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FACIAL RECOGNITION FOR AUTOMATED ATTENDANCE SYSTEM USING ADA BOOST ALGORITHM

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Abstract – Technology is advancing day to day in every field. We believe that schools and colleges can also implement some of the new technology in their day-to-day activities to ease the academic load. As taking attendance is an important yet repetitive task, this can be tackled using some of the technologies, facial recognition being one of the technologies. The aim of this paper is study of face detection using ensemble approach to mark the attendance from the recognized faces in the image captured from any camera. Here an image of students in the classroom will be captured, then it will be fed to an Haar-like facial recognition algorithm to recognize the students faces which is then fed to an ensembler to mark their presence in the attendance log. Open CV extracts countenance of the given images and retains a number of the variations within the image data. Currently, many techniques are available for the detection of faces, this work specifically focuses on facial recognition using AdaBoost algorithm . The proposed monitoring system yields an accuracy of 98% with optimal performance.

Keywords: Smart Attendance, ADA Boost Algorithm, Facial recognition, Statistical Model

I. INTRODUCTION

The marking of attendance to identify the presence of students is an everyday requirement for academic organizations to monitor their progress offline. Traditional approach involving paper/pen with instructor calling names in class consumes productive learning time. Digital transformation has empowered us to solve this issue with technological aids. Multiple automated and semi automated solutions are in focus today to solve attendance monitoring like:

- Smart phone based attendance systems are popular too among the shopping community to track customers.
- Login credentials like Badge, access card, Identity Card , Punch cards are given to monitor the legitimate students.
- Biometric based attendance tracking such as fingerprint and retina scans are found in corporates, schools and colleges
- ERP based attendance systems in mid size and large companies.

Information system consisting of individual person attendance is a key requirement to monitor the people working. It helps to track them, what they are doing , when they came, what time they left etc. Paychecks are generated with their aid by the employer.

Shortage of attendance if any is informed by teachers to parents through dedicated information systems. Today we have a varied approach to monitor attendance with the help of various surveillance tools and our approach is one towards it. In this work we discuss a statistical approach involving ensemble learning algorithms. The proposed approach helps to monitor the entry / exit of students in a classroom of a university,

II. Related Works

Biometric-verification plays a vital role in authentication . single or multimodal biometric traits involving iris, face, palm, retina representing the biological characteristics of a human being are used for resemblance analysis. Applications of it are found in various industries from education sector, corporates, manufacturing industry, retail marketing and many more.

Hossen et al.,[1] proposed a way with the assistance of Open CV's Viola-Jones set of rules that discards incorrectly detected faces constructed on coding eyes. +ve and -ve pictures are taken for input and Adaboost rules are implemented which converts vulnerable classifiers to robust classifiers. The Classifier Cascade process is faster and provides a precision of 98.97%.

Mary Prasanna et.al,[2] got here with a direct GUI primarily based on totally biometric identity and evolved the usage of Open face. HOG is used for changing the dimensions of anterior part of the detected faces . DNN is adopted for extracting facial features from the image obtained using landmark algorithm . In this all pixels are inspected with adjoining pixels which ends up in an image with sixty eight landmarks. SVM is used for person identification.

Alankar Patil et al.[3], detected faces using a supervised approach. Student images were procured and labelled when they register for the course. Image feeds of students who will attend a course is made available initially. In the second phase facial recognition is performed with cameras and the details are updated in an electronic form.It helps to identify the presence or absence of a student. Using this approach a person can be tracked for his actions that help to provide security at high risk places like airports, nuclear stations, offices, IT industries and banks. Process automation has led to reduced errors

Wu-Chih et.al., [4] proposed a three-stage scheme. First, pores and skin areas are saved. In the subsequent stage, a container is used to get rid of different areas. The FERET image database was used from which the faces of different poses and sizes were selected and was used to evaluate the performance.

Khumbhar et.al., [5] adopted Haar-like capabilities to stumble on faces. The proposed technique captures faces from different angles extracted from the HD video. Simple CV and OpenCV are some of the framework libraries used alongside the Raspberry Pi BCM283 CPU processor. The prototype could be used for real time image censoring desired objects.

Viola et al.,[6] introduced the concept of integral image to assist fast evaluation , feature selection is followed by classification using AdaBoost and the rich

fundamental features obtained successively are further cascaded by training classifiers using AdaBoost to improve face detection accuracy and speed.

