Common Approaches for Face Recognition

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Abstract—Attendance is a crucial part of every educational institute to keep track of its students' punctuality and performance assessment. Most commonly used attendance systems are signing attendance sheets or roll calls by the faculty which are time consuming as well as prone to forgery which results in inaccurate performance records. Biometric approach solves these issues especially Face Recognition which is the most secure of all biometrics and also fast, easy and convenient. The paper outlines different approaches for face recognition which uses different algorithms to provide authentic, accurate and efficient results in an attendance system.

Keywords-- Attendance System, Face Recognition, Literature Survey, Machine Learning, Deep Learning, Image Processing, Algorithms, OpenCV, SVM, PCA, LDA, CNN, LBPH.

I. INTRODUCTION

Most of the places worldwide we use manual approach for taking attendance, searching for the criminals using CCTV footages or even employee identity detection using cards. All these situations can be improved by using a face recognition system in place of a manual or electronic card system. The application of face recognition technology is immense ranging from an attendance system to ATM machines. It is highly advantageous in terms of efficiency and security. For example, it is easy to forge someone's debit card or give a proxy attendance. But face recognition system will prevent such misuse and make the overall system more accurate.

The manual method of taking attendance in colleges currently is roll-calling by the professor, there are chances of proxy and the method is time consuming. The main purpose of taking attendance is to take a count and to encourage the students to attend lectures on time. Although the existing method can have a good accuracy it is definitely time consuming. Many institutes have also used electronic system like card swipes. The main disadvantage of this system is that anyone can use another person's card. To address all these issues, a face recognition system in educational institutes like schools and college will significantly improve the efficiency of working, reduce proxies and save a good amount of time which can be used for improving the quality of education. With the new age technology like Machine learning and deep learning we can achieve a good accuracy as well.

Machine learning is an apropos technology to be used here as it will help to automate the system and it will learn and improve on its own. There are mainly 4 steps in a face recognition system: face detection, image preprocessing, applying a face recognition algorithm and finally updating the database to mark the attendance. Viola Jones is a well-known algorithm to detect faces[6]. Also, hybrid models can be used to fulfill our requirements [8]. The main issues that affect the face recognition accuracy are: rotation of face and low light or shadowy environments. Choosing the right dataset is important as our model will be as good as our dataset. The dataset should be large enough to train and test and must contain images of people from various ethnicities and different lighting environments. The hardware also forms an important aspect of the system. Most used hardware is Raspberry Pi or HP true vision camera. Raspberry Pi is small and affordable so it is preferred. This paper takes a comparative study of many research papers in the literature survey. Many algorithms and processes have been analyzed in the literature survey. Out of them CNN stood out due to its various advantages over others as mentioned in the Results.

This paper contains the following sections; Section 2 includes a literature survey of all the researched papers. Section 3 includes the results and observations made in the research papers; section 4 is the final section which contains the conclusion.

II. LITERATURE SURVEY

Rabab Alayham Abbas Helmi et.al, [1] "Face Recognition Automatic Class Attendance System (FRACAS)" based on Eigen Face Algorithm. The paper proposes face recognition to authenticate the identity of the students. The system also provides the class administrator authority to unmark students who are not recognized by the system or mark students whose faces cannot be recognized due to injuries or other circumstances. The system follows a four-phase methodology 1) Review of all Related Products 2) Analysis of Requirements 3) Development process of the system 4) Results. The primary algorithm used is Eigenface algorithm which provides accurate results since it compares features rather than the whole face and also can match the face with added features in it.

Arshath Khan. B, et.al, [2] "Modern Face Recognition with Deep Learning" based of Histogram of Oriented Gradients (HOG). HOG is a technique to determine the facial features that makes up the face. The images are converted to black and white since color is not required for feature detection, then features of the face are calculated. More the number of images fed to the system better is the accuracy. OpenFace of python is used for deep learning face recognition which also provides security.

Yogalakshmi .S et.al, [3] "Review on Digital Image Processing Techniques for Face Recognition" is a study and review on different face recognition algorithms which provide good accuracy. The various algorithms reviewed are geometric based algorithm, Eigenfaces, hidden Markov model, principal component analysis with ANN, template matching algorithm, face recognition using artificial neural networks, lighting compensation, and skin tone detection face recognition using convolutional neural network. The various advantages of all these above-mentioned algorithms are discussed.

