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I – Classroom with Attendance System using Image Processing

Bhavna Patel[1], Vedika Patil[2], Onkar Pawar[3], Omkar Pawaskar[4], Dr. Jayant Mahajan[5]

[1,2,3,4,5]*Department of Electronics and Telecommunications,*
MCT's Rajiv Gandhi Institute of Technology,Mumbai, Maharashtra, India.

Abstract- *Automated attendance monitoring systems with image processinginvolving a user interface for the administrator to keep track of attendance of the classhave been extensively researched upon to build a successful technique to manage the attendance and records of students. It is widely acknowledged that the face recognition has played an important role in surveillance system as it doesn't need the object's co-operation[10].Advanced concepts like Machine Learning are used in the implementation of such project ideas to overcome the implications in traditional hand-crafted features like uncontrolled environments such as pose, facial expression, illumination and occlusion that influence the accuracy of face recognition. This paper critically examines the main advances in automated attendance monitoring systems using image processing. In addition, systems using Machine Learning branch of reinforcement are elucidated and its performance accuracy is discussed.*

Keywords:*Machine Learning, Attendance System, Literature Survey, TensorFlow*

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I. INTRODUCTION

Attendance is one of the most essential activities in day-to-day educational routine. But manual data handling procedures are time consuming and demand efforts. There can be executed a viable framework which will mark the attendance of students via an automated attendance system.

There are many biometric methods available in which the basic concept is same. One of them is the finger print identification. In this method first the finger prints of the individuals are collected and stored in the database of finger print sensor. In RFID, system Radio Frequency Identification (RFID) cards are placed in identity cards of students. The other biometric method available is eye ball detection. In this method,an eyeball sensor is used to sensethe blinking rate of eye ball and the location of iris, and then compared with the eye ball in the database.The disadvantages of these systems likeintrusive nature and time inefficiency are overcome with the help of face recognition management which does not consume time and the data is not lost until erased by the administrator. In this method, the camera is fixed in the classroom to capture the image, the faces are detected, then recognized with the database and finally the attendance is marked.This method is most efficient in these days.

A smart classroom environment with an attendance system can prove helpful in monitoring attendance for the institutions.This system functions automatically and includes detection of human face through a high definition camera, capturing the students and comparing with images stored in the database. Furthermore, the user interface developed makes it easier for the faculty administrator to monitor the activities of the students and inform them accordingly. The face recognition system works based on the values of the nodal points on the person's face. The values measured with each nodal point helps in identifying and verifying the person's face. These values captured from the face's nodal points are given to other applications or software to easily and accurately identify the person. Machine learning can be applied, which can provide a system that can automatically learn and takes decision on its own experience without any explicit programming.

The main aim of using machine learning is to allow the computers to learn and take decision automatically without any human interference. Convolutional Neural Network has a unique advantage in speech recognition and image processing with its special structure of local weight sharing. Its layout is closer to the actual biological neural network, and the weight sharing reduces the complexity of the network, especially the image of multidimensional input-vector can be a direct input to the network to avoid the complexity of data reconstruction in the process of feature extraction and classification[8]. It can access data and learn on its own by the instruction given earlier or from past experience and makes better decision.Furthermore, by applying face

recognition technology the process of identifying student attendance or a lecturer in a classroom can be done during the learning session. This paper presents a detailed literature survey of articles related to the attendance system without human interference.The study has been carried out in multiple factors that comprehensively justify the basis of selection of necessary components for designing an automated attendance system. The areas of research are: Machine Learning platform, Algorithm, Image Processing Method, Dataset and Camera.

II. LITERATURE SURVEY

E. Varadharajan R. Dharani et.al, [1] "Automatic Attendance Management System Using Face Detection" based on Eigen Face Method. Eigen faces are a set of Eigen vectors which are used in computer vision problems of face recognition. In this system, the method used for face recognition is Eigen face approach due to its speed, simplicity and learning capability. After calculation of Eigen weight, the detected faces are compared with the database and attendance gets marked.