Rowley et al., [7] presented a neural organization based face identification framework. Little windows of the picture are looked at by the neural organization that are retinally associated for deciding the presence of a face. They make use of a bootstrap calculation for making ready, which provides bogus discoveries into the instruction set as making ready advances. Basic heuristics helps to wipe out the troublesome assignment of physically choosing non-face preparing models to traverse the whole space of non-face pictures. The framework has better execution regarding recognition and bogus positive rates.

Zhao Pei et al., [8] proposed a CNN-based face recognition system for class monitoring. Data augmentation methods associated with the data were carried out with orthogonal experiments. and the ortogonal table determines the best. CNN generates the feature automatically and reduce the bias leading to better accuracy. Increase in samples improved the accuracy from 86.3% to 96.1%.

Senigla et atl., [9] implemented a deep learning model with more epochs in training for attendance monitoring with optimized execution. Data integrity is made available by storing the register content online in a cloud database and ensures integrity and prevents tampering. The non intrusive system helps to mitigate fake attendance due to proxies. Emerging technologies like Machine learning, Image Processing and IOT have made it a feasible smart system to opt for.

Tabatabaie et al., [10] used Viola and Jones face location strategy with a shading based technique to propose an improved face recognition strategy. Exploratory outcomes show that their strategy proficiently diminished bogus positive rate and therefore expanded exactness of the face recognition framework particularly in complex foundation pictures

III. Proposed Methodology

Attendance monitoring with technical aid is a common process we find across organizations today. fingerprint based biometric attendance system is the most widely used information system across continents. The IOT based system uses a microcontroller based circuit along with fingerprint sensor, minimal power supply and a wi-fi modem to interact with internet based systems. Although the IOT based attendance monitoring method is more secure it is overly dependent on the equipment. In order to reduce manual intervention among each other in covid era, an automated system using surveillance cameras/ web cams is proposed to monitor students. Since most of the student community is not vaccinated it would benefit them to the maximum.

In the proposed system, the image is captured using an IP camera /web-cam installed in the classroom that covers the faces of all the students. In the pre-processing stage ,the captured image is fed to Open CV's Haar-like features algorithm and the location of all faces are recognized and cropped. The cropped images are used for facial

recognition by comparing with the existing dataset. If the faces are recognized, attendance for that particular subject will be marked as present. If it fails to recognize some faces, then we need to mark the attendance manually on the website.

The basic outline of the proposed automated attendance-management system is depicted in Figure.1 and Figure 2.

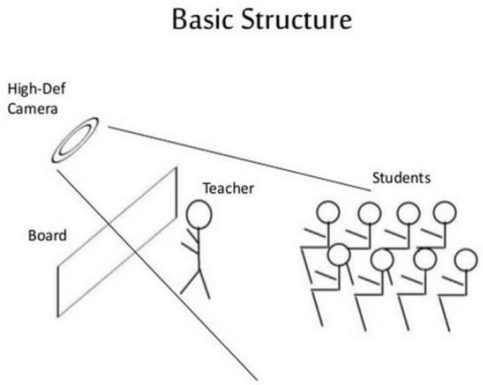

Figure 1: Basic Structure of how proposed method works

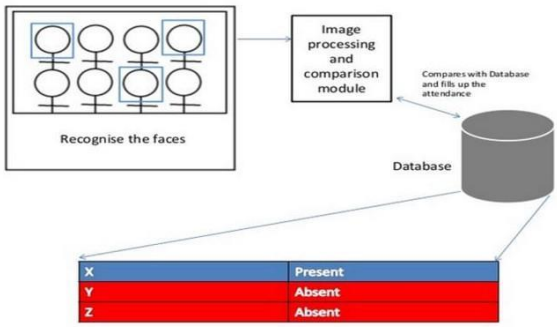

Figure 2 : How attendance is marked

The pictorical representation and proposed architecture for the automated attendance management system is depicted in Figure 3 and. Figure 4 respectively. Input image obtained through an IP camera is fed to the system. HAar-Like cascade classifier recognizes the face and is fed to the ensembler for further classification. ADABoost classifies the faces based on statistical models and helps to identify the student present accurately.

