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Original paper

Facial Recognition Based Attendance Management System Implementation: A Deep Learning Approach for the Auchi Polytechnic Institution, Edo State

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ABSTRACT: Taking attendance in a large class can be time-consuming and tiresome, wasting important instructional time. To address this issue, this research introduces the Auchi Poly-Convolutional Neural Network (AP-CNN), a deep learning-based automatic attendance system. The system is image recognition-based, with two key processes: face detection and face recognition. The system's goal is to recognize students in the School of Information and Communication Technology (ICT), tag them with their names, and then match those names with faces in a database using real-time video feeds from a designated learning environment. According to the study's findings, the small student dataset had a 96% accuracy rate. Using real-time attendance records of the students present, this technology can help instructors manage efficient classes. It can also be useful for monitoring student participation, spotting absenteeism trends, and comprehending the class's overall attendance. The information can also be utilized to identify any attendance-related problems and to modify the class schedule or teaching strategies as needed.

Keywords: Attendance management system, deep learning, face recognition, algorithm
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INTRODUCTION

When examining the total number of students that participated or were present for the class to learn from the educator, attendance is regarded an important component, making it a crucial part of the class. The traditional method of documenting student attendance has been a serious issue in developing countries such as Nigeria. These concerns range from manual attendance gathering via passing sheets of paper to some students signing on proxies and the distraction it provides to both the professor and students at the start or finish of the lecture(s) (Salim et al., 2018). When working with larger classes, this strategy is also time-consuming, but it may be more dependable when producing a list. As a result, automation of the recording process will supplant the traditional way. This procedure will save time, give security feeds, and prevent attendance fraud. Biometric Recognition is defined as the data analysis of people's unique behaviour and physical traits, such as iris, voice, retina, fingerprint, face features, and others, that are primarily utilized for identification and security purposes. Face detection is recognized as the safest and most exact approach (Shetty and Rebeiro, 2021). Facial recognition technology may identify persons through ID verification services by recognizing their faces using a facial database and video feeds (Budiman et al., 2023). The use of deep learning in the deployment of facial recognition systems has resulted in considerable improvements in terms of the speed and accuracy with

which faces are detected (Sun et al., 2015). As a result, utilizing Auchi Polytechnic Nigeria as a case study, this research suggested the Auchi Poly-Convolutional Neural Network (AP-CNN) method for the construction of the facial recognition attendance system. This technology will bridge the attendance collection gap between student and lecturer, ensuring a steady flow (uninterrupted lecture session) of learning during classes. The paper is divided into four parts. The first section covers a literature review of existing facial recognition systems. The methodology section delves into the details of the improved AP-CNN algorithm on the section. The results section examines the outcomes of implementing the AP-CNN, and the final section summarizes the research.

LITERATURE REVIEW

The literature review section is divided into two parts. The first part covers the selection of authors' datasets created for facial Recognition, and the second part examines the implemented Convolutional Neural Networks (CNNs) algorithms.

Datasets

To achieve high prediction accuracy, deep learning models require a large and complicated training dataset. Cornett et al. established the Biometric Recognition and Identification at Altitude and Range (BRIAR) programme to create a unique dataset that will aid in the development of algorithms for difficult situations such as person detection and tracking, image enhancement, and atmospheric turbulence mitigation (2023). The dataset contains over 350,000 still photographs and over 1,300 hours of video of around 1,000 people. This study intends to develop algorithms that can accurately distinguish humans at distances of up to 1,000 metres.

The resulting dataset can be used for numerous investigations, including face and WB recognition, reidentification, augmentation, and detection. Due to the COVID-19 pandemic, which led in widespread use of face masks and the introduction of isolation regulations by governments' worldwide, human connection was severely restricted in 2019. Wang et al. generated three datasets: the Masked Face Detection Dataset (MFDD), the Real-world Masked Face Recognition Dataset (RMFRD), and the Simulated Masked Face Recognition Dataset (SMFRD) (2020).