Shreyak Sawhney et.al, [2] "Real-Time Smart Attendance System using Face Recognition Techniques" based on Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN). The given model is linked with two databases. One for the faces and the other one is used for marking the attendance. This system proposes a high-definition camera installed outside the classroom, where students avail the access to enter the classroomby scanning their faces in that camera. Another camera installed inside the classroom is such that every student in the class is visible to the lens of the camera. Facial detection and recognition algorithms are applied to both the cameras to analyse the faces and mark their attendance accordingly.

JenifW S D'Souza et.al, [3] "Automated Attendance Marking and Management System by Facial Recognition Using Histogram" is been implemented with 4 modules such as Image Capturing, Segmentation of group photo &Face Detection, Face comparison &Recognition, and Updating of Attendance in database. In this system, camera takes 5 pictures of an interval of 5 minutes and uploads it at a constant period of every 40 minutes. Here segmenting the face of person and detecting face from the captured image is carried out using Haar cascade algorithm, and identify the face by using trained dataset using histogram values.

Poornima S et.al, [4] "Attendance Monitoring System using Facial Recognition with Audio Output and Gender Classification" an automated attendance system with audio output using image processing techniques and voice conversion methods. This researchusesan experimental approach in a classroom with students sitting in columns with various postures, gestures and accessories. This system is developed by capturing real time human faces in the class. The detected faces are matched against the reference faces in the dataset and attendance of the attendees is marked. Finally, the absentee list is said aloud through voice conversion system for confirmation. Additionally, the system is trained to classify the gender of the students present in the class.

Bana Handaga et.al, [5] "Attendance System based on Deep Learning Face Recognition without Queue". The prototype system for managing student attendance in classroom based on deep learning facial recognition technology without queue. Feature extraction uses 128-d facial embeddings from Face Net, and its implementation uses libraries originating from OpenCV and dlib. This system overcomes the traditional attendance monitoring problem in such a way that it allows the process of identifying the faces of students present in the classroom during the learning session in the class, and detects their presence in classroom.

Rekha A L et.al, [6] "Automated Attendance System Using Face Recognition Through Video Surveillance"based algorithm is automatic and efficient in intelligent surveillance applications. Video surveillance is used to detect the object movement thereby the captured image undergoes face detection and recognition process and searches the student database and enters the attendance if it is valid in the list.

Rathod H et.al,[7] "Automated Attendance System using Machine Learning Approach"uses Viola-Jones Algorithm and HOG features along with SVM classifier to perform quantitative analysis of recorded images on the basis of PSNR values. Various real time scenarios have been considered such as scaling, illumination, occlusions and pose, in designing an effective attendance system which crops and converts RGB images into grayscale and resizes it for feature extraction. The mechanism further involves counting the occurrences of gradient orientation in localized portions of an image and overlapping local contrast normalization. The results suggest that higher the PSNR, the better the quality of the compressed or reconstructed image.

Yuan L et al,[8] "A Convolutional Neural Network based on TensorFlow for Face Recognition"makes use of Adaboost Rectification Linear Unit (RELU) Learning Algorithm for improved accuracy. This research usesseveral image processing concepts like SVM & elastic graph match method and Haar eigenvalue, that is, the rectangle feature is the difference between the sum of the black pixels in the feature rectangle and the sum of the white pixels. Each computing layer of the network (CNN) is composed of a plurality of feature maps, and each feature map is a plane, where the weights of all neurons are equal. The weights of the neurons on the same feature map are the same enabling the network to parallel learning, which has proved to be a big advantage, according to findings of the research.

Kawaguchi, Yet al, [9] "Face Recognition-based Lecture Attendance System". This research proposes a method for estimating the attendance precisely using all the results of face recognition obtained by continuous observation. This system makes it possible to estimate automatically whether each student is present or absent and where each student is seated with the use of face recognition technology. The proposed Active Student Detecting (ASD) Method is directed towards building an architecture to successfully estimate students' existence using Face detection and recognition and to determine the seat of each student.

