

Face Recognition Attendance System – A Survey

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Abstract:- In today's academic system, proper student attendance management is crucial for the academic institutions to disseminate and give quality education and success to students. Managing the attendance of each student can be a great burden on the teachers if they do it manually. The traditional methods practiced in most of the institutions include calling names of students or signing on papers, which are highly time-consuming and insecure methods. To overcome these problems, a smart and auto attendance management system may be developed. Earlier, several automated attendance systems have been proposed based on biometric recognition, barcode, near field communication mobile devices like Bluetooth module attendance system and QR code. However, all these systems are not efficient in terms of processing time, cost, and accuracy. Face recognition is one of the biometric methods to improve this system. The purpose of this work is to survey several algorithms, their benefits, and their drawbacks. We also go over the steps followed in the facial recognition process. This review will be beneficial for upcoming researchers for selection of appropriate techniques for face recognition.

Keywords:- Machine Learning (ML), Logistic Regression (LR), Support Vector Machine (SVM), K nearest neighbour (KNN), Random Forest (RF), Principal Component Analysis (PCA), Convolutional Neural Network (CNN).

I. INTRODUCTION

For academic institutions to ensure a good academic result, regular attendance of all students is crucial. Lack of a proper and efficient monitoring system causes the students to abstain from attending the class regularly which can lead to poor results. In a certain university, minimum 70 percent attendance of students in a course is also used as one of the requirements for students to take the exam. A conventional approach to record student attendance is the manual attendance system performed by asking every student to sign on an attendance list that passes through all students during the beginning of lectures or by calling the names. However, this approach is not efficient as it is time consuming and can potentially lead to fraud especially in a large class, where a student can sign on the attendance list for other students who are not present in the class or by marking proxy.

To avoid the fraud scenario, sometimes the lecturer calls out students' names one by one who have signed on the attendance list. This method will take away a lot of lecture time and will have an impact on the quality of lecture.

A modern approach to record attendance is by using an automated attendance system. It will decrease the manual work of teachers. Several automated attendance systems have been proposed earlier by employing bio-metric recognition, such as fingerprint recognition. In this system, at every check in and check out times, employees needed to scan their fingerprint to record attendance. There is a drawback of this method, the system cannot recognize an individual's fingerprint if it is wet, dirty, or broken. Another method is palm vein recognition in which recognition is based on the vein pattern of the individuals. The other proposed attendance systems used barcode, QR code and near field communication (NFC) mobile devices like Bluetooth module attendance system to obtain student ID for the attendance process.

In face recognition technique, a camera will be installed outside the classroom. Students will get the access to enter the classroom, by scanning their faces in that camera. Facial recognition algorithms will be applied to the cameras to analyze the faces and mark their attendance accordingly. Few of the most used face detection algorithms include Viola – Jones Algorithm, Convolutional Neural Network and Local Binary Pattern Histogram. Few of the most used face recognition algorithms in the research papers include Local Binary Patterns Histograms, Eigenfaces algorithm and Convolutional neural network. As face recognition will be done automatically, it saves a lot of time for both students and faculty and also there is no space for error.

II. LITERATURE REVIEW

Today technology is growing rapidly and devices are inclining more towards automation and result in rapid progress with respect to software technology. There are numerous ways to take attendance used in institutes, companies and industries. Manual attendance system is not efficient as it is time consuming and can potentially lead to fraud especially in a large class. Therefore, we read 20 different research papers based on automated attendance management system.

Convolutional Neural Network has been used to detect the face and KNN has been used to classify faces.[1] LBPH has been used in one of the papers for face recognition. However, one limitation is that the dataset used is very small. It is also studied that the performance of haar cascade classifiers can be improved through the synthesis of new training examples. [2]

LBPH algorithm along with face detection by Haar feature-based cascades and distance-based clustering have been used.[3]

This paper typically puts forward the idea to train the dataset so that it distinguishes between positive images (faces) from the negative images(background) [4]

This paper presents an automated real-time attendance management system (AMS) using face recognition techniques which will reduce human dependency and thereby saves time. A modified local binary pattern histogram (MLBPH) algorithm based on calculation based on pixel neighborhood gray median for extracting the significant features of the human face. [5]

This paper focuses on how face recognition incorporated with Radio Frequency Identification (RFID) detect the authorized students and counts as they get in and get out from the classroom. [6]

The paper proposes a model based on face recognition using Haar Cascade classifier and LBPH(Local Binary Histogram Pattern). [7]

The system described in this paper is a slight deviation from the traditional systems of attendance and introduce a new approach to identify a student using the generation of a 3D Facial Mode. [8]