Shubhobrata Bhattacharyaet.al, [4] "Smart Attendance Monitoring System (SAMS): A Face Recognition based Attendance System for Classroom Environment" proposes a system in which a video sequence is taken as the input to the system for face detection, facial features extraction and normalization of facial features. For better accuracy in recognizing faces a face tracker is used based on the idea proposed by Viola and Jones. The correlation tracker is used which is provided by the dlib library. Each normalized parameter of features of the face are given weights to make the image quality best during real-time video sequence. In the end all the images are fed into a deep convolution network to obtain the accurate classification of images.

Xiujie Qu, Tianbo Wei, Cheng Peng, Peng Du et.al, [5] "A Fast Face Recognition System Based on Deep Learning": This paper proposes a real-time face recognition method on FPGA. The method system is divided into two parts. First, the PC terminal is used to complete the training of the network and get the network parameters. Second, the face recognition system is built on the FPGA. The advantage of FPGA parallel processing is to speed up the computation speed of the network. The test results showed that the recognition speed of the system has reached 400FPS, recognition rate is 99.25%. CNN is used as it has unique superiority in image classification because of its special weight sharing structure.

Hemavati Sabu, Madhumala Sonawane et.al, [6] "Attendance System Based on Face Recognition": The system uses Eigenface face recognition technique as it is fast, simple with a good success rate. Viola and Jones face detection algorithm also known as the Ada-Boost algorithm for face detection is applied before actual recognition task. Face detection cannot cope well with 45° face rotation both around the vertical and horizontal axis. It is sensitive to lighting conditions and performs badly in dark or less lighted environment. While detecting face parts, we might get multiple face detections in an image even though only one face exists. To overcome the lighting problems eigenface technique is used but the face rotation problem has not been solved.

Ms.Sarika Ashok Sovitkar, Dr. Seema S. Kawathekar et.al, [7] "Comparative Study of Feature-based Algorithms and Classifiers in Face Recognition for Automated Attendance System": The Viola Jones algorithm has been used for face detection. In this method a Hybrid model of PCA and LDA is used. PCA is used to extract lower dimensional value and to reduce data redundancy. Also, it calculates the Eigen faces using Eigen values. LDA is used to extracts more discriminating features from faces know as fisher faces. The Eigenfaces and Fisherfaces are used for classification. Dataset used had different lighting conditions and facial expressions. The results were satisfactory.

Edy Winarno, Imam Husni Al Amin, Herny Februariyanti, [8] "Attendance System Based on Face Recognition System Using CNN-PCA Method and Real-time Camera": This paper has used a hybrid feature extraction method by combining CNN and PCA. The CNN method is used to produce a 3D face image from a 2D face image. The PCA method is used as for feature extraction and to reduce dimensions of the image. The Mahala Nobis distance method has been used in the classification process to determine the degree of similarity between features in order to produce a more optimal face recognition. The proposed system has showed better results than CNN method by resulting in a high accuracy of up to 98%.

Radhika C. Damale and Prof.Bageshree. V.Pathak, [9] "Face Recognition Based Attendance System Using Machine Learning Algorithms": The authors of this paper have proposed a system for using Face

recognition technique for attendance system using a combination of computer vision and machine learning algorithms such as Deep Neural Network (DNN), Support Vector Machine (SVM), Multilayer Perceptron MLP) and Convolutional Neural Network (CNN). In this system, facial recognition is being used because it's more convenient than other biometric systems such as fingerprint, iris or palm-print. The system makes use of DNN and OpenCV library to detect faces, then SVM and MLP for classification and also presents the alternative of CNN to use instead of SVM and MLP. The attendance is marked when the detected face matches with the provided input database.

Liyun Zhuang and Yepeng Guan, [10] "Deep Learning for Face Recognition under Complex Illumination Conditions Based on Log-Gabor and LBP": The authors of this paper have proposed a method to overcome the problems caused by complex illumination condition faced by facial recognition systems. The proposed system makes use of Log-Gabor filter and Local Binary Pattern (LBP) features to address the same. The Log-Gabor function (alternative to the Gabor function) causes reduced influence of the mentioned conditions helping to improvise the image processing for face recognition. In this proposed system, after using the filter for image processing, LBP feature extraction is performed and these images are used by the Deep Belief Network (DBN) to get a final output for training the model for face recognition. The final output is compared to the initial input for identifying a person.

