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Smart Attendance System Using Feature Descriptors

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***Abstract* - Advances in the information era provided various human authentication options such as fingerprint recognition, eye iris recognition, human face detection, and recognition. The Human face recognition technique is based on facial features detection and comparison with an existing features database. The proposed system uses face detection and recognition techniques for identifying the presence of many people at a time.**

Keywords: Authentication, Attendance system, Face recognition, Feature Descriptor.

I. INTRODUCTION

Nowadays, technology within the field of artificial intelligence is growing rapidly. Even though there's an outsized area in AI yet to explore more, that is computer vision. Moreover, computer vision plays an important role in research areas of domains like analysis, forecasting, and recognition. The software applications developed in these technologies are abundantly utilized in daily lives[1]. The answer for different problems can be found in a more efficient way using these technologies.

Face recognition could be a powerful field of research supporting computer digital technology. [2]

Attendance plays a huge role in areas like schools and colleges additionally in professional workplaces for determining staff regularity and for marking the attendees. Every institute has its way of doing it [3][1]. A number of them use the paper or file-based technique and a few have adopted technology such as automatic attendance using some biometric techniques. But the traditional way of maintaining records do have some drawbacks, the most important one being wastage of your time and papers. Moreover, it is difficult to manage, and also the chances of human errors are a lot more. Present strategies of taking attendance and making records are tedious and time-consuming. Attendance records can be easily manipulated by manual recording.

In this approach the face of the student is recognized by the system and attendance is marked automatically with the name of the student as well as the date and time. It will detect the face and compare it to the saved database and if the match is found then it will enter the name of that person in the database with the date and time. According to the earlier attendance system, the precision within the collected data was the most important problem [4]. The explanation for this might be that the attendance might not be recorded individually by the first person, in another word, the attendance of a specific person is taken by a third person without the institution being aware of, which violates the accuracy of the data. Thus, all the recorded attendance within the previous system is not authentic to use for analyzing purposes.

The development of this system is aimed to accomplish digitalization of the normal system of taking attendance by calling names and maintaining pen-paper records. Face recognition for the utilization of marking attendance is an imaginative implementation of the attendance system. As the number of registrants in an educational institute or employees at a company increases, the needs for faculties or the organization also increase to automate it.

II. LITERATURE REVIEW

This section presents the literature review of related work in the automatic attendance system. P.S Hegde et al. in [5], discussed the "Face Recognition based Attendance Management System" that is composed of 4 stages. First is data creation, in this step the images of students are captured and cropped to obtain the region of interest. Then they are converted to RGB format. In the second stage, face detection is performed using Haar cascade with OpenCV. In the next stage, face recognition is performed using a linear binary pattern histogram. In the last stage, the attendance will be updated according to the recognized faces. The module is high accuracy and very effective. Very user-friendly and easy to use. Classified features for all types of users for easier implementation and understanding.

Serign ModouBah and FangMing in [6], discussed "An improved face recognition algorithm and its application in attendance management system", In this system, the images will be given as input and will be processed. The image detection algorithm will be applied. After that improved face recognition will be applied and feature extraction and

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detection will be performed. If the match is found then it will be saved in attendance else it will be given for training. Better image extraction and High-quality training of template face images are also part of the system.

Pooja M. R et al. in [7], suggested "Face Recognition based Attendance System", In this approach, the image is converted to a feature vector in higher-dimensional space. Next, the images are enrolled in one subfolder per person. Then the images are converted from BGR to RGB then face detection is performed using OpenCV and dLib. Then in the final step the name of the student along with the day and time of attendance is stored in the database. This method has higher accuracy in the recognition of multiple faces from a single frame with lower response time.

Minakshi Vharkate et al. in [8], put forward "Automatic Attendance System Using Face Recognition Technique", In the given system firstly the details of students are stored and the database is created by training images. After applying Haar features and Adaboost, the live image will be captured and will be compared with the database. If a match is found then save in attendance with information. And if an image is not found then it will be stored in the unknown folder. It can handle a large database. The accuracy of this system is more than other algorithms. Able to capture from 80 cm away. The image capturing speed is good

Ashwin Raj et al. in [9], proposed "Smart Attendance Monitoring System with Computer Vision Using IOT", In this module object detection is done using HOG-Histogram of oriented gradients algorithm. The work is divided into two parts: - first is recognizing the human face – in this first find all faces then projecting the faces after that encoding and at last finding the person's name. And the second is storing and sending the records of data. Also, it Consumes less time and space. And is Smart enough to train itself by a single image. Data can be easily accessed from anywhere as stored on the cloud.

Himanshu Tripathi et al. in [10], presented a "smart attendance portal using facial recognition", This module uses C++ Facial Recognition Library: Training and testing Facial Detection and recognition model. It Develops C++ Library for the Backend and Builds interface between Node.js and C++ Library. Node.js Backend will serve stateless API for React-based frontend. The system has good accuracy and spoof detection. Image processing time 30 to 50 Ms per picture.