This paper studies to convert it into frames, link it to a database to ensure their presence or absence, to mark the presence of a real student to keep a record. [9]

This paper automates the attendance system by integrating the face recognition technology using modified Local Binary Pattern (LBP) and Support Vector Machine (SVM) algorithm with Matlab Graphical User Interface (GUI). [10]

Different algorithms are compared for face recognition like Eigenfaces, Fisherfaces, deep convolutional neural network algorithm, OpenFace and Local Binary Pattern Histogram. Open source facial recognition is the most robust algorithm also emotions recognition can be used for facial recognition in future. [11]

Viola-Jones algorithm used for face detection and Local Binary Pattern (LBP) used for face recognition. Haar Cascade is one of the method for face detection. [12]

Another solution is feature extraction using Histogram of Oriented Gradient (HOG) features instead of Eigenfaces mainly used in standard PCA algorithms. Support Vector Machines (SVM) classifier used. HOG Features and SVM , in

comparison with Eigen feature based PCA algorithm, has improved face recognition rate by 8.75 on ORL database. [13]

Deep Convolutional neural networks are used for face recognition. CNN used Deep face model that tends to be human level accurate work with multiple sets of images for its training. Adaptive threshold identification a specific domain of CNN based face recognition. CNN accomplish the best outcomes for bigger datasets. [15]

Fares Jalled[15] discussed the face recognition system in detail. The author also explained techniques like Principal Component Analysis (PCA) and Normalized Principal Component Analysis (N-PCA) and compared them based on their success rate. The author also wrote that N-PCA gives better performance for both the IFD and ORL databases.

There are four steps to develop an automated attendance management system: Enrollment, Face Detection, Face Recognition and Attendance Marking. Viola-Jones algorithm is used for face detection. Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN) have been used for face recognition. [16]

Having a video sequence as the input to the system and using correlation tracker from the dlib library to keep track of the face from frame to frame saves computational paper since we don't have to detect the face after transforming to a new frame in the real-time video sequence. Different parameters pose estimation, sharpness, Image size or resolution, Brightness used for image consideration. [17]

This paper suggests to use YOLO V3 (You only look once) algorithm for face detection and Microsoft Azure using face API for face recognition (face database). These are parts of convolution neural networks (CNN). [18]

The model focuses on how face recognition incorporated with Radio Frequency Identification (RFID) is used to detect the authorized students. Every student has its RFID tag and as it passes through the RFID reader it marks its attendance. Saving Energy by using IR module for system implementation. [19]

An android based course attendance management system can be developed using face recognition. QR Barcode systems generate the QR code containing course information and displayed at the entry gate of institutions, companies and industries. The student only needed to capture his/her face image and displayed QR code using his/her smartphone. [20]

The literature reviewed summarizes the face recognition process in the following steps. The steps are as follows: -

➤ *Dataset Identification*

The literature reviewed for this project has used several datasets which are listed and compared in the table.1.

TABLE I. FACE RECOGNITION DATABASES

<i>Dataset</i>	<i>No. of persons</i>	<i>No. of images</i>
IFD [15]	61	671
Color Feret [13] [14]	1199 individuals, 365 duplicates	14126
Yale Databse [13]	15	165
Yale Face Database [13]	10	5760
BioID [13]	23	1521
Georgia Tech [13]	50	750
FEI [13]	2000	17000
LFW [13][14]	5749	13233
Adience [14]	2284	26580
ORL [13][15]	40	400

• *Taking Input*

In this step, the image of the student is captured. The image can be captured by a good quality camera.

• *Face Detection*

This involved detecting the face of the person in a background so as to separate the human face from it. Typically, the first feature to be detected is human eyes followed by other facial features like nose, ears, moustache etc. Few of the most used face detection algorithms used in the research papers include Viola – Jones Algorithm, Convolutional Neural Network, Haar Cascade classifier and Local Binary Pattern Histogram.

• *Feature Extraction*

This involves extracting the facial features from the human face which is detected in the face detection step. The facial features are extracted like ears, nose etc. This step is very important which initiates the process of face recognition. Typically, eye extraction is followed by the extraction of other facial features.

• *Face Recognition*

This involves recognizing the identity of the individual using the extracted features from the detected face in the image. It is this recognized face which will be used to compare the images in the database in order to mark the attendance of the student. Few of the most used face recognition algorithms in the research papers include Local Binary Patterns Histograms, Eigenfaces algorithm and Convolutional neural network.

• *Classification*

This involves categorizing the recognized identity into categories like enrollment number on the basis of our training dataset. Few algorithms for classification suggested in the research papers include K-Nearest Neighbors, SVM and Eigenfaces algorithm.

