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Face Recognition Smart Attendance System- A Survey

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Abstract–*A biometric is a study of human features and characteristics. Despite the fact that no faces can be prevented as a security solution, face recognition is a rising field of biometrics for security. Manual attendance systems have various drawbacks, such as being less accurate and difficult to maintain, hence attendance systems are vitally important in schools and universities. So, in this day and age, we see several systems such as IoT and PIR sensor bases, as well as various models. So, for the sensor, we want to keep it in good condition so that it doesn't become damaged. In diverse models, we confront problems such as selecting which feature to use or, more importantly, managing variance in lighting, postures, and size. As a result, we are attempting to construct an "InClass" solution to address the aforementioned issue and provide a valid attendance sheet digitally.*

Keywords: Face Recognition, Face feature, Face selection, Feature Extraction

1. INTRODUCTION

In today's world, the face recognition technique changes the biometrics field. In this technique, we use people's faces for identification. As we know each person has unique facial traits so it's very easy to differentiate or uniquely identify an individual. Face recognition, which has gallantly outperformed in a variety of disciplines, has the potential to be employed efficiently for security systems but has not been explored owing to obvious weaknesses. As we know, the traditional system which is pen-paper has its own pros and cons. The manual attendance marking method is susceptible and time demanding, resulting in a setback for the kids. . In order to address this issue, advances have resulted in the widespread usage of biometrics. As we know biometric technique for attendance comes at an uncomfortably high cost for users as well as very time-consuming on the user's part. So face recognition is a very valuable technology And develop strategies that incorporate it into our system.

Biometric In most cases, iris recognition or thumb scanning is used in attendance management. With the passage of time, advances are also required to keep up with ever-increasing technology. Attendance Management with biometrics is being developed and adopted as multi-tech classrooms become more prevalent. As marking procedures advance, the notion under consideration is the urgent need to remove impediments, the complexity of devices, delays, and genuine attendance.

Unlike all traditional systems which are comparatively slow and susceptible, the InClass system employs face recognition to identify and note down the student attendance. In our system, there is no requirement for equipment further than a camera or laptop. The students' presence is validated via the use of their faces. This method is very effective for recording attendance and keeping the record with us or the person who is taking the attendance (Instructor, administration). . Algorithms are employed to match the student's faces with those in the database. In this system, we also use a mail function. We will help to store the attendance on the drive which is also helpful to reduce the usage of paper and whenever the record of attendance is required it can be fetched easily and any were.

2. METHODOLOGY OF RESEARCH PAPERS

Sajid and colleagues (2014) [1] In this study, he developed a model for identifying people when females wear headscarves and males have beards. For face detection, they use a Local Binary Algorithm (LBA). In this, they use fiducial points for matching the Face. In the system, two databases are used. First, one memory collection includes previously saved photos, while the second database has attendance data used to check attendance.

They use an image for marking attendance, so they capture an image. Then they removed Background and noise from that Image, and using the Gabor filter, they marked the 31 fiducial points, which will help calculate facial features. Then it will match with the database, and attendance is marked. They capture the images three times in between lectures to validate the attendance.

Raghuwanshi et al. (2017) [2] In this paper, they compare two feature extraction methods: PCA and LDA. For their comparison, they selected three parameters: Time elapsed, Subspace Projection, and Accuracy based on an oral and class database. PCA is used to reduce the number of face recognition variables, and LDA is used to minimize the within-class scatter means moving the same faces together.

They use two databases in which first is oral databases which contain 400 images of 40 individuals, and the second is the Class database which includes 25 images of 5 individuals. Also, they plot ROC and CMC graphs for analysis and comparison of databases. ROC plot is used for different possible cute points of a diagnostic test, and CMC is used to measure recognition performance. PCA and LDA work well in normal light, DistanceDistance from camera 1 to 3 feet, no pose variation.

Winarno et al.(2017)[3] In this paper, we can see they use a 3 WPCA(Three-level model wavelet decomposition Principal component analysis) method for face recognition. Initially, they took images of a person from two cameras from left and right. After capturing the Image, they normalize the images. Normalization is done in two steps first is preprocessing, and another is half joint. In preprocessing, they use RGB to Gray conversion and cropping, resizing, and adjusting contras brightness. The half joint is used to minimize the forgery of facial data.

