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AN EFFICIENT AUTOMATED ATTENDANCE MANAGEMENT SYSTEM (AAMS) BASED ON DEEP LEARNING

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ABSTRACT

This research study proposes automated student attendance management system (AAMS) with the help of image processing and deep Learning methods. The AAMS system used to manage, create, and maintain the student IN and OUT timing class wise with the help of face detection and recognition methods. The face recognition is problematic due to the dimension, clearness, orientation, appearance, illumination, and intensity of facial pictures. The AAMS system is designed to recognize figures representing the faces of positive pictures and eliminated the backdrop of negative images with environment by using dataset. The main aim of this system is to improve responsiveness and alertness of AAMS system procedure, and reduce the burden of manual workload, for instance, adding, updating, and manipulating the records of attendance individual as well as automatic calculations, the number of absentees and presenters created on class and cordiality of class then compile report in format CSV and spreadsheet documents. The AAMS uses the images and videos for recording the attendance of the students by identifying variant facial features. This System managing the attendance more accurate and effective. The suggested AAMS approach provides outstanding accuracy with the help of Feature engineering and Deep Learning methods.

Keywords: AAMS; Automated Attendance System; Image Processing, CNN, Face Detection, Face Recognition, Deep Learning

1. Introduction

Face Recognition is an old technology which been used before also It is the same as practical working or authentication the student or anyone with their identity or

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fingerprint, iris scan and many more so in this type of project we are using upcoming or emerging technology which is called as deep learning or Artificial Intelligence [1]. This project's major purpose is to detect attendance on behalf of facial recognition. In our project attendance system will be made and detect whether the student is present or not [2]. In this, we will be using the Deep learning tool of artificial intelligence (AI) which is a very mind-blowing technology with explosive growth [24]. Facial recognition is a very eye-catching topic that holds many AI technologies including, CNN, training skills, Face Net, SSD object detection, data preparation, data cleaning, data augmentation, etc. Our project will be controlled through a program through which it will be able to detect student attendance [24]. The system will scan the picture and then detect whether the person is present or absent. CNN's face identification algorithm was used to design an automated attendance system. To be effective, the system needs video capturing equipment as well as the running CNN algorithm [4]. It recognizes people and records their attendance. This technique will eliminate the loss of class time that is normally squandered during the roll number calls.

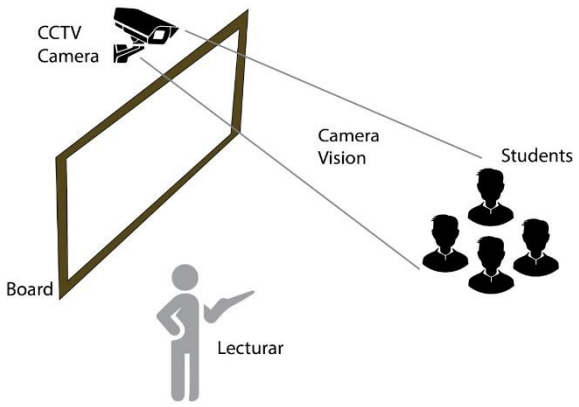

Figure 1. Attendance based Real CCTV

Physically signing attendance sheets in a computer framework for analysis is one of the traditional standard approaches for assessing student involvement in particular sessions. This technique is dull, irritating, and prone to errors since participants would sign for their absent colleagues, turning it ineffectual. The use of a face identification and confirmation framework rather than traditional techniques will provide a quicker and much more compelling method for accurately capturing understudy involvement while also providing secure, consistent, and strong limitations of the framework data, which could be accessed for any reason such as organisation, caretakers, and even for the under held in captivity studies themselves after approval.

2. Literature Review

Table 1 summarized the literature of recent year's research conducted on face recognition and attendance record management system based on deep learning, machine learning and other traditional approaches. The critical review analysis has

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highlighted the studies in the existing literature review technology, applications, domains, and their fields with finding or results.