A cutting-edge algorithm was also developed and employed for contactless facial verification in community access, campus administration, and enterprise resuming scenarios. The algorithm enhanced scientific and technological capabilities for coronavirus pandemic prevention and management, as well as industry production restart.

Deep Learning Algorithm

In recent years, CNN techniques have garnered much interest in face recognition. This section briefly reviews these CNNs algorithms. Convolutional neural networks (CNNs) are effective in recognizing faces, and a recent study by Hu et al. (2015) investigates why this is true and how to design a "good" architecture for CNN-based face recognition systems (CNNFRS). The authors conducted a thorough study of CNNFRS using the public database LFW (Labeled Faces in the Wild). They then propose three CNN architectures; the first designs reported using LFW data. They evaluate the impact of various implementation approaches and identify multiple useful features of CNNFRS. The dimensionality of the learned features can be greatly reduced while maintaining face recognition accuracy. They also evaluate a traditional metric learning strategy that employs CNN-learned properties. The tests reveal that metric learning and fusing many CNNs are critical components for good CNNFRS performance. AlBdairi et al. (2022) present a new classification approach for assessing people's ethnicity based on facial traits utilizing Machine Learning (ML) and Deep Learning (DL) tools in their study. The strategy developed by AlBdairi et al. (2022) was based on a Deep Convolutional Neural Network (DCNN) model and outperformed current methods. Nevertheless, because to the low compute power provided by contemporary central processing units, the DCNN-based face recognition system necessitates the use of specialist high-performance computing (HPC) gear (CPUs). Field-programmable gate arrays (FPGAs) were examined in the authors' effort to improve network efficiency. Using an image dataset of 3141 photos of residents from three different nations, the performance of the new DCNN-based approach utilizing FPGAs is compared to that using graphics processing units (GPUs). According to the results, the suggested DCNN model based on FPGAs obtained an accuracy level of 96.9 percent and an F1 score of 94.6 percent while consuming an acceptable amount of energy and hardware resources. Salim et al. (2018) build a university classroom automated attendance system based on two deep learning approaches: multi-task cascade convolution neural network (MTCNN) face detection and Center-Face face identification. Salim et al. (2018) found that their facial recognition model was 98.87% accurate, with an actual positive rate of less than 1/1000 and a false positive rate of 93.7% on LFW. Pei et al. (2017) use CNN for their attendance management system and report an increase in recognition rate, resulting in more dependable and accurate attendance. In Kadambari et al. (2019) study, automatic attendance management replaced the university's traditional system. Face detection and recognition are the two stages of the facial recognition system. It compared Viola-Jones and dlib to Histogram Oriented Gradients (HOG) and CNN and discovered that

CNN is more accurate and preferable. The system takes an image, detects faces, compares them to a database, and records attendance in an excel sheet. We employ deep learning techniques to train the recognize faces in order to solve the school's attendance problem. This network recognizes faces well because it can learn the distinctive aspects of faces automatically. Subsequent sections of the study will go over the specific facts and methodologies used.

METHODOLOGY

The facial recognition attendance system is broken into two stages: face detection and face recognition. The camera was utilized to implement the Face Detection stage, which used Turk and Pentland's Viola-Jones algorithm (1991). The Haar classifier is a machine learning algorithm that extracts information from images using Haar features. The Haar features and Adaboost are used in the Viola-Jones algorithm. While for Face Recognition, we used face recognition 1.3.0. It is a python library built using dlib's state-of-the-art facial recognition pattern that has recorded an accuracy of 99.38% on the Labeled Faces in the Wild benchmark. The algorithm for the proposed system implementation can be seen below:

Enrollment of students

The students from the department of computer science were used for this study.

Figure 1: *Examples of data augmentation.*

The Thirty-five (35) National Diploma (ND) students were captured in the database with their names and matriculation numbers. We took 21 different images of each student using an external live webcam feed, and these images are stored in a folder carrying the individual name and matriculation number. This will serve as the dataset for the deep learning training. Upon importing the data into the network, we employed two data augmentation methods: rotation and scaling. Each image was subjected to a random rotation between -90 to 90 degrees and random scaling within 1 to 2. These data augmentation techniques helped increase the training data's diversity and improve the network's performance. Figure 1 illustrates a sample of the data augmentation.