Sakina and Sehrish Larik in [11], recommended "Face Recognition for Automated Attendance using HOG & Machine Learning", The proposed automated attendance system is based on face recognition. The module is divided into four stages: In the first stage detection and extraction is done using hog. In the second stage, face positioning is done using a python script. In the third stage, face encoding is extracted the unique identifying facial feature for each image. In the last stage, face matching is done using deep learning. Accurate Quality faces recognition. High-performance levels in recognizing human faces and analyzing facial features work in complex backgrounds.

Priya Pasumarti and P. Purna Sekhar in [12], came up with "Classroom Attendance Using Face Detection and Raspberry-Pi", the module is divided into three parts. First is database creation, which includes initializing the camera, getting user-id, capture images, and converting into grayscale and storage. The next step is training that is done using lbph face recognizer and saving the trained data. In the last step, the image is captured from the camera and predicts the face using the above recognizer.

Pranali Patil in [13], proposed "A smart attendance system based on face recognition" which illustrates that it works on different stages like training dataset and augmentation, training the model, and taking the attendance and storing it. Then used the scikit image, a python library for image transformation and manipulation. The next is Face net, which is a deep learning architecture that uses CNN which embeds each face. Finally, face recognition is done, it generates the excel sheet and marks the attendance. This model was more efficient and accurate than the previous one. But it fails to recognize the twin students correctly. After performing recognition, it marks those present who get recognized otherwise it marks absent and it will store the attendance subject-wise in the same file but a different sheet.

Raymond Erz Saragih et al. in [14], discussed "Automatic Attendance System for University Student Using Face Recognition Based on Deep Learning", In this given system ML algorithm like Convolutional Neural Network (CNN) is used as face detection, DLib is used to convert 128-d embedding and K-NN is used for face classification. It detects the face in an image then marks the unique part of the face and adjusts the image position then embedding the face lastly classifies the result using the KNN algorithm. After successfully recognizing the face along with photo, name, id number, date, and time is saved in the database. For accuracy, it is necessary to take photos with a Raspberry pi camera for the more significant and similar photo size and lightning. The stored student data has been identified in the form of the ID number, date and time.

Dr. R.S. Sabeenian in [15], suggested "Smart Attendance System Using Face Recognition", In this approach face detection, an ultra-light detector module is used and after that ONXX model is created. Moreover, MobileFaceNet is a deep

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learning algorithm that is accurate for face recognition. Then the images and videos training for recognition. At the final stage, the name of the person and time is stored in the database sheet. About accuracy among all the face detection algorithms, the ultra-light face detector is accurate. MobileFaceNet algorithm attains accuracy up to 85% on labeled faces in the database. And 90% accuracy on recognizing faces.

Aditya Deshmukh in [16], proposed "Attendance system using face recognition", For face detection and face alignment, YOLO is much faster and accurate as compared to MTCNN and R-CNN. And also YOLO is used for face recognition as the whole network is trained from scratch to provide better results. Face Net is used to capture the image and adjust it to find better solutions and recognition. For training, the algorithm uses a different framework like Darknet/Dark flow is used. By the system making of algorithm YOLO and Face Net, it achieved a Map of 78%.

Nisha Mohan P M et al. in [17], discussed" Face Recognition Based Attendance Management System Using Machine Learning", in this, they have used LBPH algorithm and Adaboost for face detection as well as hog features and Haar features. They have obtained steady results around 90% of accuracy. This can be upgraded to allow for multiple people recognition.

R. Kamble et al. in [18], proposed "Attendance Monitoring using Face Recognition and Machine Learning", In this, they have used Haar Adaboost and LBP-Adaboost. In terms of this Haar-Adaboost is the best. We will use this. This is secure enough, reliable, accurate, and efficient no need for specialized hardware for installing the system in the classroom.

Dulyawit Prangchumpol in [19], suggested" Face Recognition for Attendance Management System Using Multiple Sensors", The proposed method uses quite one sensor for the aim of face recognition. the answer provided by the author uses OpenCV to detect and recognize an individual's face using a webcam. The given approach also uses Google Cloud so that the knowledge will be edited from any location without any restrictions. Using this, higher accuracy of the system is attained. this method is extremely accurate, reliable, and robust.

Shashank Reddy Boyapally, Supreethi K.P in [20], presented" facial recognition and attendance system using dlib and face recognition libraries", The method follows the below discussed steps: the first step is finding faces, then in the next step positioning the faces and identifying unique facial features is done and thus in the last step identification of the person takes place. The combination of the algorithm used in the paper provides good accuracy and efficiency.