• *Marking Attendance*

Once the image is recognized and if the image matches with an image in database, the attendance of the student is marked. Then the attendance is stored in the excel file for having a complete record.



Fig 1. Face Recognition Process

TABLE II. COMPARATIVE ANALYSIS OF PRIOR RESEARCH WORKS.

<i>S. No.</i>	<i>Year</i>	<i>Name of the Paper</i>	<i>Author</i>	<i>Accuracy of the Paper</i>
1.	2019	Automatic Attendance System for University Student Using Face Recognition Based on Deep Learning	Tata Sutabri, Pamungkur, Ade Kurniawan, and Raymond Erz Saragih	To determine the accuracy, a photo of a student whose face has been trained is captured. The size of the photo captured by the Raspberry Pi camera is 320 px × 240 px. It makes the face recognition process accomplish faster.
2.	2020	Face Recognition based Attendance System using Haar Cascade and Local Binary Pattern Histogram Algorithm	Bharath Tej Chinimilli, Amrita Vishwa Vidyapeetham, Vihas Reddy Kaipu, Amrita Vishwa Vidyapeetham, Anjali T, Akhil Kotturi, Jathin Varma Mandapati	The Face recognition rate of students is 77% and its false-positive rate is 28%. Face Recognition of unknown persons for both existing and proposed models is 60%. Its false- positive rate is 14% for the proposed model and 30% for the existing model.
3.	2019	Automatic Attendance System Using Face Recognition Technique	Rakshanda Agarwal, Rishabh Jain, Rajeshkannan Regunathan and C. S. Pavan Kumar	No accuracy is shared instead steps of the process are explained and challenges are mentioned.
4.	2018	Automated Attendance System using Image Processing	Smit Hapani, Nikhil Parakhiya, Nandana Prabhu, Mayur Paghdal	Here video sequence used as the input and frames are recorded at every 2 seconds. Accuracy obtained in frame 1 is 42% and 50% in frame 2.

<i>S. No.</i>	<i>Year</i>	<i>Name of the Paper</i>	<i>Author</i>	<i>Accuracy of the Paper</i>
5.	2020	Attendance Management System using Facial Recognition	Ankush Kumar, Manish Sharma, Saurabh Pratap Gautam, Ranjeet Kumar and Sandeep Raj	The overall accuracy reported by the proposed method is 95%. The results having precision 97% and recall of 95%.
6.	2020	Face Recognition based Attendance Management System	Smitha, Pavithra S Hegde, Afshin	In this paper, System implemented using the Eigenface algorithm achieved an accuracy rate of 70% to 90%.
7.	2020	Automatic Attendance system using face recognition	Mr. P. Sathiyarayanan, V. Sathiyarayanan, R. Karthick , R. Gokulnath, S.Yogesh Kumar	In this paper, systems are time-efficient. Accuracy obtained for this system is good.
8.	2020	ClassRoom Attendance System Using Facial Recognition System	Abhishek Jha, monika hooda	The extracted features are compared to those stored in the database, and decisions are made according to the sufficient confidence in the match score.
9.	2022	Face Recognition Attendance System	Shrey Bhagat, Vithal Kashkari , Shubhangi Srivastava , Ashutosh Sharma	In this paper, systems is using a skin-splitting approach to improve the accuracy of the detection process.
10.	2018	Attendance Management System Using Face Recognition	Chaitra T.K, M.C.Chandrashekar, Dr. M.Z. Kurian	For poor illumination, the accuracy is 85.9% it can be improved to 90% through preprocessing.
11.	2020	Comparisons of Facial Recognition Algorithms Through a Case Study Application	Amir Dirin, Nicolas Delbiaggio, Janne Kauttonen	OpenFace is the most robust algorithm for a good accuracy.
12.	2019	Face recognition attendance system using Local Binary Pattern (LBP)	Shamsul J. Elias, Shahirah Mohamed Hatim, Nur Anisah Hassan, Lily Marlia Abd Latif, R. Badlishah Ahmad, Mohamad Yusof Darus, Ahmad Zambri Shahuddin	No accuracy is shared instead steps of the process are explained and challenges are mentioned.
13.	2016	Improved Face Recognition Rate Using HOG Features and SVM Classifier	Harihara Santosh Dadi, Gopala Krishna Mohan Pillutla	HOG Features and SVM, in comparison with Eigen feature based PCA algorithm has improved face recognition rate of 8.75%.
14.	2018	Data-specific Adaptive Threshold for Face Recognition and Authentication	Hsin-Rung Chou, Jia-Hong Lee, Yi-Ming Chan, and Chu-Song Chen	According to the paper, proposed protocol, the adaptive threshold method can achieve a 22 accuracy improvement on the LFW dataset.
15.	2017	Face Recognition Machine Vision System Using Eigenfaces	Fares Jalled	The paper shows that N-PCA gives better performance for both the IFD and ORL databases.
16.	2019	Real-Time Smart Attendance System using Face Recognition Techniques	Shreyak Sawhney, Karan Kacker, Samyak Jain, Shailendra Narayan Singh, Rakesh Garg	Facial recognition comes out as an important option as it leads to high accuracy and minimum human intervention. This system is providing high security.
17.	2018	Smart Attendance Monitoring System (SAMS):A Face Recognition based Attendance System for Classroom Environment	Shubhobrata Bhattacharya, Gowtham Sandeep Nainala, Prosenjit Das and Aurobinda Routray	SAMS has been designed to register the face of each individual for the first time. Then, the network trains it automatically for future usage. For next classes, the students can get their self-attendance done with the GUI offering a drop-down menu for the recognized face.
18.	2020	Real Time Automatic Attendance System for Face Recognition Using Face API and OpenCV	Sikandar Khan · Adeel Akram · Nighat Usman	Different types of seating arrangement, environment and lightning conditions are tested and the system shows almost 100% accuracy in most cases