For feature extraction, they use the 3WPCA, in which they reduce the dimensionality of the images so that feature extraction using PCA is done very fast. For classification, they tested two methods, Euclidean and Mahalanobis distance method. For the testing purpose, they consider two parameters: Recognition Rate and Recognition Time, in which the Mahalanobis gives more remarkable results. They achieve 98% accuracy on a small dataset.

Soniya et al. (2017) [4] In this paper, they proposed IOT based system which uses Adriano-UNO and Camera. They are arranging that system to create a student database, which means they give the user access to add a new entry, which will help users register new users quickly. They use the PCA algorithm for feature detection and face Recognition. They try to establish such a feature if students leave the class in between, and if they do not again enter within 15 min, they are marked as absent. For face recognition, they use face tracking and Face location. Face tracking is used for size, length, breadth pixel of Face, and face location to detect suitable location. They plotted an FMR (occurred when genuine match obtained) and FNMR (occurred genuine user is blocked) graph.

In this system, they use a camera with an image resolution of 300k pixels and light sensors for switching on 4 LEDs when in the dark. Sharpness, Image control, brightness, and saturation are the feature provided by that camera. The main drawbacks are they take attendance one student at a time which is very time-consuming for a large number of people.

Nazare et al.(2016)[5] In this paper, they proposed a system using a combination of Alignment- free partial face recognition and the Viol-Jones algorithm. The Alignment-Free partial Face algorithm uses MKD (Multi-key Descriptor), which is used for prob images and dictionary creation. Each Image in the dictionary is represented in spares representation then uses GTP (Gabor Ternary Pattern) for robust and discriminative face recognition. Due to this, we can easily detect a person.

For the creation of data, they give the feature for registration, and in that, they took three images of each person from the front, left, and right side view. They also arrange a camera in the middle top of the blackboard, which covers maximum faces. They consider the one lecture as 1 hour, and they take three images of the class in between 20 min gap. So that they get a valid result. For capturing images, they use a camera having a resolution of 20 Megapixels.

Wagh et al. (2015)[6] This paper is based on PCA and Eigen Face algorithm. They are addressing the issues like head pose problems as well as the intensity of light. For that problems, they use techniques like illumination variant viol-jones algorithm. They also use the RGB-Gray conversion, Histogram normalization, and skin classification to improve face detection accuracy.

Here they use this technique one person at a time, which is very time-consuming and one of the system's drawbacks. Also, they are not addressing the issues when the person with a beard, mask, etc.

Chintalapati et al.(2013)[7] In this paper, they develop a system with a different algorithm for face detection and their classification and their combination. (i.e. are PCA+ Distance Classifier, LDA+ Distance Classifier,PCA+SVM, PCA+ Bayes, LBPH+ Distance Classifier). For comparing that technique, they use various parameters: Occluded faces, False Positive rate, Recognition Rate(real-time video), DistanceDistance of the object for correct Recognition, Recognition Rate (static Image), and Training Time.

According to their data, PCA with SVM gives excellent results in each aspect. But they do not highlight the Recognition of faces with beards, scarfs, and tonsure heads. Also, when the system recognizes a face up to a 30-degree angle, it will not recognize it if it encounters the Face more than a 30-degree angle.

Akay et al.(2020)[8] In this paper, they tested two techniques for face detection, namely are HOG (Histogram of Oriented Gradient) and another one is Haar-Cascade

algorithm. They tried both methods based on the parameters: True positive, True Negative, False positive images, Precision, recall, F1-Score, Training time. HOG is based on contras in different regions, and Haar-Cascade is based on light and dark are transition.

In this, they also introduce the medical mask detection due to covid-19, which will be helpful for mask detection also. For Recognition and classification, they use CNN and SVM, respectively. According to their research between HOG and Haar-Cascade, HOG gives more significant results on given parameters and works well in changing lighting conditions.

