A Survey on Automated Student Attendance Management System Using Face Recognition

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Abstract

The old way of controlling attendance is obviously a time-consuming one that makes it tough for the person in charge to keep track of students' attendance. A more practical biometric student attendance system is required as we transition from manual to automated labour, which will lessen these challenges. The issue of manual labour can be solved using a variety of biometric approaches. Face recognition is projected to be employed in the student attendance system since it is seen to be the finest biometric method. This study's major goal is to comprehend the work that has already been done on a facial recognition-based student attendance system. The current study performed a literature review of earlier works based on face recognition-based student attendance management systems. The methods, strategies, and difficulties of face recognition are described in this work. Regarding research based on facial recognition, there are several difficulties. This research suggested a camera-based student attendance system that used facial recognition technology to address this problem.

Keywords : Face Recognition; Student attendance system; Processes; Challenges; Approaches; Manual; Automation.

1. Introduction

Student records with respect to attendance is an important aspect at an institutional level. Therefore, maintaining these records plays a very crucial part. Each institute has its own way to maintain and record student attendance. Some institutions believe in the fact that manual attendance is better than automated attendance system. On the other hand some believe that automation will reduce efforts and difficulties that are faced by its counterpart.

In manual attendance system, attendance is taken through oral speech or a sheet is passed which can be considered as a time consuming and tiring method. Maintaining records obtained through the manual attendance processes can be a time consuming task with respect that all data is present in the physical format. If there is a loss of these physical documents, then there is no way of recovering the lost data. If the sheets are passed for the purpose of marking attendance by the students respectively, then there can be chances of irregularities caused by the students whether it be on purpose or by mistake. All the flaws in the manual attendance method are eliminated in the automated system. The traditional method cannot resolve all the issues by itself, thus an automated attendance system is the solution. A student's attendance can be recorded using a variety of biometric features, such as their iris, nose, ear, hair, face, and fingerprints.

The use of biometric systems lessens the need for humans and cuts down on error-prone situations. As was already noted, face recognition is one of the biometrics types employed in attendance systems. According to studies, face recognition is a tried and tested method, which gives optimal results for identity verification.

2. Face Recognition

Identity verification is done using a method called face recognition. There are many features which can be extracted from the face of an individual. Every individual will posses unique features. Facial Features are unique to an individual. This helps to bring out accuracy and reduces the chances of error during identity verification. In face recognition, facial features are considered mathematically and the distance between different facial features is measured. These measurements are then used for verification of an individual.

Face recognition technology was applied to automation for the first time in 1960. There is a lot of significance attached to physical characteristics like the nose, eyes, mouth, and ears. Calculations were made for the separations and ratios of these characteristics. These measured values were then contrasted with the data that had been previously saved after the computation. Goldstein, Harmon, and Lesk developed a 21-mark system in the 1970s that included characteristics like lip thickness and hair colour. The fact that all measurements were made by hand, however, made it difficult to demonstrate accuracy.

2.1 Face Detection Processes

The removal of non-facial elements from the picture is the most crucial step in the face detection process. The face detection procedure is primarily separated into two parts. Obtaining measurements of the previously recorded data is the initial stage in the detecting process. The second step of detection is the identity verification of the particular individual by extracting the subject's facial features and then calculating the distance between these features. The measured distances of the pre-stored data is then compared with the calculated distances of the subject. If the comparison does not exceed a threshold value, then the subject's measurements are equivalent to those present in the database. If the measurement exceeds the threshold value, then the individual is considered to be different to the one present in the pre-stored database.

2.2 Face Recognition Processes

One of the most crucial methods for confirming someone's identification is face recognition. After detecting the face, face recognition is done. Some of the algorithms that are used for face recognition are PCA, LBPH and HOG (Histogram of Gradients).

2.3 Face Recognition Approaches

Two basic strategies are used to deal with face recognition: a holistic strategy and a feature-based strategy [14, 15].

- Holistic Approach

The term "holistic approach" refers to using the entire face that is visible in the image as the input for the face recognition process, as seen in figure 1. Nevertheless, because this method uses the entire face that is present in the image as the input, it excludes the lighting and invariance issues.

Fig. 1. Face Structure

- Feature-Based Approach

Feature based approach as the name suggests, takes into consideration individual features of the face for calculation and evaluation operations involved in the face recognition process. Figure 2 below shows how the model/ algorithm of face recognition recognizes individual features of the human face, whether it is the nose, the mouth or the eyes etc. The lighting, position variation, and other issues are dealt with by the feature-based technique since it only uses the parts of the face for facial identification, not the entire image.