<i>S. No.</i>	<i>Year</i>	<i>Name of the Paper</i>	<i>Author</i>	<i>Accuracy of the Paper</i>
19.	2018	Face Recognition and RFID Verified Attendance System	Md. Sajid Akbar, Pronob Sarker, Ahmad Tamim Mansoor, Abu Musa Al Ashray, Jia Uddin	The model is more user friendly and it provides the most accurate and organized data.
20.	2021	An android based course attendance system using face recognition	Dwi Sunaryono, Joko Siswanto, Radityo Anggoro	The experimental result shows that the proposed attendance system achieved face recognition accuracy of 97.29 by using LDA and only needed 0.000096s to recognize a face image in the server.

TABLE III. CHALLENGES IDENTIFIED AND TENTATIVE SOLUTIONS

<i>S.no</i>	<i>Challenges identified</i>	<i>Tentative solution</i>
1.	The face detection algorithm detects random objects in the background as the face of a person.[2]	We must make sure the training dataset is free from noise and we should only use the cropped face of the person for training purpose.
2.	Some databases consume a lot of memory. [3]	Cloud-based face recognition techniques can be used in order to speed up the face recognition process.[1]
3.	Facial changes may cause inconsistency in recognizing faces. [12]	Make sure the database is up-to-date to incorporate facial changes.
4.	It is found that based on the lightning conditions, there is variation in the results. [9]	Adequate Lighting should be available. [12]
5.	It is also observed that additional accessories on face do affect the results.[4]	Train the model with a variety of images with different accessories like specs and no specs OR remove the accessories while face recognition is being performed.
6.	Background of the image should be static. [12]	We should make sure the camera is fixed and the background is white to solve this issue.
7.	The HOG features give good results with straight and front faces. However, it doesn't work for faces placed at odd angles. [13]	Used some other algorithm or use hybrid algorithms.
8.	Converting this system to a software or an application so that it can be used throughout every university.[3]	Web development tools/software can be used to create an application for face recognition attendance system.

III. CONCLUSION

Technology is growing rapidly and devices are inclining more towards automation and result in rapid progress with respect to software technology. There are numerous ways to take attendance used in institutes, companies and industries. Face recognition technology has proven to be one of the most impactful technologies in recent decades. We chose to go ahead with the project as we thought the concept would be highly beneficial for the society at large. It will help in the reduction of manual errors while noting the attendance in classrooms. Using this concept, the traditional way of attendance can be easily replaced by a quicker way of taking attendance. This will ensure that attendance taking is not a time-consuming process and that the time saved can be used for better purposes in schools and universities.

This survey is an attempt to review some of the research papers in the field of face recognition. The paper starts by giving a general introduction of various techniques that have been used to mark attendance and a brief introduction about attendance system using face recognition. Followed by the steps of face recognition process. Various face detection and face recognition methods are covered in the 20 distinct research papers that we reviewed. The research papers have used a

variety of databases, some of which contain more than 5000 images with several expression variations.

A comparison table is formed for comparing accuracy of different papers. The major limitations found in the research papers include memory intensive algorithms and poor quality of images and background image degrading the accuracy.

We hope that the presented review will further encourage researchers in this field and will be beneficial for them for selection of appropriate techniques for face recognition. We apologize to researchers whose important contributions may have been overlooked.

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