Madhuram M.et al, [10] "Face Detection and Recognition Using OpenCV" implies Algorithm proposed by Paul Viola and Michael Jones. This system contains three modules which are detection, training and recognition. The detection module detects the face which gets into the field of vision of the camera and saves the face in the form of an image in JPG format. Then the training modules trains the system using Haar cascade algorithm For face recognition, Haarfeaturesselection by creating integral images.

O. A. R. Salimet al, [11] "Class Attendance Management System Using Face Recognition" uses LBP Algorithm and Dataset that proposes a system with 95% accuracy and the dataset of 11 person images.The paper proposes a method of developing a comprehensive embedded class attendance system using facial recognition with controlling the door access. The system is based on Raspberry Pi that runs Raspbian (Linux) Operating System installed on microSD card. The Raspberry Pi Camera, as well as a 5-inch screen, are connected to the Raspberry Pi. If the student's input image matches with the trained dataset image the prototype door will open using Servo Motor, then the attendance results will be stored in the MySQL database. The database is connected to Attendance Management System (AMS) web server, which makes the attendance results reachable to any online connected web browser.

Olsson F.[12] The systems follows modular approach, where advancements can be integrated into the system. Any changes based on the environment can also be incorporated into the system. In each phase, an increase in the training data had a positive effect or no effect. We have identified various issues in our face recognition systems • Illumination Problem: - The illumination problem is that where the same face appears different due to a change in lighting. The changes induced by illumination are often larger than the differences between individuals, causing systems based on comparing images to classify input images. • The Pose Problem in Face Recognition: - It is not surprising that the performance of face recognition systems drops significantly when large pose variations are present in the input images. When illumination variation is also present, the task of face recognition becomes even more difficult. Here we focus on the out of plane rotation problem, since in-plane rotation is a pure 2Dproblem and can be solved much more easily. • Distance Problem: - Our face recognition system fails if the distance between the camera and the face exceeds more than 3 meters. • Camera Problem: - Resolution of a camera plays a very important role in recognizing the image. Better the camera, more accurately it will recognize the face. For example, we have tested our face recognition system with two phones and we have found that the phone with high resolution camera does the better than the other. • Number of people: - Our face recognition system is limited to only 7-8 people at a time. If this number exceeds, our system fails to recognize.

III. CONCLUSION

In this project, we have studied various factors to be considered while designing a functional automated attendance system. The results obtained in this research are applicable to address the real time problems like suitable dataset for a face recognition based attendance system, and the accuracy of training.The results of our literature survey have been divided in five points that ensure designing an efficient automated attendance system with highest accuracy. These factors have been chosen after thorough analysis of the problems that occur in processing of images in face recognition.

2.1 Machine Learning Platform

There are several differences to note between traditional methods and CNN. First, CNN does not require hand-crafted feature extraction. Second, CNN architectures do not necessarily require segmentation of tumors or organs by human experts. Third, CNN is far more data hungry because of its millions of learnable parameters to estimate, and, thus, is more computationally expensive, resulting in requiring graphical processing units (GPUs) for model training.[17]

Madhuram M. et al, [10] have developed a system for face detection and recognition using OpenCV which is used to detect and recognize human faces. The images of the persons are the datasets which are defined and trained before recognizing. In OpenCV, better face recognition and detection small features can be improved where more advance features can be added to the system.From the experiments we cannot expect significant improvements for GPU using CUDA. The one possibility to overcome this problem would be using a cluster of TensorFlow servers, so the separate operation can be carried on different machines in a distributed manner.[13]

2.2 Algorithm

The Viola Jones method builds a classifier by selecting a few significant features using AdaBoost. Viola jones method successfully merges more composite classifiers in cascade structure, which exponentially increases speed of detector by focusing on the favourable features of the face.[15]

Almost all tested algorithms can get speed gain using parallelization on a GPU. TensorFlow implementation on a CPU and GPU was used, and according to this research the running times highly depend on input data size. From obtained results GPU speedups can be expected for most of algorithms from 3.6 times to 15 times. The computation on the smaller data set obtain lower speedups due to the fact how TensorFlow handling computation, i.e. each node is assigned to device for computation rather than running the whole graph in parallel on multiple devices.[13]

2.3 Image Processing Method

This proposes the PCA (Principal Component Analysis) facial recognition system. The key component analysis (PCA) is a statistical method under the broad heading of factor analysis. The aim of the PCA is to reduce the large amount of data storage to the size of the feature space that is required to represent the data economically.[10] Through projection of self-space, the proper space is determined with the identification of the covariance matrix's own vectors.