The Web Cam based project completed by students at Kingston University of London in 2018. The software supplied with a picture, either via a webcam or by storage, and it counts the number of people on it automatically. After detecting faces, the system should crop the image and save the faces in memory for image processing in the next phase. The system is supposed to evaluate the number of faces spotted on pictures autonomously. In the second stage, the system would be able to identify faces from the preserved dataset and compare them to the data input from the first step. This approach will make use of software to sort out the faces automatically. The program will be interactive, allowing for interaction between various activities as needed. Because the system is divided into two phases, the second will require photo training on a dataset that will be used for recognition [4]. A facial recognizing monitoring system employing the Raspberry Pi 2 and the Eigenfaces algo was presented [27]. In this project, a CCTV or webcam is installed at the classroom door and integrated with a Raspberry Pi 2 module to capture individuals attending the lecture. All pictures were preserved on the Raspberry Pi 2 module. To reach optimal operating speed, the Raspberry Pi 2 module is deployed [9]. It is a final-year project completed by students at University Turku in 2018. A facial recognition-based student attendance system is used in this method. Like the others, this method begins with the input of a picture, either from preserved dataset or from a camera. The face traits are then pre-processed and extracted, followed by subjective selection and recognition of the facial photos from a database. To create comparisons, both feature extraction algo LBP and PCA are investigated in-depth and calculated. To lessen the lighting impact, LBP is increased in this method. A subjective selection technique that combines improved LBP and PCA is also being developed to improve accuracy [4]. An attendance monitoring model which uses a Surveillance camera installed at the classroom's entry point has been developed. The CCTV takes picture of an individual entering the classroom and autonomously compares it to a stored dataset using an Android-enhanced smartphone as shown in figure 1. The smartphone was chosen because of its extensive face recognition capabilities [8]. The author applied a convolutional neural network (CNN) to acquire low dimensional features in [36]. They applied the viola and Jones algorithm for face identification and then used a correlation tracker to track the face from frame to frame. The author worked on various characteristics in this article, including posture estimation, sharpness, resolution, and brightness. Three-angle roll, yaw, and pitch are being used to calculate head position. Then, by giving weights to each of the normalized characteristics, a final score called the face quality evaluation is calculated. The author's paper [37] presented a system for facial recognition that applied the Eigenfaces approach. Face detection was followed by face cropping, and then they worked on background removal for greyscale and binary photos. Along with its simplicity, quickness, and ability to learn, the author chose the Eigenface approach. In [38] Savitha et al proposed a system that uses the skin detection method for face detection. Skin pixels are captured once the skin is recognized, and the rest of the pixels in the picture are blacked out. After that, these skin pixels will be utilized for face detection by the authors, who used two databases: one for storing student faces and another for storing student data.

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Table 01. Random Predication of model on five classes

Technique	Dataset	Test size	Limitation	Result
(PCA) Personal Component Analysis	Images of students	30 different images of 10 persons	Great working with the pictures having almost correct extraction	Recognition Rate = 95%
Discrete Wavelet Transforms (DWT)	Images	Classroom setting and division of students	Work on limited length of the classroom	Results = 81%
Artificial Neural Network	10,000	20% of images are used as test size	Learn from neural networks	Results are correct with ANN
Active Student Detecting method	Real-time	Detect the faces within the classroom	Cameras	Results are according to the students in class
Face Recognition with GSM	Biometric recognition	20 pics of each enrolment	Biometric attendance system	Accuracy = 70.01
CNN, KNN	FER Dataset, JAFFE Dataset	Moods of pictures	Metrics according to each mood	Avg Accuracy=79.01
Viola-Jones Algo, Image Processing	Real-Time Dataset	Video and Image Real-Time Capturing	Manual and automatic capturing	Accuracy and confusion metrics
CNN, PCA	Smart Automatic Attendance Dataset	Automatic capture	Real-time	Metrics according to precision, Accuracy
PCA, LBPH	Dataset	Classroom Attendance	Real-Time	Real-time results with correct recognition
Deep learning, Open Cv	Images Datasets	Video Capture	Accurate success according to the dataset	A successful rate equal to 80%
Tensor flow	Jaffe Dataset	Real-time	Learn from Neural network	Accuracy =78%
Haar Cascade, KNN	Security Detection dataset	Image with Real-Time Capturing	Limitation is difficult with lighting conditions	Low False Positive and False Negative rate Higher accuracy
CNN, LBPH	400 different classes of face	400 classes with 10 images of each class	ORL database	LBPH found most higher accuracy than the other Result=98.06%
Eigen Face, LBPH	Different Datasets	Classroom Attendance	Comparison with different datasets and algorithms	Good Accuracy found with comparison
Computer Vision (Open Cv)	Application using face images dataset	Real time/Video Capture	Accurate success according to the dataset	Reliable accuracy model with comparison to facial recognition
Tensor flow (Deep learning)	Dataset	Real-time/images dataset	Learn from Neural networks using CNN layers	Higher accuracy than other models or algorithms