A biometric attendance management system developed by Varadharajan et al. (2016)[9} In this paper, they introduce the system using the Eigen Face method, which is a set of Eigenvectors. Each Face is represented in Eigenface, and this Face is converted into an Eigenvector with Eigenvalue. For calculating this value, they use the Jacobi method because their Accuracy and reliability are high.

They also use different parameters for face detection and Recognition that are Face with veil, Unveil Face, and beard. So Unveil Face gives greater Accuracy that is 93% for detection and 87% for Recognition.

Rekha et al.(2017)[10] In this paper, they integrated two techniques that are PCA and Eigenface database. They address various issues like Image size, Image quality, varying intensity of light, Face angle. For crating Eigen Face database, they took 15 people ten images each. For comparing the Training and Testing image, they use Euclidian DistanceDistance in the Recognition part. In this, the uses MATLAB for crating GUI and Training algorithm.

In this study, Lin Zhi-heng et al.(2019)[11] built an attendance system with face recognition using classroom video. First, record a video of a live classroom from the camera already installed in the classroom, send it to the server, and then recognize the student's faces. In this, they use the image segmentation method to identify. While the recognition process, the system did not get the proper image; they were allowed to recapture the video.

They use the image segmentation method to recognize. This requires more images for more accuracy. As many as many pictures are taken by the server, the accuracy increases for that they use the three parameters like number of people in the class, number of images that systems take, discern number which is how many students get recognized by the system and also their accuracy which calculated using this parameter. When students play or use mobiles or sleep, that student will not recognize.

Evta et al.(2020)[12], in this paper, uses a haar-like feature method to give a specific indication to an image and is fast computation because it depends only on the number of pixels, not on every pixel of the image. The Haar-Like value is the difference between dark and bright areas' grey level pixel value. They also compare the SFAM-NN to Cascaded Classifier Adaboost to fix the classification problem. For maintaining the edge sharpness of the image, they use the Bilateral Filter.

They use a Raspberry PI 3 B, wide-angle fisheye lens camera, Memory Micro SD card, monitor, mouse, HDMI to VGA cable. The main Drawback is to mark the attendance of only one student at a time.

Wenxian et al.(2019)[13] in this paper, for feature extraction, use an AlexNet Convolutional Neural Network algorithm and the extracted data in sore in the back-end database and they change in ReLu function for does not lose the negative part while the input image is less than 0. The new model uses the CASIA-WebFace Data set, which contains 10000 people and 500000 photos for training. For training, they got up to 94% accuracy.

The security reason, students have a unique card to swipe for login purposes after that system captures an image and passes it to RFID. After feature extraction comparison, complete try to compare and look similar, then mark the attendance for that student. Up to 91.30% accuracy has got this system.

In this paper, Soumitra et al.(2020)[14] are trying to take attendance using face recognition while video streaming. They first take data from a student and store it in a database. After all students' data is stored in the database, that database goes to the training model after that model is ready to recognize a student. For training data, they use a personal dataset that contains all students' data.

They use a CNN for feature extraction, and CNN extracts 128 facial measurements from each student's face. These are stored as 128-d vectors, and this system has up to 91-92% accuracy.

In this paper, Yang et al.(2020)[15], the attendance system on real-time video processing. For the selection of face recognition algorithms, they focus on factors like recognition rate, algorithm robustness, and matching time. For feature extraction of face, use Linear Discriminant Analysis(LDA) to find the linear transformation that minimizes the inter-class dispersion. Linear Discriminant Analysis(LDA) is also very good in face detection, but when using this method for feature extraction, some part problem often occurs. And for face recognition use Support Vector Machine(SVM) is used. For training purposes, they use the personal database.

In this system, the system takes the student's photo from the video captured in the classroom. Suppose it is matched from the database face image, then the mark attendance. This system has up to 82% accuracy.

In this paper, Radhika et al.(2018)[16] use the DNN for face detection. They use different classifier methods such as SVM, MLP, and CNN. First, create a database from taking data from students and stored in the database. Also, they use the face ROI cropping; in this, the unwanted face part will be removed and after that reshape the image for that they used Deep Neural Network(DNN) based face detection technique. They explain the advantages of selecting PCA and LDA for feature extraction.

While using this method to take attendance, they got the accuracy for SVM, MLP, and CNN are 87%, 86.5%, and 96%, respectively. They have to take attendance for only one student at a time.

