Student Smart Attendance Through Face Recognition using Machine Learning Algorithm

Nandhini R, Kumar P

ABSTRACT*: *In today's competitive world, with very less classroom time and increasing working hours, lecturers may need tools that can help them to manage precious class hours efficiently. Instead of focusing on teaching, lecturers are stuck with completing some formal duties, like taking attendance, maintaining the attendance record of each student, etc. Manual attendance marking unnecessarily consumes classroom time, whereas smart attendance through face recognition techniques helps in saving the classroom time of the lecturer. Attendance marking through face recognition can be implied in the classroom by capturing the image of the students in the classroom via the camera installed. Later through the HAAR Cascade algorithm and MTCNN model, face region needs to be taken as interest and the face of each student is bounded through a bounding box, and finally, attendance can be marked into the database based on their presence by using Decision Tree Algorithm.

Index terms: ***face recognition, machine learning (ml), haar cascade, opencv, multi task cascaded convolution neural network, decision tree.***

I. INTRODUCTION

A. CONVENTIONAL VS UNCONVENTIONAL ATTEDANCE MARKING SYSTEM

Conventional methods are still being followed to mark attendance in many schools and colleges which is a more time-consuming task. The most common conventional methods being practiced in routine lifestyle are, the student is supposed to sign the attendance sheet manually, which is passed around the classroom while the lecturer is giving the lecture, sometimes this particular approach could undoubtedly allow the students to cheat about their attendance, where a student present in the class may sign for a physically absent student. Uncommonly, this attendance sheet could easily be either misplaced or lost with/without the lecturers' knowledge. Another stricter conventional method which is more commonly used in practice is the roll call system, where the student is supposed to answer to his/her roll call made by the lecturer, sometimes this method also allows the student to cheat about their attendance by answering the roll call as present for a student who is not available in the class which is again a time-consuming task. These manual methods of taking students' attendance have been proven to be a difficult and time-consuming process. Thus, there is a need for either a semi-automated or automated attendance marking system that would eliminate all of the above-stated issues.

Revised Manuscript Received on May 21, 2020.

Nandhini R, M.E. Student,Department of Computer Science and Engineering, Rajalakshmi Engineering College (Autonomous), Thandalam, Chennai.

Dr Kumar P, Professor,Department of omputer Science and Engineering, Rajalakshmi Engineering College (Autonomous), Thandalam, Chennai.

The Automated Attendance marking system (Unconventional methodology) is a process that violates the conventional system; it adapts the methodology where the attendance can be obtained only through the physical presence of the student in the classroom. Attendance marking through the physical presence of the student can be done in many aspects like fingerprint recognition, face recognition, iris recognition, speech recognition, etc. The technique followed in this paper to mark the attendance of the student is through face recognition.

B. WHY FACE RECOGNITION SYSTEM?

Face Recognition is a process of obtaining the face of the student to ensure his/her presence in the class and to mark attendance. It can also help the lecturer to find whether the student is sleeping or awake during the lecture duration. A High-Definition camera can be installed in each classroom which is involved to capture the image of the student, further from the captured image, face of each student is segregated by bounding the face region on the captured image and attendance is marked for the student in the database to ensure their presence in the classroom. The face segregation (Region of Interest) and the attendance marking in the database can be done through some machine learning algorithms. Face Recognition technology is considered because the attendance of each student can be easily marked without any influence of the human either the lecturer or the student or any other external person, the face image of the student can be captured from a distant location and can be used for analysis; as a result, no student can imitate as another student. On considering fingerprint recognition, the physical fingerprint of the student is required to mark the attendance or on considering iris recognition, iris of an individual student is supposed to be scanned through a biometric device to mark attendance. Thus, on-going with a face recognition system, the face of the student can be easily obtained through the camera installed in the classroom and the attendance can be easily maintained in a database, whereas on considering the other recognition technology it requires the physical interference of the student but the face recognition technique doesn't require any physical interference of the student.

There are two major things that need to be maintained in the face recognition system,

i. Enhanced Security - because the face image of the student should not be misused by an external authority.

ii. Faster Processing - helps in maintaining attendance for all the students of the institution, thus faster processing helps for easier retrieval of attendance to send email or message to the parent.