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2. Methodology

The proposed methodology categories two essential parts namely training and testing of face detection. The training phase carried out to stored image in database that is used for feature extraction process, while matching with correlation process. In figure 2 initial carried out by capturing face with CCTV camera, then face will be process for further execution. The face image will be processed as training, and in extraction process for leaning features and storing database. In AAMS System the image will match with original database and store attendance record in document.
Computerized picture approach oversees advanced frames via a mechanized PC, as well as the sublimely of signs and frameworks, all while focusing on the photos. Plunge focuses on constructing a computer framework that may execute techniques on an image. Following that, an image was analysed using advanced calculations, and a picture was supplied as a result. Digital frame analysis techniques are primarily influenced by three applications, the before the automated attendance management system can function, various types of data must be entered into the system, including the individual's fundamental and mandatory student data, including student ID and faces [26]. The first method of obtaining a portrait is by using a camera or other equipment to capture the specific student's face. The program will identify you initially with the face which is not matched until the face is identified, the program will not run to the next step and message the student to input their face again until the program reaches a predator mined number of portraits, which for this case will be ten for each student. Because the number of students at the institution is too large for the system, the decision to store just 10 portraits per student was made due to the hardware support of the limited storage capacity in devices [26]. The images will then go through a set of pre-steps to produce a grayscale image and cropped faces of equal size images, which are required to use the Eigen Faces Recognizer.

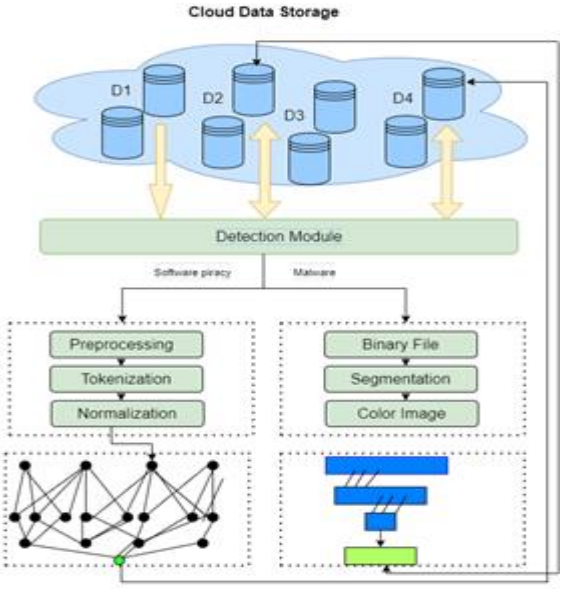

Figure 2. System Architecture of AAMS

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2.1. Image Acquisition and Pre-processing

They are saved in a directory into a file after clicking the photo. Underneath the file, all the faces in this project will be placed in a hierarchical format. When you go through the folder, you'll notice that it has a several of sub-folders, each of which includes a series of face portraits of a single student. The individual's ID address, which is unique to each student at the university, will be used to title the student data subfolders. The script Imagesfyp.py handles the whole image processing techniques, preparation, and storage method.

Figure 2. Sample of Dataset

A face database must be built before any facial recognition operation can be performed. It serves as an information library for the system to use while attempting to verify a student. During the image retrieval process, the program will initially ask for the student Institute Id. After authenticating the data submitted, the system will check for redundancies in the system. The Id length is 08 digits of a number and string into proceed. Aside from that, to avoid duplication, the ID entered must be an unregistered ID. Then, for everyone, a directory is created in which their portraits will be saved. A minimum of 10 - 30 photographs per individual must be kept in the CSV format as shown in figure 2 and figure 3 samples. After capturing pictures is done, the pictures will be pre-processed before storing them in the student’s folder.