In this paper, Arjun et al.(2020)[17] use the LBPH for face recognition and take the image and convert it to a grayscale image for generating histogram; after that, remove noise from the image and ROI used for reshaping the image. If the student's face matched, then mark the attendance. They're also one feature to send one message of absence to the student's parents' mobile number using GSM.

They compare various algorithms for face recognition with different parameters like the number of images and success rate. The main drawback of this system is to take only one image capture for student attendance. And the accuracy of LBPH for face recognition is 89% which is less.

Raj et al.(2016)[18] developed a conceptual model for an Automated Attendance System based on feature identification. To take student attendance, they utilize head tracking, face feature monitoring, and full monitoring. They improved the system's performance by employing trustworthy comparison, Generalized Match Face Recognition, Perturbation Spacing Technique, and Adaptive Regional Blend Match Algorithm.

Shreyak et al.(2019)[19] propose the system using Eigenfaces values, Principal Component Analysis(PCA), and Convolutional Neural Network(CNN). First, the students need an enrollment number and store that data in that database. For the training, they use the personal database. For face recognition, use the PCA method and, after training, produce an EigenFaces Value. After face recognition is successful, confirmation is needed from the classroom camera and marking the attendance for that student in the database, and accuracy has up to 96%.

The main drawback of this system is to take only one image capture for student attendance.

SriVignesh et al.(2016)[20], in this paper, for face recognition, uses the Fast Adaptive Neural Network classifier(FANNC) and for each student have a unique RFID card. If the RFID card is Unidentified by the RFID system, the system is rejected for recognizing the student to avoid proxy attendance. They have created a database, namely as an RFID-ROLL, containing the 14 images of each student, a total of 2800 images, and all images are 640x480 color pixels.

The system accuracy is up to 79.29%, which is less than a CNN-based model, and that's the main drawback of this system, and this system is to test 40 thousand combinations of RFID cards.

HOG is one of the most well-known face recognition algorithms. Jenif et al.(2019)[21] built an Intelligent Attendance Tracking and Monitoring System Using Graphs. HOG is a Face-Recognition Method that is utilized to detect the face of the person. It is well-known for its effectiveness and ability to differentiate a person's face from both the front and side faces.

In this research, they use HOG which has an accuracy of nearly 84%. Their process is followed by capturing the image then it passes through the haar cascade algorithm. After that coordinates are marked and then the face is detected.

Hemantkumar R[22]Introduced an Automated Attendance System using Machine Learning Approach. They use a HOG model and support vector machine to recognize the faces. And accuracy of this model is 88%.

This system consists of a camera, which is installed in the center of the classroom capturing the video frames followed by the detection of multiple faces. For detecting faces they are using a histogram of oriented gradients which is a feature descriptor widely used in computer vision. Viola-Jones algorithm is applied on the whole picture frame, which detects the faces. The decisions can be made by the SVM classifier regarding the presence of an object such as a human.

Howard Chin[23] introduced an Enhanced Face Recognition Method For Fast Class Attendance Monitoring System Based On Local Binary Pattern and Principal Component Analysis. They integrate Face Detection, Feature Extraction, Face Recognition, LBP, and PCA technologies.

The test recognition accuracy on the Yale face database of the original LBP is 81.9%, while the ELBP with radius 2 to 5 pixels has achieved a face recognition rate of 84.6% to 88.5%. The recognition rate of the system is 100% if the image is of high quality, and 92.31% if the image is of low quality.

Here accuracy of their system is great but the system can only detect one face at a time. Their system can't detect a group photo or whole class at a time.

Smit Hapani[24]implemented an Automated Attendance System using Image Processing. In this system, they take images of students from video. After that, they use image processing to mark students' attendance. But accuracy of this model is lower than the hog and CNN model.

They proposed a system that contributes to human face detection with the help of the Viola-Jones algorithm and face recognition with the Fisher Face algorithm and achieves an accuracy of 45 % to 50%.

AI-Based Techniques for Real-Time Face Recognition-based Attendance Systems, suggested by Priyanka et al. [25]. Face recognition, AWS, image processing, deep learning, and the OpenCV technology are used in this system.