Fig. 2. Face Features

3. Face Recognition Challenges

Some challenges faced during the face recognition process are mentioned below :

3.1 Aging

Aging happens to everyone. It is a natural process that we as humans have no control over. Aging can result in a lot of changes in the human body. These changes cause variance in the human face over time. But aspects of aging are depended on us whereas some are not. Factors such as eating healthy, exercising, region where we live, condition of weather etc are all depended on us as humans which can result in changes in the human body overtime.

3.2 Partial Occlusion

An occlusion simply means when something has been closed of or blocked of. In terms of face recognition it means something or someone blocking the main subject in the image being used for face recognition. Sunglasses, a scarf, hands, and hair may all block the view of the camera from the subject's face. The ability to recognize faces is hampered by these things.

During feature approach of an ear results can differ due to ear-rings in the image which can also be called as partial occlusion. Shadows can also be considered as occlusions. In order to resolve partial occlusion problems the features on the face that are clear can be used.

3.3 Pose Invariance

Pose variance is also one of the problems faced during face recognition. Taking a picture in the same pose almost every time is next to impossible, sooner or later there will be some variance in the images. The subject posing differently in the initial data and posing differently in the next can lead to decrease in accuracy for face recognition. A good system can be defined as one that can overcome the problem of pose variance to a certain extent.

3.4 Illumination

Illumination is another key point that can affect accuracy of face recognition. Illumination simply means lighting, or the amount of light that is on the test subjects. Face recognition accuracy can be very high in a controlled environment under ideal lighting conditions, but that does not always happen. In real world, lighting can differ from place to place. It can prove to be very difficult to recognize a face if the lighting is too dim. Grey level, face reflection field estimates, and gradients are a few techniques to address accuracy difficulties connected to lighting.

4. Literature Review

The use of facial recognition in student attendance systems has been extensively studied. Ayush Haate [21] pointed out that these extracted features and facial features are put into a facial recognition database to record student attendance. LBP techniques for feature extraction and comparison. However, the system did not produce good results due to poor image quality and low RAM usage. If you use a high quality image and add some RAM you should be able to get decent results in real time.

G.M. Beumer, K. Tao, AM Bazen, and R.N.J. Veldhuis [2], this study proposes a presence system to capture photos using a smartphone, an Alt-Jones algorithm, logistic regression, k-Nearest Neighbors (k-NN), and LDA to estimate student attendance. The fact that this study only uses one facial recognition technique to track student attendance is a drawback. It takes 4444 times longer and uses more network resources to recognize faces.

In another study, Daniel Miic, Ognjen Belitsa, Jelena Durutovic, and Milos Ljubojevic[03] stated that the system uses RFID cards and facial images of students for attendance. If anybody tries to mark a student's attendance with an RFID card and there is no picture, The programme will record the student as absent. and send an alert to the system. However, this means that students must carry ID.

Anyone without ID will be considered absent. Scanning RFID when entering a classroom takes a long time. Sudhir Bussa, Shruti Bharuk, Ananya Mani, and Sakshi Kaushik [20]. The elimination of the

backdrop and face identification and recognition using the Eigen Faces approach. Following that, the face is identified and cropped. After that, it does facial recognition using a special approach. But a boy with a beard and a girl with a veil cause problems with face recognition.

Dr. Shinde [8] refers to the work of Viola Jones and LBP using a feature-based face recognition method and compares face detection & face recognition algorithms. However, in this study, a static background was used for face recognition. Face recognition problems with dynamic backgrounds, lightning, and changing faces were not analyzed in this study.

In the same vein, Ravi Kishore Kodali, Raghu Vamshi Hemadri [06] showed that PCA and LDA for attendance system. this system It is a reliable and best solution to your time-consuming problem. No other biometric methods please solve this problem. However, the system failed. Face variability problem due to human face Variety of appearance is high.

We are simply saying that this problem is a result of aging. In 2021, Ashish Khuran, Bhanu Lohani, Bhanu Lohani, Pradeep Kushwaha [04] described PCA, LDA, LBP, Gabor Filters, this work provided a solution for validation. The real presence of students taking pictures of the third class by chance. But this operation fails Student attendance problem for face recognition A boy with facial hair and a girl with a veil.

In the professor's research. PY Kumbhar and Mohammad Ataullah [18] PCA and LDA for Face Detection and Recognition. Both PCA and LDA have their advantages and disadvantages when it comes to face recognition. This study also recommended a mixed approach for improved outcomes. Lighting, glassy photos & facial expression images cause problems for face recognition.

In a study by Jaehoon Jung (Paul), Minho Kim, Lee Yonghyun†, and Patrick Linga [15], the system recorded video in a classroom while students were attending a class. Captured images are used as training images for face recognition. However, this operation did not provide 100% results for . This is because the system recognized only 82% of the students and marked the remaining 18% as absent.