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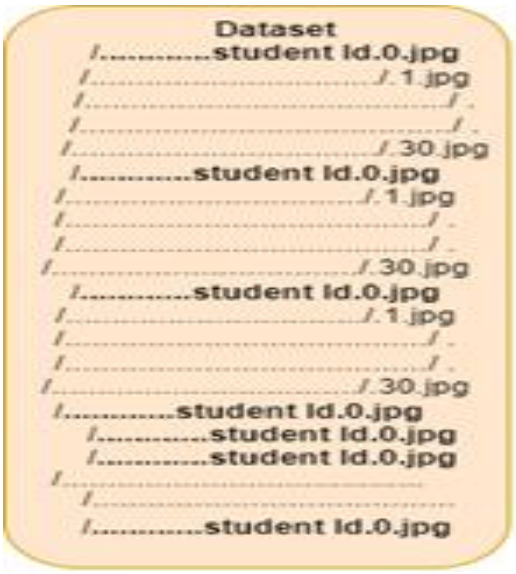

Figure 4. Database Structure

2.2. Structure of Face Database

Successful collection of all facial photographs into the folder, a Comma Separated Values file dataset is formed, which was then applied to input the faces into the recognizer for training. A script called create csv.py will be used to build the Comma Separated Values file. The figure 5 depicted the content of the Comma-Separated Values file.

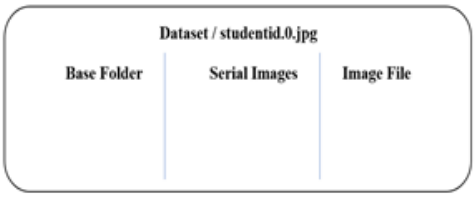

Figure 5. Organization of samples

The photographs will be utilized for training when many images have been captured in the databases. The three primary types of training stages valid in the OpenCV library are Eigen Faces, Fishers Faces, and Local Binary Patterns Histograms (LBPH) [27]. For this project, the Eigen Faces recognizer will be used. The principle underlying Eigen Faces is simple: it detects a certain face by recording the most acceptable version of that face and then translating that information into data that can be assessed when a new face arises. The CSV file will be read during the training stage to provide the position of all the photographs, which will then be placed in a variable which is called a list. Then, the list which is stored in the variable will be working with the training model, which will run for that same length of time. The longer it takes to train them, the more photos in the face database there are. A face database must be built before any facial recognition operation can be performed. It serves as an information library for

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the system to use while attempting to verify a student. During the image retrieval process, the program will initially ask for the student Institute Id. After authenticating the data submitted, the system will check for redundancies in the system. The Id length is 08 digits of a number and string into proceed. Aside from that, to avoid duplication, the ID entered must be an unregistered ID. Then, for everyone, a directory is created in which their portraits will be saved. A minimum of 10 - 30 photographs per individual must be kept in the CSV format. After capturing pictures is done, the pictures will be pre-processed before storing them in the student's folder.

2.3. Algorithm

AAMS face Recognition System

Step 1: Input Image is captured through the Dataset
Step 2: convert colour images to grey colour
Step 3: Now Haar Cascade is used to identify the images
Step 4: CNN algorithm used for face recognition
Step 5: Images will be compared
Step 6: matching a student with a database.
if a student is presented mark "present"
if a student is absent mark "absent" on the excel
Step 9: Update the Attendance excel sheet
Continue step 6
Step 11: End

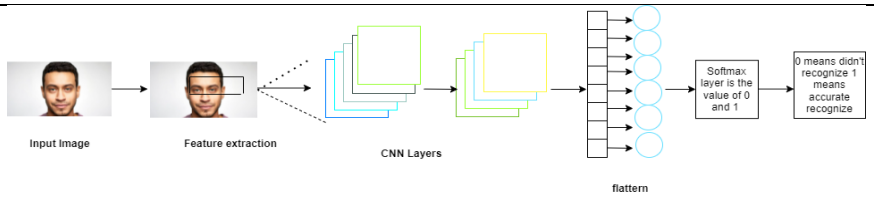

Figure 6. CNN Network

2.3. Basic structure of CNN

Neural Networks divided into 2 kinds of Biological Neural Network and Artificial Neural Network. The ANN is used as a data model which process information same as brains neurons works.

