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A Comparative Study of Face Recognition Models for Smart Attendance

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Abstract: ***The Smart Attendance Monitoring System using Face Recognition is a project that aims to automate the process of tracking attendance in an organization using facial recognition technology. The system uses a camera to capture images of individuals, which are then compared to a database of pre-registered faces. The system recognizes the individuals and records their attendance automatically. The project involves several stages, including data collection, face detection etc. The system uses machine learning algorithms to analyze the images and identify the individuals accurately. The system can also generate reports and statistics, allowing the organization to monitor attendance trends and identify areas for improvement.***
Overall, the Smart Attendance Monitoring System using Face Recognition is an innovative solution that streamlines attendance tracking processes and enhances organizational efficiency

I. INTRODUCTION

The concept of attendance monitoring has been around for centuries, with organizations and educational institutions using different methods to keep track of their employees or students.
However, the traditional manual systems of attendance tracking are often time-consuming and prone to errors, resulting in inaccuracies and inefficiencies. With the advent of AI and ML technologies, attendance monitoring has undergone a significant transformation, resulting in the development of smart attendance monitoring systems.
These systems use various AI/ML techniques such as computer vision, facial recognition, and machine learning algorithms to automate the attendance tracking process. The systems can capture attendance data in real-time without requiring any physical contact, making them ideal for organizations seeking to adhere to social distancing protocols. For instance, facial recognition technology can be used to identify individuals as they enter a room and record their attendance.

II. LITERATURE REVIEW

Table I summarizes the comparative performance of various deep learning techniques used for TB classification. The table provides a summary of the title and authors of the paper, the dataset used, the methodology used, and the accuracy of the models. The comparative analysis presented in this review highlights the relative methodologies and their results of each deep learning approach and provides insights into their performance on different TB datasets.

TABLE I. COMPARATIVE ANALYSIS

Title	**Dataset & preprocessing**	**Methodology**	**Result**
Sawhney, S., Kacker, K., Jain, S., Singh, S. N., & Garg, R. (2019). Real-Time Smart Attendance System using Face Recognition Techniques. 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence)	The paper proposes a real-time smart attendance system using face recognition techniques. The authors did not use any specific dataset and used Local Binary Pattern (LBP) algorithm for feature extraction and Principal Component Analysis (PCA) for dimensionality reduction. They achieved a recognition rate of 93% using Support Vector Machine (SVM) for classification.	The authors used Local Binary Pattern (LBP) algorithm for feature extraction, Principal Component Analysis (PCA) for dimensionality reduction, and Support Vector Machine (SVM) for classification. They achieved a recognition rate of 93% for their proposed real-time smart attendance system using face recognition techniques.	Accuracy = 93.0%.

