A Survey on Automated Student Attendance Management System Using Face Recognition

Imran Khan, Ayaan Khan, Alfred George, Junaid Golandaj and Shubham Bhandari

March 31, 2023

A Survey on Automated Student Attendance Management System Using Face Recognition

Imran Khan
JSPM's Imperial College of
Engineering and Research
ikmaz1816@gmail.com

Guided by
Prof. Shubham R Bhandari
JSPM's Imperial College of
Engineering and Research

Ayaan Khan
JSPM's Imperial College of
Engineering and Research
aykayk507@gmail.com

Alfred George
JSPM's Imperial College of
Engineering and Research
alfredgd2001@gmail.com

Junaid Golandaj
JSPM's Imperial College of
Engineering and Research
junaidgolandaj84@gmail.com

Abstract— **The traditional system of managing attendance obviously is a time consuming method which creates many difficulties for the person in charge to record students' attendance. As we are moving from manual work to automation, there is a need for a more convenient biometric student attendance system to reduce these difficulties. There are various types of biometric techniques to resolve the problem of manual work. As face recognition is considered to be the best biometric technique, face recognition technique is anticipated to be used in student attendance system. The main purpose of this study is to understand the existing work on student attendance system using face recognition. The current study conducted a survey on previous literature based on student attendance management system using facial recognition. This paper elaborates processes, approaches and challenges involved in face recognition technique. There are many challenges with respect to studies based on face recognition. To address this challenge this study proposed a camera based student attendance system by using face recognition technique.**

Keywords—Face Recognition, Student attendance system, Processes, Challenges, Approaches, Manual, Automation.

I. 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. In automated attendance system, all the irregularities present in the manual attendance system are removed. Automated attendance system is the means to overcome all the problems that cannot be alone be handled by the traditional system. There are different type of biometric attendance system, which includes, Iris, nose, ear, hair, face, fingerprint for marking the attendance of the student.

Biometric system reduces the human involvement and chances of errors are decreased. Face recognition as mentioned above, is also one of the types of biometrics used in attendance system. According to studies, face recognition is a tried and tested method, which gives optimal results for identity verification.

II. FACE RECOGNITION

Face recognition is a technique that is used for identity verification. There are many features which can be extracted from the face of an individual. Every individual will posses unique features. Features such as eyes, nose, mouth, ears 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.

For the first time in 1960, face recognition was used for automation. Main features such as nose, eyes, mouth and ears hold an important significance. The distances and ratio of these features were calculated. After the calculation, these measured values were then compared with the pre-stored data. In 1970's Goldstein, Harmon and Lesk created a system with 21 marks like the thickness of lips and color of hair. But accurate measurements were impossible to prove because all measurements were entirely done by hand.

A. Face Detection Processes

In face detection process, the most important part is discarding of non-facial aspects of the image. Face detection process is mainly divided into two steps. The

first step of detection involves getting the measurements of the pre-stored data. 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.

B. Face Recognition Processes

Face recognition process is one of if not the most important techniques used for identity verification. After detecting the face, face recognition is done. Some of the algorithms that are used for face recognition are PCA (Principal Component Analysis), LBPH (Local Binary Pattern Histogram) and HOG (Histogram of Gradients).

C. Face Recognition Approaches

Face recognition is dealt with two main approaches that are holistic and feature-based approach [14, 15].

- *Holistic Approach*

Using the whole face present in the image as the input for the process of face recognition as shown in figure 1 is called Holistic Approach. Using holistic approach however, does not include the illumination, invariance problem because this approach takes the whole face present in the picture as the input.

shutterstock.com · 548848999

Fig. 1. Holistic Approach

- *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. Feature based approach handles the illumination, pose variance and other such problems as it uses features of the face for facial recognition and the not the full image as a whole.

Fig. 2. Mouth, Nose, Eye Features

III. FACE RECOGNITION CHALLENGES

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

A. 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.

B. 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. Different obstacles such as sunglasses, scarf , hands, hair can come in between the face and the camera. These objects create a problem in face recognition.

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.

C. 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.

D. 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 is not always the case. In real world application lighting can differ from place to place. It can prove to be very difficult to recognize a face if the lighting is too dim. Some methods to improve illumination related accuracy issues are grey level, face reflection field estimation and gradients.

IV. LITERATURE REVIEW

Numerous studies on the use of facial recognition in student attendance systems have been done. Ayush Atul Hate [21] highlighted that these extracted features and facial features are placed in a database for face recognition to record student attendance. The LBP technique was utilized for feature extraction and comparison .But, this system did not give good results due to the use of low-quality image and low Ram capacity. By using the high-quality image and increasing RAM we may take good results in real-time face.

In another study conducted by G.M. Beumer, Q. Tao, A.M. Bazen, and R.N.J. Veldhuis [2], this study proposed an attendance system to use a smartphone for picture capturing to mark student attendance using viola jones algorithm , logistic regression, k nearest neighbor(k-NN) and LDA. The drawback of this study was that it proposed a single-face approach for face recognition to mark student attendance. For single face recognition more time and network resources are consumed.

In another study, Danijel Mijić, Ognjen Bjelica, Jelena Durutović, Miloš Ljubojević [03] stated that The system used the both RFId card and face image of students for attendance. If someone wants to mark attendance of student using his/her RFId card and face picture is missing, then system mark the student attendance as absent and also send the warning. But this would mean that it would be Compulsory for students to take ID card with them. Without ID card it will be considered absent. Take a lot of time to scan RFID when entering into the class.