C. WHY MACHINE LEARNING FOR FACE RECOGNITION?

Machine Learning (ML) is a subfield of Artificial Intelligence (AI), wherein the goal of ML is to understand the structure of the data and fit that data into models that can be understood and utilized by people, by using the process feed-forward artificial neural network the field of Convolutional Neural Networks (CNN or ConvNet) analyses the visual images or video data successfully. Machine learning algorithms are categorized into training and testing, where it allows the computers to train on data inputs and use statistical analysis to output values that fall within a specific range. Because of this training and testing upon the statistical values, machine learning facilitates computers in building models from sample data to automate decision-making processes based on data inputs. The network model needs to be trained to automatically identify the images captured in the database. The finished output will be the attendance marked of an individual student, if the captured face image exists in the trained dataset of images, if the captured image doesn't exist the trained database then an unknown student is present in the class or a student from other class may visit the class during the time of image capturing.

II. LITERATURE SURVEY

Setia Budi et al [1] have proposed a low-cost solution in recording student attendance aiming in recording or capturing the images of the student seated in the classroom on photographs, using a smartphone camera or tablet camera, then the captured image is uploaded to IBAtS server to detect the face of the student captured in the photograph so that the face region is bounded (Region of interest) automatically with the help of the face detection algorithm, and the attendance for the student-t is marked by simply identifying their face on the records (pre-trained image). Mobile applications were developed for both students and lecturers as the primary interfaces to interact with the system and to have a note of their attendance. The algorithm pointed out by Setia Budi et al was to deal with Viola-Jones, HAAR Cascade. Omar Abdul Rhman Salim and others [3] worked to develop a comprehensively embedded class attendance system using facial recognition along with controlling the door access technology based on Raspberry Pi camera, where the camera is fixed on the door to acquire and handle the face of the student. If the students' face matches with the trained dataset of images that are already obtained then the door opens with the help of the servo motor fixed to it, as the door opens attendance for the student is marked in the attendance database. HAAR Cascade, Local Binary Pattern has been used to mark student attendance.

Jalendu Dhamija et al [5] in their paper "An Advancement towards Efficient Face Recognition using Live video feed" proposed on three algorithms namely Fisherface, Principle Component Analysis (PCA) and Single Vector Decomposition (SVD) where the face recognition rate is improved by combining them. The recognition rate is improvised by the process of leaving one out methodology and hold out methodologies.

Aayush Mittal, Fatima Sartaj Khan, Praveen Kumar, Tanupriya Choudhury [6] focused to automate the traditional way of taking attendance on registers and to integrate the system with the cloud so as to make all the records readily available in order to reduce the errors. This system proves to mark attendance at a single point of time for a group of students in the classroom. Thus, when compared with the other alternatives for marking the attendance, this system proves to be more reliable and accurate using Viola-Jones, Eigen Vectors, Adaboost algorithms.

Aesha Shah et al [10] describes about a prototype of Auto Face Tagger on Android Phones, for the purpose of deploying the process of face recognition on mobile phones using sensor technology whose face input is obtained via a camera are being auto tagged. Client-server architecture has been used to test the image in the phone and training on the server. Once the image of the person obtained in the android phone is recognized by comparing it with the trained dataset of images, then an automatic tag is applied to the face image captured on the android phone. Thus, the process tagging is done to the recognized face for the fast retrieval of the image. The most adaptive algorithm used in recognizing the face was Haar-cascades algorithm.

Miss. Nilofer Tamboli and Dr. M. M. Sardeshmukh [14] proposed research work on Students' attendance marking system using face recognition for high efficient signal transfer system applications. Overlapping of faces captured in an image is one of the common factors in face detecting applications. Initially, the face image is detected from the database for feature extraction and the extracted faces are compared to test images already obtained. Hereby using Dominant Rotated Local Binary Pattern algorithm the face is identified and used in extracting the overlapped faces, and finally the attendance is being recorded.

The most common issues faced in the surveyed papers are decreased image quality affecting the effectiveness of the image leading to improper detection of face, recognizing the face in small image is more difficult, not capturing the image of the students' carefully which therefore requires devices with added functionalities to capture the image properly, Security to be maintained on the captured face image.

III. UNCONVENTIONALLY PROPOSED SYSTEM

The system proposed in this paper is to maintain the attendance record with day to day activities of the students present in the classroom. The conventional method in practice is a time-consuming process and there is always a chance of proxy attendance, thus the automated process of marking attendance for the students present in the classroom helps in saving the time of the lecturer.

The proposed system is categorized into two different phases namely,

A. Registration Window
B. Face Recognition Window
C. Attendance Window

A. Registration Window

Initially, when the student joins the institution, Name of the Student, Registration Number, Year of study, Branch of study, Date of Birth needs to be registered in a database and 20 face images of the student need to be captured to maintain a dataset by naming them with the student name and registration number. The data stored in the database and the dataset are the pre-trained data to mark attendance for the student to ensure their presence during the lecture hour.