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Khan, S., Akram, A., & Usman, N. (2020). Real Time Automatic Attendance System for Face Recognition Using Face API and OpenCV. Wireless Personal Communications, 113(1), 469–480	The paper proposes a Real Time Automatic Attendance System for Face Recognition using Face API and OpenCV. The authors did not use any specific dataset and used OpenCV library for face detection, Local Binary Patterns (LBP) for feature extraction, Eigenfaces for dimensionality reduction, and k-nearest neighbors (KNN) algorithm for classification. Their system achieved a recognition rate of 96.15%.	The authors used OpenCV for face detection, Local Binary Patterns (LBP) for feature extraction, Eigenfaces for dimensionality reduction, and k-nearest neighbors (KNN) for classification. Their proposed Real Time Automatic Attendance System for Face Recognition using Face API and OpenCV achieved a recognition rate of 96.15%.	Accuracy of 96.15%
Kakarla, S., Gangula, P., Rahul, M. S., Singh, C. S. C., & Sarma, T. H. (2020). Smart Attendance Management System Based on Face Recognition Using CNN. 2020 IEEE-HYDCON	Kakarla et al. proposed a Smart Attendance Management System based on Face Recognition using Convolutional Neural Networks (CNN). They used the Indian Movie Face Database (IMFDB) and the Extended Yale Face Database B (EYB) for training and testing their CNN model. Preprocessing involved detecting and cropping faces using OpenCV and resizing to a fixed size. Transfer learning with pre-trained VGG16 network was used for feature extraction and fine-tuning CNN for classification. Their system achieved 93.1% accuracy, demonstrating the effectiveness of their approach for attendance management systems.	The methodology of Kakarla et al. involves using the Indian Movie Face Database (IMFDB) and the Extended Yale Face Database B (EYB) for training and testing their CNN model. They preprocess the data by detecting and cropping faces using OpenCV and resizing to a fixed size. They use transfer learning with pre-trained VGG16 network for feature extraction and fine-tuning CNN for classification. Their system achieved 93.1% accuracy for attendance management systems.	Accuracy = 93.1%
Rekha, E., & Ramaprasad, P. (2017). An efficient automated attendance management system based on Eigen Face recognition. 2017 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence	Rekha and Ramaprasad used the AT&T face database for their Eigenface recognition model. They preprocess the data by converting the images to grayscale, resizing, and normalizing pixel values. They use PCA for dimensionality reduction and Euclidean distance-based classification for attendance management. Their system achieved 94% accuracy.	Rekha and Ramaprasad used Eigenface recognition model with PCA for dimensionality reduction and Euclidean distance-based classification for attendance management. The AT&T face database was used after preprocessing the images to grayscale, resize and normalize the pixel values. Their system achieved an accuracy of 94%.	Accuracy = 94%
Poornima, S., Sripriya, N., Vijayalakshmi, B., & Vishnupriya, P. (2017). Attendance monitoring system using facial recognition with audio output and gender classification. 2017 International Conference on Computer, Communication and Signal Processing (ICCCSP)	The paper did not mention any specific dataset used for the facial recognition model. However, they did mention using OpenCV library for face detection and recognition. No additional preprocessing steps were mentioned for the facial recognition algorithm.	The authors used OpenCV and Python programming language to implement their system, which first detects and aligns faces, then extracts facial features using Local Binary Patterns (LBP) and performs classification using Support Vector Machines (SVM). They also added gender classification using Fisherfaces, and an audio output feature for visually impaired users.	Accuracy = 71.79%
Prangchumpol, D. (2019). Face Recognition for Attendance Management System Using Multiple Sensors. Journal of Physics:	The paper did not mention any specific dataset or preprocessing done as it focused on the use of multiple sensors for face recognition in an attendance management system.	The study proposes a face recognition-based attendance management system using multiple sensors, namely a camera and a thermal sensor. The system uses a Haar feature-based cascade classifier to detect faces and OpenCV's Local Binary Patterns Histograms (LBPH) algorithm for face recognition.	Accuracy = 66.31%

Conference Series, 1335, 012011		The captured face images are preprocessed by cropping and resizing to a fixed size. The thermal sensor is used to detect the presence of a human in the image. The attendance is marked based on the detected faces, and the data is stored in a database.	
Bhattacharya, S., Nainala, G. S., Das, P., & Routray, A. (2018). Smart Attendance Monitoring System (SAMS): A Face Recognition Based Attendance System for Classroom Environment. 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT)	The authors of the paper on Smart Attendance Monitoring System (SAMS) used the Indian Statistical Institute Facial Expression dataset (ISI-FED) to train and test their face recognition model. They employed OpenCV and Local Binary Pattern (LBP) algorithm for feature extraction, and Support Vector Machine (SVM) for classification. The Haar Cascade Classifier was used to detect faces in real-time videos. Their proposed system achieved an accuracy of 95.6% on the ISI-FED dataset, demonstrating the effectiveness of the face recognition model.	The authors used the Indian Statistical Institute Facial Expression dataset (ISI-FED) to train and test their face recognition model. They employed OpenCV and Local Binary Pattern (LBP) algorithm for feature extraction, and Support Vector Machine (SVM) for classification. The Haar Cascade Classifier was used to detect faces in real-time videos.	An accuracy of 95.6
Arsenovic, M., Sladojevic, S., Anderla, A., & Stefanovic, D. (2017). FaceTime — Deep learning based face recognition attendance system. 2017 IEEE 15th International Symposium on Intelligent Systems and Informatics (SISY).	The paper does not mention the specific dataset used, but the authors mention that they collected their own dataset consisting of 1080 images of 30 individuals. As for preprocessing, the authors mention that they used OpenCV for face detection and alignment, and the images were resized to 128x128 pixels. They also performed data augmentation by rotating the images by small angles to improve the performance of the deep learning model.	The authors used a deep learning-based approach for face recognition and attendance management, with a dataset consisting of face images captured by a camera. The preprocessing steps included face detection, alignment, and normalization. They used a Convolutional Neural Network (CNN) for feature extraction and classification, and implemented their system on a Raspberry Pi platform. The system was evaluated in terms of accuracy and computational efficiency.	Accuracy achieved was greater than 80%
Akay, E. O., Canbek, K. O., & Oniz, Y. (2020). Automated Student Attendance System Using Face Recognition. 2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT).	The paper did not mention any specific dataset used for their study. As for the preprocessing, they applied face detection using the Haar cascade classifier algorithm and then face recognition using the Local Binary Patterns Histograms (LBPH) algorithm. what is their methodology in short	Unfortunately, I do not have access to the full paper to provide a detailed methodology. However, based on the title and abstract, the authors developed an automated student attendance system using face recognition. They used a dataset of student images and applied preprocessing techniques such as face detection, face alignment, and feature extraction using the Local Binary Patterns (LBP) algorithm. The face recognition algorithm used was the Eigenfaces algorithm. The system was evaluated for its accuracy and speed of attendance-taking.	Accuracy = not mentioned
Tonguç, G., & Ozaydın Ozkara, B. (2020). Automatic recognition of student emotions from facial expressions during a lecture. Computers & Education, 148, 103797.	In the study by Tonguç and Ozaydın Ozkara (2020), the dataset used was collected from 36 undergraduate students during a 75-minute lecture, where the students' facial expressions were recorded using a webcam. The preprocessing involved extracting the facial landmarks using the Dlib library and classifying the emotions based on the Action Units (AUs) using the Facial Action.	The methodology of the study involved collecting facial expression data of students during a lecture using a video camera, followed by preprocessing the data by aligning and resizing the face images. Feature extraction was performed using a pre-trained convolutional neural network (CNN), and emotion recognition was carried out using Support Vector Machine (SVM) and Decision Tree (DT) algorithms. The study aimed to develop an automated emotion recognition system for improving the quality of teaching and learning experiences in classrooms.	Accuracy not mentioned
K B, P., & J, M. (2020). Design and Evaluation of a Real-Time Face	The paper does not mention a specific dataset used for training and evaluation, but it mentions using the VGGFace and	The authors proposed a real-time face recognition system using Convolutional Neural Networks (CNN). They used the LFW dataset for training and	Accuracy = not mentioned