Sudhir Bussa, Shruti Bharuka, Ananya Mani, Sakshi Kaushik [20] employed Eigen Faces method for face detection and for face recognition, Background subtraction was done in this work. After this face detection and the face is cropped. Then the Eigen face method was used for face recognition. But, Boys with beard and girls wear veil created problems in face recognition

In another study, Payal Patil, Prof. Dr. S. Shinde,[8] mentioned that viola jones and LBP study used the feature based approach for face recognition and also compared the face detection and recognition algorithms. However, This study used static background for face recognition. Dynamic background, lightning and facial changes problems of face recognition were not analyzed by this study.

In the same token, Ravi Kishore Kodali, Raghu Vamshi

Hemadri [06], carried out a study which used PCA and LDA for the attendance system. This system gave a reliable and better solution to solve the problems of time-consumption. The other biometric technique does not solve this problem..However, The system did not handle the problems of face variability because the human face has a high degree of changeability in its appearance. Simply we say this problem is an aging effect.

In 2021, Ashish Khuran, Bhanu P Lohani, Bhanu P Lohani ,Pradeep K Kushwaha [04] studied PCA, LDA, LBP, Gabor Filters ,this work gave the solution to check the student actual presence by taking class picture three times randomly. But, this work did not handle the problems of student attendance during face recognition of boys with beard and girls who wear a veil.

In a study by Prof. P Y Kumbhar and Mohammad Attaullah [18], PCA and LDA were used for face detection and for face recognition. In some situation, PCA is best and in some situation, LDA is the best technique for face recognition. This study also suggested to use the hybrid technique for better results. Illumination, Glass images and Facial Expression images caused problems for face   recognition.

In a study, Jaehoon (Paul) Jeong∗, Minho Kim†, Yeonghyeon Lee†, and Patrick Lingga[15], The system captured class image when students were busy listening to the lecture. The captured image was taken as a training image for face recognition. But, this work did not give the 100% result because the system recognizes only 82% students remaining 18% that are not recognized are marked as absent.

In a study done by Mohsin Karovaliyaa and Saifali Karediab [11], The techniques employed for face detection and recognition were PCA and LDA. According to this study, LDA is the best algorithm for partial occlusion and PCA is the best approach for illumination. Using the PCA technique, the face recognition rate was 66 percent under light. Due to partial occlusion utilizing LDA, the face recognition rate was 86%. This study suggested using a hybrid strategy for face recognition, which combines PCA and LDA methods. Ageing issues and pose variance were not covered in this work.

V.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(Local Binary Histogram Pattern) and HOG(Histogram Of Gradients).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.
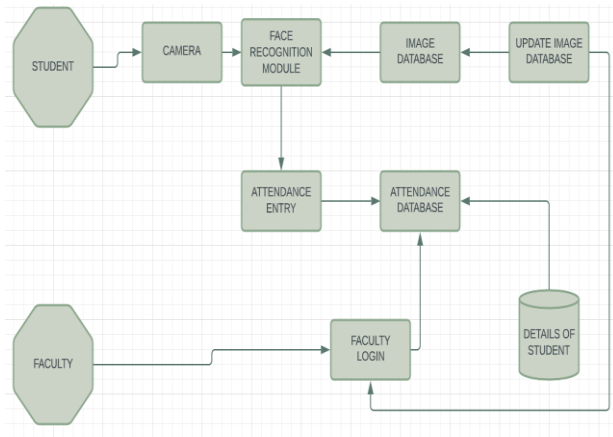

Figure 3 : Layout of proposed algorithm.

VI. ALGORITHM

1. HOG

HOG stands for Histogram Of Gradients. This is an algorithm which is used for feature extraction and the comparison are done these extracted feature and face features stored in a database for face recognition to mark student attendance .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.

2. LBPH

LBPH stands for local binary pattern histogram. This is an algorithm which is used for feature extraction and the comparison are done these extracted feature and face features stored in a database for face recognition to 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 be able to detect faces and chooses 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.

A. 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.

B. 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.

C. 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.

D. Encoding Of Resized Image

The features of the resized images are then extracted using the LBPH(Local Binary Pattern) and HOG(Histogram Of Gradient) .The encodings of the resized images are then stored in a list for future comparisons.

E. 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.

VII. CONCLUSION

This system targets to build an efficient automated attendance system using face recognition technology. The proposed system will be able to mark the attendance via face biometric feature. It will detect faces using webcam and then recognize the faces. And it will mark attendance of recognized student face. 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. The result of our preliminary experiment shows improved performance in the estimation of the attendance compared to the traditional attendance marking systems. Face recognition systems are currently associated with many top technological companies and industries making the work of face recognition easier. The use of python

programming and OpenCV makes it an easier and handy tool or system which can be made by anyone according to their requirement. The portal provided the students with a way of easily viewing their attendance and gaining useful insight. The teachers were provided a way of digitally updating attendance without the hassle of paperwork to mark and recall current attendance status. This system can take over the existing methods followed in institutions and can turn out to be very efficient and with many advantages, providing ease to the teachers, students and education as a whole.

VIII. REFERENCES

[1] Xuhang lian, School of Electrical and Information Engineering, Tianjin University, Tianjin 300072, A face Recognition Approach Based on Computer Vision(ICSGEA), 2010.

[2] 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.

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

[4] Ashish Khuran, Bhanu P Lohani, Bhanu P Lohani ,Pradeep K Kushwaha , An AI Integrated Face Detection System for Biometric Attendance Management ,Department of CSE Amity University Greater Noida, 2nd International Conference on Intelligent Engineering and Management (ICIEM), 2021.

[5] 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.

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

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

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

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

[10] 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.

[11] 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).

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

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

[14] 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.

[15] 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.

[16] 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.

[17] 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.

[18] 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.

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

[20] 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.

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