In a study by Mohsin Karovalia and Saifali Karediab [11], PCA and LDA methods were previously being utilized for facial detection & recognition. According to this study, LDA is the best partial occlusion algorithm and PCA is the best lighting method. When using PCA technology, the face recognition rate under lighting is 66%. Thanks to partial occlusion using LDA, the face recognition rate is 86%. This study proposes a hybrid face recognition strategy combining PCA and LDA methods. This article does not address issues of aging and posture differences.

5. Proposed Model

The administrator has the ownership of image database which consist of test images. The proposed model will work for images present in the database. The proposed model of study contains two steps. The first step is the getting the features of the data that is stored in the image database. The database is predefined and no data is updated in the image database. Encoding is the process of feature extraction in which the distance between the features are calculated. For encoding it uses the LBPH and HOG. The encoding of this dataset is then stored in a list. Then the second step is the capturing of live data. Live data gets captured with the help of camera. The non-facial aspects are discarded .For fast execution the image is resized. The encoding of image takes place. Then encodings of the live data is compared with the encodings of the predefined dataset present in the list .If the value is less than the threshold then the live data is considered to be a part of dataset and then the attendance of the particular individual is marked in the attendance data set.

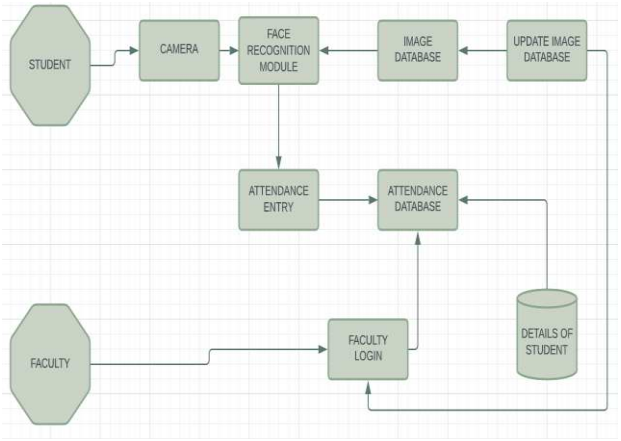

Fig 3 : Layout of proposed algorithm.

6. Algorithm

6.1 HOG

HOG stands for Histogram Of Gradients. This method extracts characteristics, compares them to face features recorded in a database, and then uses the comparison to determine if a student was there. HOG uses the principle of Histogram. The image is divided into 128 grids and in one grid nine pixels are converted to binary values and then later converted to numerical.

6.2 LBPH

LBPH stands for local binary pattern histogram. This technique is used to extract features, compare them to face features recorded in a database for face recognition, and mark student attendance. LBHP also uses the principle of Histogram. It is used with HOG. Inside the 128 grids nine pixels are converted to one histogram. These histogram patterns are used for comparison.

According to the proposed module we will be using supervised machine learning which the model will work on labeled dataset. The machine learning model will train itself on the predefined dataset. The data will be captured through the camera and the model will then detect faces and choose the correct data from dataset if it matches with the labeled dataset. The detection is only possible if the data is present in the data set.

6.2.1 Storing Of Data In Image Database

The administrator has the full responsibility of updating the dataset. The model will only work on images that are stored in the dataset.

6.2.2 Encoding of Image From Database

The data is present in the dataset is in the BGR format. This format has to converted to RGB for further processing of data. Then the images are converted from BGR to RGB. After the conversion of images

from database then feature extraction of these images are done. Using the LBPH(Local Binary Pattern) and HOG(Histogram Of Gradient) .Then this encoding are stored in a list for future comparisons with the live data.

6.2.3 Capturing Live Image

The live image is captured through the camera. Working on a large image would slow the process of feature extraction and comparison and hence the image is resized to one fourth the actual size.

6.2.4 Encoding Of Resized Image

The facial features of resized images are then implied from, by using LBPH and HOG .The encodings of the resized images are then stored in a list for future comparisons.

6.2.5 Comparison

The encodings of the predefined images are compared with the encodings of the live images. A particular image will generates a minimum value after the comparison of both the encodings. The index of the minimum value is considered. If the minimum value exceeds the threshold(0.5) then we discard the particular comparison else we consider it and mark the attendance of the particular in the attendance database.

7. Conclusion

The goal of this system is to develop a reliable automatic attendance system that makes use of facial recognition technologies. With the use of a facial biometric function, the suggested system will be able to record attendance. It will use the camera to identify faces before recognizing them. Also, it will record the presence of identified students. The world is increasingly more automated, thus we suggested the idea of an attendance management system using facial recognition. This project automatically transmits student attendance to the appropriate faculty members. The HOG feature extraction was employed. This technique eliminates the shortcomings of the attendance system and minimizes human involvement. The project is precisely planned to automatically record attendance and aid universities in data administration.As compared to the conventional attendance marking systems, the early experiment's results demonstrate increased performance in the estimate of . The task of face recognition is made easier by the fact that face recognition systems are presently connected to several leading technology enterprises and industries. It is a simpler and more practical system or tool that anybody may create to meet their needs thanks to the usage of Python programming and OpenCV. With the use of the site, students have an easy method to check their attendance and obtain insightful information. Without having to deal with cumbersome paperwork to record and remember current attendance status, the teachers were given a mechanism to digitally update attendance. This approach has the potential to replace the currently used methods in educational institutions and might prove to be highly effective and advantageous for instructors, students, and education as a whole.