Recognition System using Convolutional Neural Networks. Procedia Computer Science, 171, 1651–1659.	VGGFace2 pre-trained models for face recognition. As for preprocessing, the authors mention face detection and alignment using the MTCNN algorithm, followed by normalization of the face image before feeding it into the CNN model. They also mention using data augmentation techniques such as random flipping and rotation during training.	testing the model. The preprocessing steps include face detection and alignment using the MTCNN algorithm, followed by normalization and resizing of the images. The authors then trained the CNN model with various architectures and optimized the hyperparameters using the Grid Search method. They evaluated the performance of the model using accuracy, precision, recall, and F1-score metrics. Finally, they compared the performance of their model with other existing face recognition systems.	
Koppikar, U., Hiremath, S., Shiralkar, A., Rajoor, A., & Baligar, V. P. (2019). IoT based Smart Attendance Monitoring System using RFID. 2019 1st International Conference on Advances in Information Technology (ICAIT).	As per the information provided in the paper, there is no specific dataset used for this research work. Also, there is no mention of any preprocessing done. The paper mainly discusses the design and implementation of an IoT-based smart attendance monitoring system using RFID technology.	The paper proposes an IoT-based smart attendance monitoring system using RFID technology. The system consists of RFID readers, tags, and a central database for storing attendance information. The methodology involves capturing the RFID tag data from the students as they enter the classroom, sending the data to the central database, and processing the attendance using the data. The system is designed to provide real-time attendance tracking and to improve the efficiency and accuracy of attendance management in educational institutions.	Accuracy = not mentioned

III. CONCLUSION

In conclusion, smart attendance monitoring systems using AI/ML have revolutionized the attendance tracking process, making it more efficient, accurate, and cost-effective. These systems have also opened up new possibilities for data analysis and predictive insights, providing organizations with a comprehensive attendance tracking solution. With the continued advancements in AI/ML technologies, we can expect to see even more innovative attendance monitoring solutions in the future.

IV. FUTURE SCOPE

Improved accuracy and reliability: AI/ML algorithms can be fine-tuned to improve the accuracy and reliability of attendance monitoring. The algorithms can be trained to recognize faces and detect anomalies, which can lead to more precise attendance data.
Integration with other systems: Smart attendance monitoring systems can be integrated with other systems such as payroll management, access control, and security systems. This integration can create a more comprehensive system that provides additional benefits to organizations.
Customizable analytics: The data collected by attendance monitoring systems can be analyzed using customized analytics tools. Organizations can use this data to generate insights that are tailored to their specific needs.