Training the model

This network is pre-trained using a substantial dataset and produces highly accurate, almost unique 128-dimensional vectors for a specific face, provided that the input images are adequately cropped and aligned. The network requires input images to be of size 160 X 160 X 3. The model can also process colored images.

Marking attendance

The second neural network (face recognition) is employed for the classification task. It features a dense architecture that takes a 128-dimensional vector as input and outputs the probability that the face belongs to one of the students.

Store attendance to the database

A counter in the database is increased once the attendance has been recorded via real-time face recognition. Additionally, it creates a CSV file with the attendance records of the students' names after completing the attendance task.

RESULTA AND DISCUSSION

The proposed deep learning model was implemented using the python programming language through the Jupyter Notebook framework. Python has been widely used for machine learning and deep learning application; for this study, the open CV, numpy, and face-recognition 1.3.0 libraries were installed and imported to the python script.

For this proposed system, three Python scripts were created. The first script collects selfies by extracting student face frames from a video recording. These selfies are trained in the second script, which then stores them in a classifier that will later be used to identify the faces of the students. By comparing the input face with the trained data using the classifier, the finished program can identify the input face. Selfies can be collected by creating a video and determining the "Region of Interest" (ROI) or the area of the face. The ROI is next clipped, encoded, and saved as strings in a text file. Each string line represents a student's face. (Figure 2) displays samples of images of the students.

