. **Model Training:**
 - **Face Detection:** YOLO model has been trained with a large collection of faces to make it more accurate and faster to detect the face bounding boxes.
 - **Face Recognition:** The images were captured of the face which were used to train the CNN model.

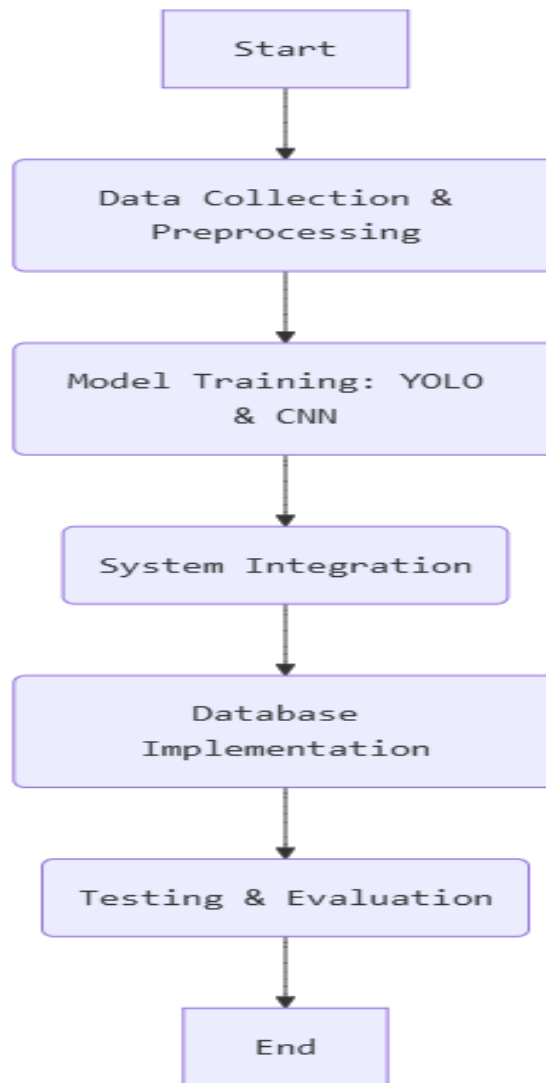


Figure 2: Shows the flow-diagram of the research methodology

3. **System Integration:** After their training, the two models YOLO and CNN were integrated into an efficient system, wherein the output of the YOLO algorithm (i.e. face detection) was used as an input to the CNN algorithm (i.e. face recognition).
4. **Database Implementation:** A database was created to store the data related to the users' profile and attendance. The database has been connected with the recognition system.
5. **Testing and Evaluation:** The developed system has been tested with another set of face images both in laboratory and in the office and college for actual field testing of the system.

Objectives of the Research

Overall, the proposed work is expected to lead the design and testing of a completely new AI system, significantly better than the classical methods of monitoring access to the office and class attendance.

To put it more simply, the efficiency of the new system will be assessed in terms of its ability to:

- Identify faces in real-time, even in difficult lighting and/or when the person being identified is in different positions in the photo.
- Provide a convenient and safe access to the office.
- Auto-tick off attendance to ensure that other staff members can't be seen as taking attendance for a student.
- Operates quickly, with no waiting in line.
- Ensure the security of personal and attendance sensitive data.

Conclusion and Future Scope

The attendance system in the college with the help of AI based smart office entry and face recognition is intelligent and feasible solution to improve the security and attendance management system. Through the integration of YOLO, which is used for face detection in real-time with CNN, face recognition takes place, making sure that the right people get recognized and their attendance recorded without any need for physical contact. This approach will help save on manual work and inaccuracies, and eliminate issues such as proxy attendance. Besides, this system makes the offices and colleges more secure as only the registered users can access to the offices. It can be further developed by optimizing the system for challenging scenarios such as low illumination, facial expression variations and faces covered by objects and/or masks. Future research directions may involve applying state-of-the-art deep learning architectures like Vision Transformers, along with developing lighter neural networks, for achieving high recognition rates in real-time. There are additional ways to enhance the system that can involve having multiple camera settings, visitor tracking and cloud-based attendance management systems for large businesses and schools. Also, the system can be connected to mobile applications, access control devices and smart building technologies via Internet of Things (IoT) to enable centralized management and efficient operation.

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