III. HISTOGRAM OF ORIENTED GRADIENTS (HOG)

HOG is a feature descriptor first described by Robert K. McConnell of Wayland Research Inc. It is used for the aim of face detection/image detection in computer vision and image processing. HOG is described as the distribution of edge directions in an image. Here the image is split into small cells. In every cell, there are several pixels present within which a histogram of gradients id is formed [1]. The HOG is contrast-normalized for better accuracy; this is often done by calculating intensity over a bigger area of several cells referred to as a block. Now, this value is employed to normalize all the cells within that block, and then the normalized result gives better performance on variation in intensity and illumination. HOG is invariant to geometric and photometric transformations which are one of many of its major advantages over other descriptors but object orientation is an exception. HOG extracts the features pixel by pixel. This is done using gradients [21]. Every image that's registered includes a particular gradient orientation which helps the HOG to extract the unique features from that individual image.

IV. METHODOLOGY

The proposed system uses feature descriptor -HOG technique for building Smart Attendance System which authenticates the user or student using face recognition. The procedure is followed in different stages, including Data Enrolment, Face detection, Face Recognition, Marking Attendance, and saving records in ExcelSheet [22]. This single image of the student along with the name needs to be registered as their database. When any registered user comes in the frame, then it will detect the face and try to match with the registered users.

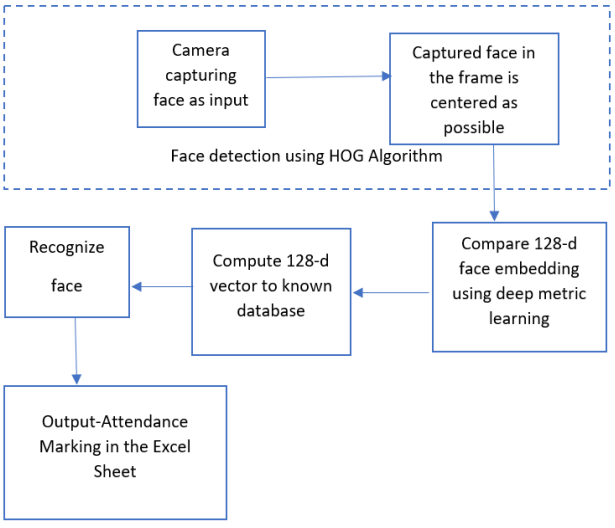

Figure 1: Proposed System Workflow

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If a match is found then the name of that user along with the date and time will be stored in an excel sheet. The implementation has been done using the HOG algorithm (Histogram of Oriented Gradients) and SVM classifier (Support Vector Machine) for face detection in the above system [7]. Dlib's HOG+SVM do not separate training and data enrolment into two different processes, unlike a few algorithms available.

There are four major stages in the system. A detailed explanation of different stages is discussed below:

A. Data Enrolment

In the first stage for data enrollment, a small ResNet neural network is defined for storing the database. A Single image of the user is enough for the designed module to perform the desired task. The images for the database are not captured using a webcam but stored directly. The saved image then goes under processing, during which the facial landmarks of the person are identified. Then using these facial landmarks the image is transformed to "perfectly centered" or as close as possible [21]. For the training purpose, any extra processes or images are not required. The training is completed on its own using the image given in the database. Then in the next step, the enrollment image is converted from BGR to RGB format, because Dlib uses RGB format as its default [7][5]. So these images are going to be saved as the names of that individual student in a very folder.

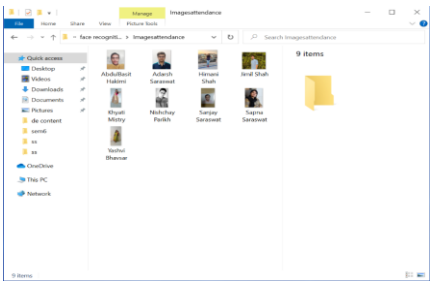

Figure 2: Data Enrollment method in the system

B. Face Detection

There are various kinds of algorithms available for face detection, such as Face geometry-based methods, Feature Invariant methods, Machine learning-based methods, and many more. For the enhancement of the system, a proper and efficient algorithm is advised. The earlier implementation for detecting faces was performed using the haar cascade approach. But haar cascade is not efficient in detecting faces. The second approach was done using the dlib's HOG+SVM classifier. HOG extracts the features pixel by pixel. This is done using gradients [21]. Then the image that is registered needs to be converted from BGR to RGB and then from RGB to grayscale because HOG works on grayscale images [23]. In the backend, the image is divided into small squares of 16x16 pixels each. Then in all the major directions counting of gradient points will be done. The function is to conclude whether the faces emerge in the frame or not as well as the location of those faces. The next step is generating 128 different measurements for each student [7]. This is done by the neural network. For the identification of faces and differentiating them from the rest of the stored images, these 128-d measurements are used. Every image that is registered has a particular gradient orientation which helps the HOG to extract the unique features from that particular image.