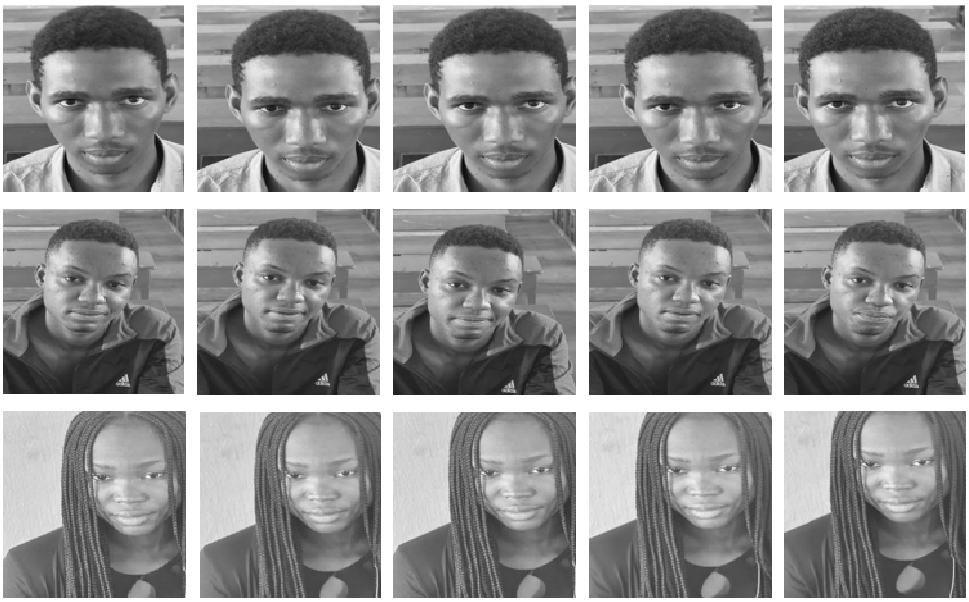

Figure 2: *Sample images of the students*

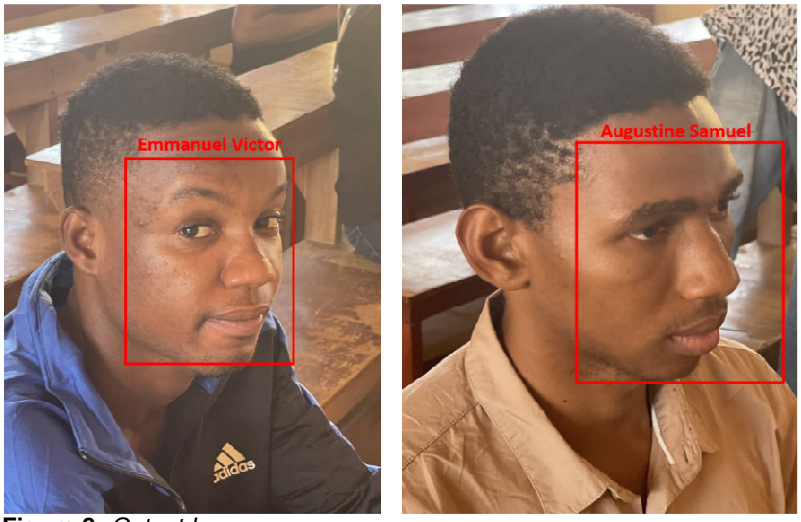

Figure 3: *Output Images*

Recognition result

The image in Figure 3 summarizes the results of the facial recognition attendance system for three students. Although each student has more than twenty-one (21) trained photos, only five are displayed in the image. Figure 3 demonstrates the performance of the face recognition process. It is worth mentioning that if a student has not enrolled for the class, the system will not be able to identify them and will instead show "Unknown individual," as depicted in (Figure 4). The system was found to have an accuracy range of between 85% and 95% in normal lighting conditions. A test scenario with challenging lighting conditions was also conducted, and the system achieved an accuracy range of between 70% and 80% in this scenario. These results highlight the significance of lighting conditions in determining the

Figure 4:*Unregistered image*

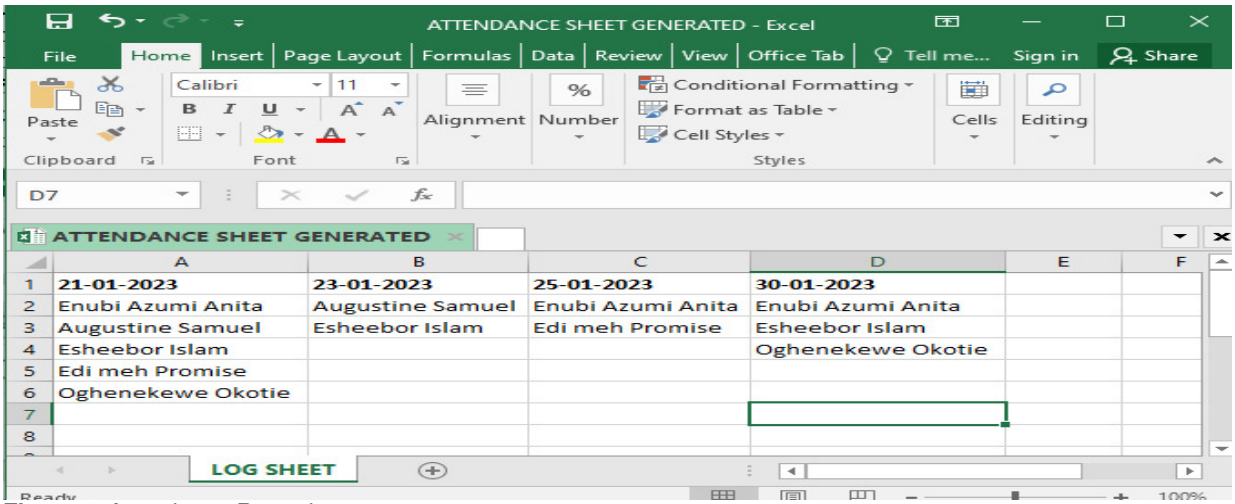

Figure 5:*Attendance Record*

performance of facial recognition systems.