$$h_{W,b}(x)=f(W^T x) = f\left(\sum_{i-1}^{3} W_i x_i + b\right)$$

Neural Networks consists of many neurons the output of the pervious neurons can be used as the latter neurons. A convolutional neural network (CNN) is a type of deep neural network used to evaluate visual images in deep learning as shown in figure 6. When we think about neural networks, it performs a method known as Convolution. Convolution is a mathematical operation on two functions that yields a third function that explains how the form of one is changed by the other. This unit also called as

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Logistic Regression models; the neurons are connected to each other when they are in the form of layer they are called as neural Networks.

4. Result and Discussion

In this paper, we have tested automated face attendance system on Sindh Madressatul Islam University (SMIU) students, the dataset is collected from university students of six and seventh semester. The AAMS uses 1000 students' faces for testing and training model, the size of images is 50 X 50 as per structure of face recognition system [2]. This system used to CNN (Convolution Neural Network) and feature engineering and pre-processing method. The learning of deep learning much faster compared to other traditional methods. The CNN consists of multi-layers involving input layers, output layers, and fully connected layers. The AAMS Face Recognition system evaluated from different metrics (confusion matrix and F1-score). These metrics get accuracy of model by identifying the correct and incorrect values [1]. The process face recognition starts with a webcam, and then passes from application, which is used to open CV and a deep learning neural network to find the face of students [22]. This face image is then saved in the application, both on the local file system and in the database, append with a Student ID. In some papers we have reviewed, we can easily conclude the whole scenario that the more datasets that are given to the computer, the higher the success rate will be in finding accurate face objects [19].

PRECISION: From all the predicted positive results, it will predict the truly positive one.

$$precion = \frac{TP}{TP + FP}$$

RECALL: Out of the total number of positive, what percentage are predicted positive. It is the same as TPR (true positive rate).

$$recall = \frac{TP}{TP + FN}$$

For Recognition of faces to work with the best performance, the background must be static because it is difficult to recognize or detect the face with a dynamic background. Lighting also plays a vital role in the Recognition of faces. A normal light environment shows more successful results rather than low light environment. Changing faces with having masks or spectacles (glasses) with students will be more difficult to recognize the student. Because the system trained according to images without masks or glasses [25]. The AAMS was actively recording every entrance and exit of targeted students, monthly and weekly based report has generated, and cross validated the data against the gathered information. The random prediction result of five students is presented in table 2.

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Table 02. Random Predication of model on five classes

S 1	S 2	S 3	S 4	S 5	Predictions
330	8	0	5	2	S 1
3	369	2	0	1	S 2
1	0	401	0	4	S 3
8	4	9	266	0	S 4
2	5	6	2	336	S 5

The training phase will be done according to face images and extraction of face features, Dataset are taken in real time from 40 student using web camera then web camera reconnects with five student face in 1 group. There are 30 images of students which are captured and store in database. The table 3 calculated the overall accuracy, precision, recall and F score and time complexity of algorithm. Accuracy per class is presented in Table. The overall accuracy of the system is 88.01% with CNN and without 82%.

Table 03. Results of model on CNN.

Algorithm	CNN with Haar	CNN without Haar
Accuracy	88%	82%
Overall time Complexity	124	120
Precision	79.01	73
Recall	78.01	73
F 1 score	81.9	77

4. Conclusion

The Automated Attendance Management System built on face identification for saving time and efforts. The AAMS system is used to manage the student attendance by using face detection and recognition with the help of image processing and CNN method. The main reason of this system to improve the conventional and manual attendance system in the different educational institutions with support latest technology. The AAMS system also detect and analysed the unseen faces with help real cameras. The CNN method outperforms other machine and deep learning methods with low false positive rate and better recognition. The System only identify and recognize the 30-degree angle variation images and the performance of AAMS model compromised due to the poor lighting conditions and other factors. This framework can not only aid in the participation framework, but it can also boost an organization's generosity and significantly reduce time and paper waste. In future, this work shall be extended, and recognition rate can be improved with different samples, feature engineering and unintentional changes in face like clean-shaven, using scarf, beard.

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