B. Face Recognition Window

The proposed face recognition window is categorized into four major steps namely,

i. Image Acquisition
ii. Face Detection
iii. Face Recognition
iv. Attendance Marking.

i. Image Acquisition

The initial step involved in the second phase is image acquisition i.e., obtaining the face image of the students present in the classroom. It can be obtained through the High Definition Video Camera installed in each classroom. From the video sequence obtained during the lecture hour, frames of each sequence are extracted from the video and numbered for further processing. From the extracted frames, two or more frames are taken at random and to proceed with further processing steps.

ii. Face Detection

From the extracted frames, each face image needs to be segregated. For this segregation purpose, we go with the process of face region bounding box methodology usually called marking the Region of Interest using HAAR cascade classifiers and MTCNN Model available in the OpenCV and face-recognition library respectively. After segregating the frame, the first frame is taken and the face image is detected and marked. Then the second frame is taken ad the face image is detected and marked. The same process is repeated for all the available frames.

iii. Face Recognition

The face image detected in each frame is taken and it is compared with the directory where the pre-trained face image of the student has resided. The same process is repeated for all the frames. To perform this comparison process Decision Tree Machine Learning algorithm is employed.

iv. Attendance Marking

If the face image present in frame1 matches the pre-trained image then the attendance is ensured for the particular student for the concerned lecture hour. If the student named as frame1 is not available in the trained dataset then the student's face saved as image1 doesn't belong to the particular class which means that the particular student may belong to the different class. The attendance can be maintained in any kind of SQL database for further easier retrieval of attendance data of a student.

C. Attendance Window

Attendance window is used in checking the attendance of a particular class of students by inputting certain factors like date, branch ad year. On providing these inputs, the attendance for the corresponding date will be provided as a report. Thus, an unconventionally attendance marking system by using some of the machine learning algorithms like HAAR cascade classifier, MTCNN model, and decision tree algorithm can improve its accuracy and learning rate.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

Jalendu Dhamija et al [5] in their paper "An Advancement towards Efficient Face Recognition using Live video feed" has been proposed to understand several preexisting face detection and recognition algorithms and provide solutions for live video-based facial recognition with better accuracy, higher speed, and efficiency to help develop a technology which can help in catching criminals promptly and is used to secure people's privacy. Many facial datasets have been taken to differentiate the face images in conditions of changes in poses, illuminations, and emotions. Various other conditions to obstruct the identification of faces have also been discussed.

Jalendu Dhamija et al have considered three algorithms namely Fisherface, Principle Component Analysis and Single Vector Decomposition which are more responsive to improve the efficiency of recognizing a face, it also improved efficiency of face-recognizing methodology. Two processes namely the Leave-One-Out method and Hold-Out method have been followed in their papers.

Leave-One-Out methods is a process of leaving certain areas of the face region like eyes, nose, mouth, eyebrows, etc., and recognize the face of a person which is not most commonly used. The hold-Out method is a process of training and testing. The training datasets are the set of data to which the model is been trained to and the testing dataset is to see how well the trained model performs on unseen data.

Here three different datasets have been taken namely AT & T Dataset, Yale Dataset, Facepix Dataset where each dataset maintains their uniqueness and the Hold-Out methodology has been worked out. Some of the major factors influencing all the three datasets are represented in Table1.1

Factors Influencing	Datasets		
	AT & T	Yale	Facepix
Image	10 distinct image of 40 subjects	11 images of 15 subjects	181 distinct images of 30 subjects
Format	PGM	PNG	JPG
Image Size	92x112	320 x 243	60 x 51
Face Direction	up-right, frontal position	up-right, frontal position	0, -1, 1 to -90,+90
Factors influencing the image	Images taken at different time, varying light intensity, Facial Expressions (open/close eyes, smiling/non-smiling), Dark homogeneous background	Center Light, with glasses, without glasses, Happy, Sad, Normal, LeftLight, Right Light, Wink, Sleepy, Surprised	Different Angle
Color Image	Grayscale	Grayscale	Grayscale

Table 1.1 Factors Influencing Different Datasets

DATASET	SVD		PCA with FISHERFACE	
	EXPECTED	PREDICTED	EXPECTED	PREDICTED
AT & T	88.89	84.85	93.92	91.29
YALE	88.89	86.06	93.92	91.44
FACEPIX	88.89	86.34	93.92	91.08

Table 1.2 Expected and Predicted Outcome of SVD and PCA with Fisherface Algorithm