Attendance Result

Figure 5 shows a visual representation of the attendance records captured using excel. It displays the names of the students and their attendance status and can be used by teachers to keep track of their student's attendance throughout the course. It is a helpful tool for monitoring student participation, identifying patterns of absenteeism, and understanding the overall attendance of the class. The data can be analyzed to identify any issues related to attendance and used to make necessary adjustments to the class schedule or teaching methods. Overall, the attendance records captured using excel provides a valuable resource for teachers to monitor and improve student engagement in their classes.

Conclusion and future work

In this study, we presented a facial recognition-based attendance system for the Auchi Polytechnic Institute, with the goal of automating and streamlining the attendance process. Deep learning techniques are used in the system, which employs a Convolutional Neural Network (CNN) for face identification and recognition. Our trials show that the system can accurately recognize and register the presence of pupils in the classroom. The system can capture a picture, detect faces, match them to a database, and finally record attendance in an excel sheet. Unfortunately, the scope of this study is limited and focused on a small number of students; the next step for this system is to increase its deployment on a bigger scale and test its performance on a greater number of students. Furthermore, we will look into the incorporation of emotion recognition as a feedback analysis for student-level concentration in class. With this new capability, the system may be able to provide useful insights regarding student interest and participation, which can then be used to improve the entire learning experience. Therefore, our proposed facial recognition-based attendance system appears to be a potential alternative for automating the attendance process while also offering significant information about student interest and participation. We are excited to continue researching and developing the system in order to make it more robust and practical for real-world applications.

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REFERENCES

AlBdairi, A. J. A., Xiao, Z., Alkhayyat, A., Humaidi, A. J., Fadhel, M. A., Taher, B. H., Alzubaidi, L., Santamaría, J., AND Al-Shamma, O. (2022). Face Recognition Based on Deep Learning and FPGA for Ethnicity Identification. Applied Sciences, 12(5), Article 5. https://doi.org/10.3390/app12052605

Budiman, A., Yaputera, R. A., Achmad, S., and Kurniawan, A. (2023). Student attendance with face recognition (LBPH or CNN): Systematic literature review. Procedia Computer Science, 216, 31–38.

Cornett, D., Brogan, J., Barber, N., Aykac, D., Baird, S., Burchfield, N., Dukes, C., Duncan, A., Ferrell, R., and Goddard, J. (2023). Expanding Accurate Person Recognition to New Altitudes and Ranges: The BRIAR Dataset. Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision, 593–602.

Hu, G., Yang, Y., Yi, D., Kittler, J., Christmas, W., Li, S. Z., and Hospedales, T. (2015). When face recognition meets with deep learning: An evaluation of convolutional neural networks for face recognition. Proceedings of the IEEE International Conference on Computer Vision Workshops, 142–150.

Kadambari, S., Prabhu, G., Mistry, D., and Khanore, M. (2019). Automation of attendance system using facial recognition. 2019 International Conference on Advances in Computing, Communication and Control (ICAC3), 1–5.

Pei, Z., Shang, H., Su, Y., Ma, M., and Peng, Y. (2017). Convolutional

neural networks for class attendance. 2017 13th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD), 809–814.
Salim, O. A. R., Olanrewaju, R. F., and Balogun, W. A. (2018). Class attendance management system using face recognition. 2018 7th International Conference on Computer and Communication Engineering (ICCCE), 93–98.
Shetty, A. B., and Rebeiro, J. (2021). Facial recognition using Haar cascade and LBP classifiers. Global Transitions Proceedings, 2(2), 330–335.
Sun, Y., Liang, D., Wang, X., AND Tang, X. (2015). Deepid3: Face recognition with very deep neural networks. ArXiv Preprint ArXiv:1502.00873.
Turk, M., and Pentland, A. (1991). Eigenfaces for recognition. Journal of Cognitive Neuroscience, 3(1), 71–86.
Wang, Z., Wang, G., Huang, B., Xiong, Z., Hong, Q., Wu, H., Yi, P., Jiang, K., Wang, N., and Pei, Y. (2020). Masked face recognition dataset and application. ArXiv Preprint ArXiv:2003.09093.