In this paper real-time, attendance monitoring uses a web app that can be operated remotely by using a local server and Amazon Web Service (AWS) cloud recognition Application Programming Interface (API).

In this research, the OpenCV library is used which contains a Haar Cascade Classifier which helps us to detect a face from the image or form a video. Also, this research consists of the YOLO algorithm. It is made for the early stage, which is for a one-stage detector which is based on CNN. Also, their system uses a face recognition library that uses Dlib's state-of-art. It provides an accuracy of 99.38.

Kurniawan et al.(2017)[26] introduced an attendance system using the Eigenface algorithm. For recognition, the Eigenface algorithm and Euclidean are used for the calculated distance between the face and the camera. The test result shows up to 87% accuracy for five training images and a drop down to 69% accuracy for the 10 training images. This system fails to recognize because of low lighting conditions.

Harikrishnan et al.(2019)[27] suggested a Vision-Face Recognition Attendance Monitoring System for Surveillance using Deep Learning Technology and Computer Vision. The camera fits in one corner, takes images for recognition, and compares with the face database and attendance mark in an excel sheet. In the end, the system provides up to 74% accuracy for recognition.

The recognizer, that is used here, is the local binary patterns histograms (abbreviated as LBPH). Also, Image recognition is done using Local Binary Pattern Histogram (LBPH) in which a 3x3 matrix window is moved along the image and the pixel value at the central location of the matrix is calculated. The accuracy of the system is a little bit low which can be improved.

FaceNet and Support Vector Machine classroom attendance system was created by Nyein et al.(2019)[28]. FaceNet is used to extract features, whereas SVM is used to evaluate them. For multiple face recognition, their system achieves incredible accuracy of up to 98%. And it significantly outperformed the VGG16 model.

Their proposed system uses the face recognition algorithm from python libraries to detect faces. Such as Tensorflow (1.4.0), Scipy (0.17.0), Scikit-learn (0.19.1) and Opencv (2.4.9.1)).Using FaceNet and SVM, the accuracy is around 99.6 on testing. When using the general CNN model, it also gets around 95% accuracy, and using pre-trained VGG16 gets an accuracy of nearly 97%.

The face attendance method is described by Dev et al.(2020)[29]. Face recognition incorporates three algorithms: K-nearest neighbor, Convolutional neural networks, and support vector machine to accomplish 98 % accuracy. CNN has an inadequate computing complexity, and SVM has been established to be less efficient.

Lukas et al.(2016)[30] developed a student attendance system that employs the Face Recognition Technique. This system, along with the Discrete Wavelet Transform and Discrete Cosine Transform for feature extraction and the Radial Basis for classification is used for authentication. This system has a successful facial recognition rate of up to 87%.

3. CHALLENGES

We all know that human faces are unique and stiff things. Several aspects influence the appearance of the structure of faces. The origin of the diversity of facial appearance can be classified into two kinds of appearance. They are intrinsic factors and extrinsic factors. So intrinsic factors are related purely to the physical traits of the face and are independent of the observer. This intrinsic factor is further split into two categories that are intrapersonal and interpersonal. The intrapersonal aspects can affect the face appearance of the same person, with some examples like age, facial stuff like glass, facial hair cosmetics, and so forth, facial expression. Interpersonal aspects, one of each hand, are essential for the variance in face appearance. For example ethnicity and gender. Extrinsic factors contribute to the appearance of the face to change as a result of the interplay of light with the face and the observer. These elements include resolution, imaging, noise, focus.

Assessments of state-of-the-art techniques undertaken in recent years, such as FRVT 2002 as well as FAT 2004, have demonstrated that lightning, age, and pose variation are three fundamental issues with current facial recognition.

4. CONCLUSIONS

This project helps us to know the different techniques of face recognition. Which also gives us knowledge about the pros and cons of that technique. As we know face recognition is also a challenging field of computer vision or image analysis. But in the last few decades, it has had many applications in various domains.

So in our system, we use CNN-based face recognition. Which works well in normal conditions. Our system stores images of persons in the system and during lecture time using video we will detect the faces and record the attendance.

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