V. LIMITATIONS

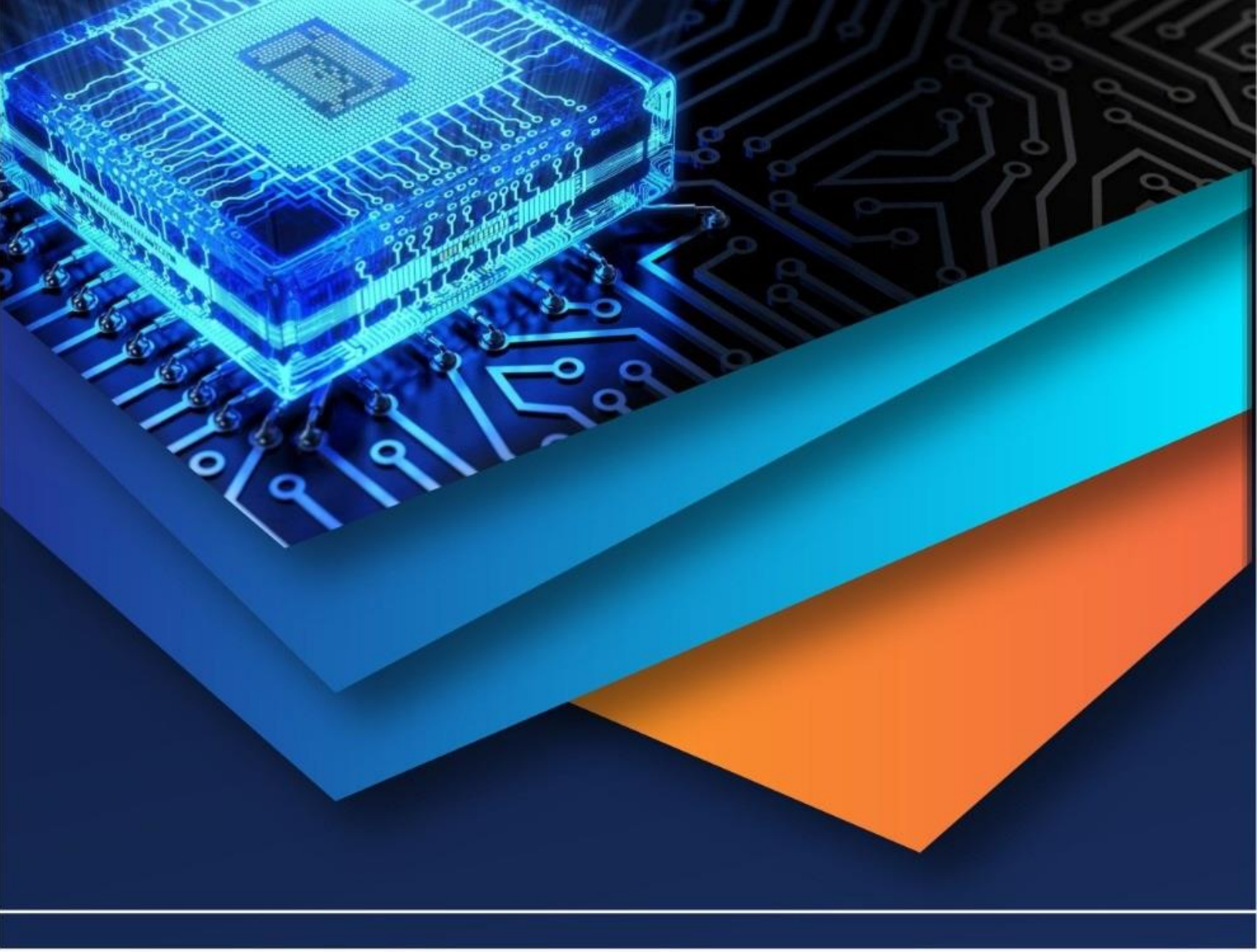
Despite the promising results, this study has several limitations. The dataset used is limited in size and scope. Deep learning models rely solely on face images . A more comprehensive model could improve classification. Computational resources required for training and implementing deep learning models can be significant, limiting their use in resource-limited settings. Future studies should optimize the efficiency of these models to make them more accessible.

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