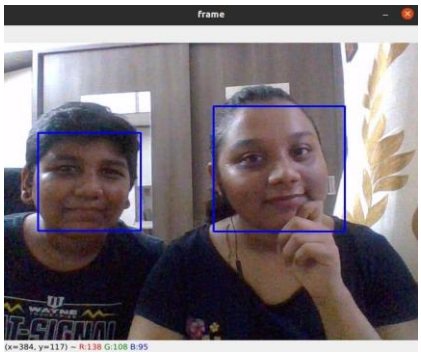

Figure 3: Face Detection by the proposed solution using HOG Algorithm

C. Face Recognition

At this stage, we have already registered the data of students' i.e the images of the students with their names. And we are also able to detect the face live from the frame. The next step after the representation of faces is to identify them. This will be performed using the face recognition technique. Face recognition is a process of identifying the face based on the registered data. One of the most efficient approaches for identifying a person is using face recognition rather than other methods available, such as fingerprint biometric, barcode, etc [24]. Reason being that the proposed module does not require any action from the user or any physical touch. Implementation of this proposed solution is done in python language.

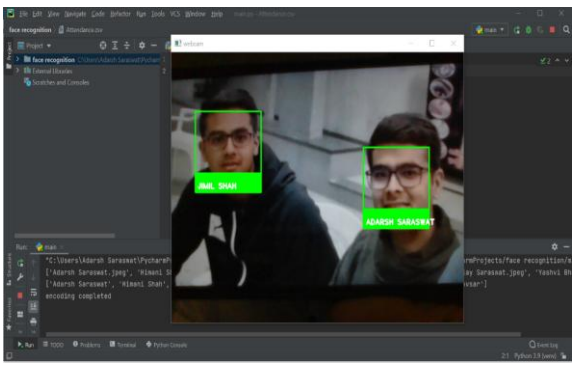

Figure 4: Face Recognition by the proposed system

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To perform face recognition any algorithm is not applied. But the library is already available named face_recognition. By directly calling this function, face recognition is performed. At the backend, the system uses the different 128-d vectors to identify a person. So as the frame detects the face, automatically it generates 128-d vectors for captured images [21]. Then it compares the newly formed vectors to the already registered vectors. The vectors with similar values or the closest values are chosen. The name corresponding to that image is then shown on the screen under the frame.

D. Attendance

The last stage of the module marks the attendance of the users that are recognized. Once the attendance is taken by recognizing the user in real-time, it updates the database [7]. But if the attendance list is already updated by a particular username then it does not matter how many times face is detected, the stored data will be off when the user was recognized for the first time on the particular date. After the end of a task, it generates a CSV file including the name of the recognized user with the date and time of that particular instance. Along with this system will automatically generate an excel sheet. Name of the sheeting being the date. Then recognized names with date and time of recognition will be stored in the generated excel sheet as well. Thus storing the attendance of students.[13]

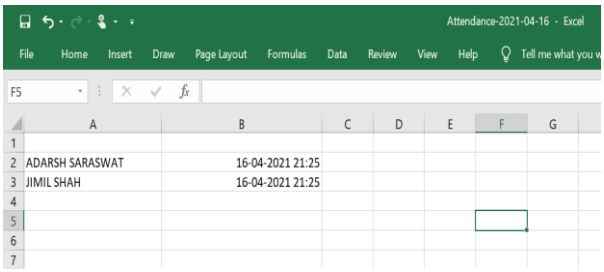

Figure 5: Attendance saved in excel sheet

V. DISCUSSION

The proposed system "Smart attendance system" successfully overcomes the problems faced in the traditional method of recording attendance such as wastage of your time and resources. Face recognition is a better alternative to fingerprint, biometric because the proposed solution reduces any physical human contact. The system is tested using a variety of inputs and using single and multiple users at a time as well. The compile-time of the system increases as the database increases, making it one of the drawbacks of the proposed method. On the other hand, at run time the recognition process and attendance saving do not depend upon the quantity of the database. The recognition and attendance marking speed are quick. This proposed technique is capable of handling more than one face simultaneously. Multiple student's attendances can be marked at the same time which is later stored in an exceedingly self-generated excel sheet with the date being the name of the file. The system can accurately recognize at least 4 users at the same time, the accuracy being 95%, reaching a maximum of 100%. The system does not recognize users from the side faces. Thus, the Histogram of Oriented Gradients (HOG)+SVM-based face recognition and attendance system is discussed in the research paper. Face recognition rate depends on the sampling of data base, classification, and techniques of feature extraction [25].

VI. CONCLUSION

The proposed system uses a gradient-based approach for face detection with well-pre-processed data. To make the system more accurate and efficient, we can also add side edge image recognition. Cloud-based facial recognition to accelerate the facial recognition process.

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