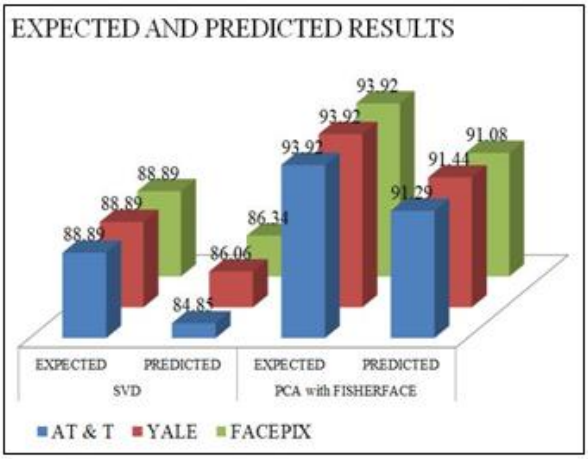

Fig. 1.1 Graphical Representation of Table 1.2

DATASET	SVD + PCA with Fisherface
AT & T	92.89
Yale	93.12
Facepix	92.87

Table 1.3 Average Accuracy Rate on combining SVD and PCA with Fisherface

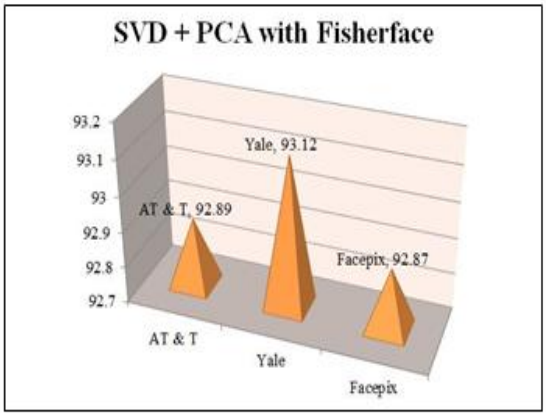

Fig. 1.2 Graphical Representation of Table 1.3

Under Hold-Out methodology, the expected outcome of the SVD algorithm is around 88.89% and on working with the SVD algorithm, face-recognizing rate of about 84.85 %, 86.06%, 86.34% for AT &T Dataset, Yale Dataset, and Facepix Dataset has been obtained respectively. And the expected outcome of the PCA with the Fisherface Algorithm is around 93.92 % where 91.29%, 91.44%, 91.08% face-recognizing rate has been obtained for AT &T Dataset, Yale Dataset and Facepix Dataset has been obtained respectively.

On combining the standalone SVD with PCA and Fisherface algorithm the accuracy rate obtained was about 92.89%, 93.12%, 92.87% for AT &T Dataset, Yale Dataset, and Facepix Dataset has been obtained respectively.

Hence in [5], it is observed that better efficiency and accuracy can be obtained by combining certain algorithms together for the increased face-recognizing rate and it has been proposed that there is no analysis for live video feed to recognize face easily. So, capturing the ideology from [5], “Student Smart Attendance through Face Recognition using Machine Learning Algorithm” is being implemented using face recognition algorithm and a model namely HAAR cascade classifier and MTCNN model to recognize the face of the student from the video streams obtained from the web-camera installed in the classroom and mark attendance for the student present in the classroom, and the problem of the live video feed is overcome in this implementation.

V. CONCLUSION

Thus the attendance of the students present in the class is marked by using face recognition technology which is implied with the machine learning algorithms. The Automated Attendance System helps in increasing the accuracy and speed ultimately to achieve the high-precision real-time attendance and its evaluation process.

FUTURE ENHANCEMENT

In future the work can be extended to process face recognition technique on various degree of angle upto which the system can recognize. This work can also be extended to mark attendance for identical twins where a minute change can be noted from the face of the identical ones.

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AUTHORS PROFILE

R.Nandhini

R. Nandhini, M.E. Student, Computer Science and Engineering pursuing my degree course in Rajalakshmi Engineering College, Chennai. I have published paper in referred International Journals and in referred national and international conferences. I have done my UG project in Speech Recognition under blog and obtained accuracy around 95% and doing my PG project under Face Recognition to mark student attendance.

Dr. P. Kumar

Dr. P. Kumar, Professor, Computer Science and Engineering has been with Rajalakshmi Engineering College, Chennai since June 1998. He has 23 years of teaching and published more than 30 papers in the referred National and International Journals. He has guided many UG and PG projects and one of his project have won Best Project in IBM TGMC. He also published a book on Computer Programming.