8. References

G.M. Beumer, Q. Tao, A.M. Bazen, and R.N.J. Veldhuis University of Twente, EEMSC, Signals and Systems P.O. box 217, 7500 AE, Enschede, The Netherlands, A landmark paper in face recognition(IEEE), 2006.

Danijel Mijić, Ognjen Bjelica, Jelena Durutović, Miloš Ljubojević, East Sarajevo, Republic of Srpska, Bosnia and Herzegovina(IEEE), 2019.

Chandra, Harjanto, Feisal, Meyliana, Ford Lumban Gaol, Winanti , Application of "Face Recognition" Technology for Class Room Electronic Attendance Management System, Universitas Bina Nusantara, Jakarta, Indonesia(IEEE), 2021.

Ravi Kishore Kodali, Raghu Vamshi Hemadri, National Institute of Technology, Warangal, Attendance Management System , International Conference on Computer Communication and Informatics (ICCCI), 2021.

Burham Isnanto, Ari Amir Alkodri, Supardi, Attendance Monitoring With GPS Tracking on HR Management, Pangkalpinang, Indonesia, 2020.

Payal Patil, Prof. Dr. S. Shinde, Fourth International Conference on Electronics, Communication and Aerospace Technology (ICECA-2020) IEEE, 2020.

Puja S. Prasad, Rashmi Pathak, Vinit Kumar Gunjan and H. V. Ramana Rao, Deep Learning Based Representation for Face Recognition, Springer ,2020.

Dongmei Feng 1, Peng Wang 1, Lei Zu2, Design of Attendance Checking Management System for College Classroom Students Based on Fingerprint Recognition, Cornell University Libraryfrom IEEE ,2020.

Mohsin Karovaliyaa , Saifali Karediab , Sharad Ozac , Dr.D.R.Kalbanded, Enhanced security for ATM machine with OTP and Facial recognition features, International Conference on Advanced Computing Technologies and Applications (ICACTA2015).

Tejashree Dhawle Urvashi Ukey, Rakshandha Choudante, Face Detection and Recognition using OpenCV and Python, International Research Journal of Engineering and Technology (IRJET), 2020.

R. Brunelli a and T. Poggio , Face Recognition through Geometrical Features, Artificial Intelligence Laboratory Massachusetts Institute of Technology Cambridge, Massachusetts 02139, USA ,2001.

Rakib Hasan, Sajedul, Habibur, Saifuzzaman, Farjana, Nazmun, Implementation of Low Cost Real-time Attendance Management System: A Comparative Study, 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO) Amity University, Noida, India. June 4-5, 2020.

Jaehoon (Paul) Jeong∗, Minho Kim†, Yeonghyeon Lee†, and Patrick Lingga, IAAS: IoT-Based Automatic Attendance System with Photo Face Recognition in Smart Campus, (IEEE), 2021.

Gang Hua, Senior Member, IEEE, Ming-Hsuan Yang, Senior Member, IEEE, Erik Learned-Miller, Member, IEEE, Yi Ma, Senior Member, IEEE, Matthew Turk, Senior Member, IEEE, David J. Kriegman, Senior Member, IEEE, and Thomas S. Huang, Fellow, IEEE, Introduction to the Special Section on Real-World Face Recognition, 2011.

Qi Hong , Zhongyuan Wang, Zheng He , Nanxi Wang , Xin Tian , Tao Lu, Masked Face Recognition with Identification Association, IEEE 32nd International Conference on Tools with Artificial Intelligence (ICTAI), 2020.

Prof. P Y Kumbhar , Mohammad Attaullah , Shubham Dhere , Shivkumar Hipparagi, Real Time Face Detection and Tracking Using OpenCV, INTERNATIONAL JOURNAL FOR RESEARCH IN EMERGING SCIENCE AND TECHNOLOGY, VOLUME-4, ISSUE-4, APR-2017.

Sofoklis Goulas a , Rigissa Megalokonomou, School attendance during a pandemic, Economics Letters 193 (2020).

Sudhir Bussa, Shruti Bharuka, Ananya Mani, Sakshi Kaushik, Smart Attendance System using OPENCV based on Facial Recognition, International Journal of Engineering Research & Technology (IJERT), 2020.

Ayush Atul Hate, Face Recognition Attendance System, International Journal of Innovative Technology and Exploring Engineering (IJITEE), 2019.