Although PCA has proved to be sufficient for face verification, Principle Component Analysis requires a lot of memory and time for processing in multidimensional images. In such cases, a combination of PCA and LDA algorithm have been proposed to implement Face Recognition System on Raspberry Pi3. Borkar N R et al, [18] show that Optimal features have to be obtained to improve accuracy and remove noise from images. PCA is extensively used to reduce dimensionality. Next after reducing the dimensionality the images are projected onto eigen space using LDA.Among several methods, the use of Linear Binary Pattern Histogram (LBPH) and Linear Discrimination Analyser (LDA) together in the system increases its efficiency and reliability toward recognition of faces of the students.[19] The findings in our research are that a support vector machine (SVM) performs better than all other classification algorithms, and the neural network (NN) approach gives the lowest mean squared error (MSE) for the regression problem, which is a metric used in evaluating the performance of both classification and regression algorithms. We found that ROC is best for regression, and constructing a confusion matrix works best for classification. In the future, we would like to work with data having N dimensions on the distributed platform. The performance of each of the MLAs is evaluated using a metric like throughput, response time, overload on each machine in a cluster of machines.[20]

2.4 Dataset

We chose to utilize 60,000 pictures with a 32x32 pixel measure CIFAR-10 database. Each class comprises of 10 classes that are exclusively separate from every classification comprising of 6,000 pictures (don't overlap). The pictures are small, obviously labeled and have no clamor which makes the dataset perfect for this assignment with impressively significantly less pre-processing.[14]

Cao Q. et al, [16] have designed a new VGGFace2 dataset containing 3.31 million images from 9131 celebrities spanning a wide range of ethnicities. They have used Images downloaded from Google Image Search and show large variations in pose, age, lighting and background. The dataset is approximately gender-balanced, with 59.3% males, varying between 80 and 843 images for each identity, with 362.6 images on average. It includes human verified bounding boxes around faces, and five fiducial keypoints.Sripathi Vinayak et al, [21] The variation in illumination and posing as well as focus issues and blurring are important factor to be considered during face identification process in the classroom using real-time videography. The execution is performed with the help of Histogram of Oriented Gradients algorithm for detecting the faces. The training data sets comprises of different qualities of images. These data sets are fed to Convolutional Neural Network, through which the result of recognition is thoroughly obtained.

2.5 Camera

The camera plays a crucial role in the working of the system hence the image quality and performance of the camera in real-time scenario must be tested thoroughly before actual implementation.[19] Resolution of a camera plays a very important role in recognizing the image. Better the camera, more accurately it will recognize the face.[12] After testing with two phones, the results suggest that the phone with high resolution camera does the better than the other. The crucial point to focus upon while selection of a camera is the resolution parameter such that problems like illumination, occlusion, further away distance of students, unusual posture of students can be overcome.

According to our research, the most appropriate camera can be PTZ or Odroid camera. A PTZ camera is more advantageous because it has the ability to navigate, so the possibility of being able to capture the faces of all students in the classroom to be better [5]. PTZ cameras have been functional in advanced automated attendance systems and make the system reasonably economical [11].

The implementation of Viola Jones Algorithm in TensorFlow is a suitable choice for increased accuracy of the system. For Viola Jones Algorithm, the most preferred factors are HOG features, and primary dataset of a student in the classroom. The camera requirement can be fulfilled with higher quality laptop or mobile cameras that are technologically advanced and immune to excess or low light. The dataset and image processing methods to be used are dependent on the algorithm.

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