Gurlove Singh and Amit Kumar Goel, [11] "Face Detection and Recognition System using Digital Image Processing": The authors of this paper have explained different approaches used by different face recognition systems and have also presented the advantages and limitations of these approaches. The paper also presents the use of Digital Image Processing for Face recognition for improving the quality of the images thus helping in the classification and recognition part of the entire process. The paper during explaining the different face recognition approaches has included the concepts of Active Shape Model (ASM), Low-level feature-based Analysis, Viola Jones method and Gabor Feature method for Feature searching, Neural Network and PCA.

Arjun Raj A, Mahammed Shoheb, Arvind K, Chethan K S, [12] "Face Recognition Based Smart Attendance System": The authors of this paper have proposed a system that would implement Face Recognition for marking the attendance of the Students. The system is implemented using OpenCV library, Local Binary Pattern Histogram (LBPH) face recognizer and Raspberry Pi. LBPH is used to overcome the problem of getting affected by the light conditions in Eigen faces and Fisher faces. LBPH converts the images to grayscale thus being unaffected by the light conditions. The test image will be compared to the training image to automatically mark the attendance in excel sheet. The parents of the absent students will receive a message about the same using GSM and students will be able to keep a track of their attendance with the help of android application.

III. RESULTS

From our literature survey we have learned about many approaches, techniques or methods for Face Recognition for biometric attendance that fall under various research areas such as Machine learning, Deep learning, Algorithms, Image Processing. The knowledge about these approaches can help avoiding their disadvantages or limitations and make use of the various advantages provided by different methods hence can be helpful to develop an efficient face recognition system for biometric attendance.

Many Machine Learning methods and algorithms such as SVM, MLP, CNN, PCA, LDA have been used in most of the systems that we have come across. SVM is mainly being used for small datasets as it doesn't give a good enough accuracy on being used on large datasets. SVM and MLP methods, both use PCA and LDA as feature extraction techniques. These techniques show significant influence of illumination conditions affecting their recognition rates.

Radhika C. Damale, Prof.Bageshree. V.Pathak [9], have compared the approaches using SVM, MLP and CNN which shows that CNN had the highest accuracy of 98%. Systems using OpenCV can also give a sufficiently good result. OpenCV (Open Source Computer Vision) which is a machine learning library has very easy to use methods for detecting and recognizing faces but it is still facing more Illumination problems than CNN. OpenCV along with LBPH can be used to work efficiently with a small dataset. LBPH, since it converts input images to grayscale, avoids facing issues due to the light conditions and has a simple working. Algorithms like Eigen faces and Fisher faces have also been used. Although Eigen faces provides advantages such as dimension reduction, speed and efficiency the recognition rate is highly affected by illumination or light conditions. Hence, it is not a suitable fit in every environment.

Deep learning methods like using Log-Gaborfilter along with LBPH and DBN was also found to be used. Log-Gabor is not developed for face recognition particularly but it can provide good accuracy rates though it becomes time consuming for the feature extraction part. Another approach for face recognition is with image processing.

In [11], the system presented includes using Digital Image Processing for improving the recognition process by performing image pre-processing, image segmentation, image description and then image recognition. Thus, there are many approaches and options to develop an efficient face recognition system but

even after looking upon most of them, using CNN for recognition seems to be a good option. The pros of working with CNN are the automatic feature detection, not getting affected by light and good accuracy.

IV. CONCLUSION AND FUTURE SCOPE

In this project, we outlined various approaches for attendance system which uses face recognition for efficient and accurate results. Different face recognition algorithms like SVM, PCA, LDA, LBPH and CNN were analyzed. Advantages and efficiency of these algorithms were also analyzed which made us conclude that algorithms involving Convolutional Neural Networks (CNN) provides better results and are more accurate than other algorithms. Hence going forward attendance systems incorporating face recognition would be very beneficial educational institutes.

The papers also show cased the true potential of all the Face Recognition algorithms and how it can be used efficiently for detecting faces. Especially algorithms making use of Convolutional Neural Networks which add several layers to the features of the face show cased that a system can be designed which can detect faces with higher accuracy under suitable conditions. This is a sign that such face recognition systems can be made commercial for educational purposes in the near future.

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