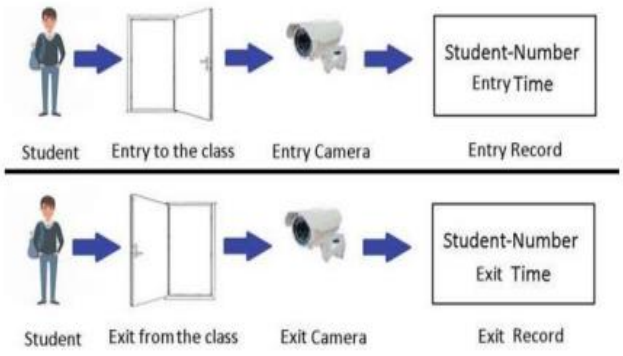

Figure 3: Pictorial representation of our proposed model

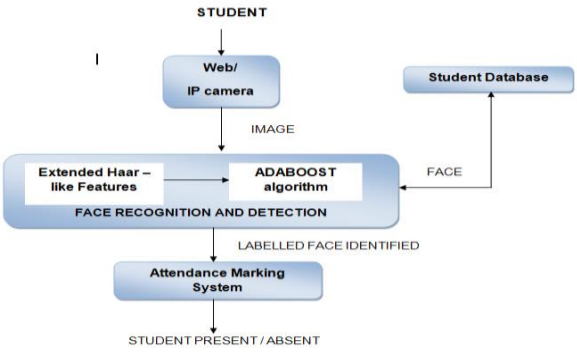

Figure 4: Architecture of our proposed model

Face detection:

The proposed approach begins with face detection using Haar-like features that enable it to detect facial objects of interest. The kernel processes the edges, lines and rectangles features to determine the bounding box around the identified face as shown in Figure 5.

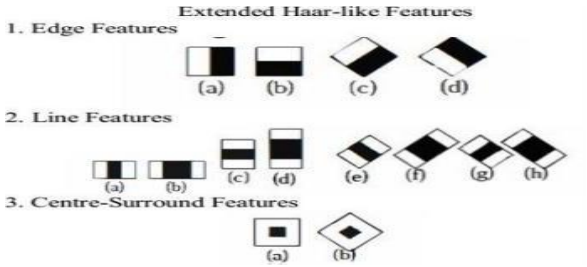

Figure 5 : Extended Haar-like Features

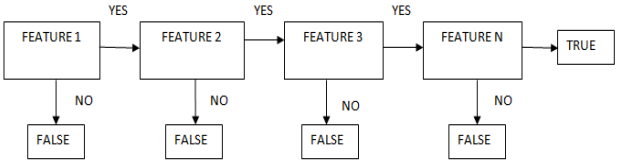

Figure 6: Feature based cascade classifier

After a classifier is prepared, it has a tendency to be implemented to a locale of interest in a statistics photograph. The classifier yields "1" if the vicinity might be going to reveal the face and "0" in any case. To search for the desired facial item with inside the whole photograph one could get the inquiry window throughout the photograph and take a look at every vicinity making use of the classifier as shown in Figure 6.

Adaboost

The steps involved in Ada Boost algorithm representing an ensemble approach utilized is discussed herewith.

The Ada Boost Algorithm :

1. **Input**: Give sample set S = (x_1, y_1) ,... (x_n, y_n)
   1. $x_i \epsilon$ X, $y_i \epsilon$ Y = {-1, +1}, number of iterations T.
2. **Initialize**: $w_{i,j} = \frac{1}{N} i = 1, \dots N$
3. **For** t = 1, 2,...,T,

   a. Train vulnerable classifier the use of distribution W_t.

   b. Calculate the weight (w_i) schooling flaw for every hypothesis.

$$h_n \varepsilon_t = \sum_{i=1}^{N} W_{t,i} |k_i - y_i|$$

   c. Set: $a_t = \frac{1}{2} log \frac{1-\varepsilon t}{\varepsilon t}$

   d. Update the weights:

$$W_{t+1,i} = 1 + \frac{W_{t,i}}{Z_t} \times \begin{cases} e^{-a_t} \\ e^{a_t} \end{cases}$$
$$= \frac{w_{t,i} \exp(-a_t y_i h_t(x_i))}{Z_t}$$

Output: The very last hypothesis, the more potent classifier that can recognize faces better.

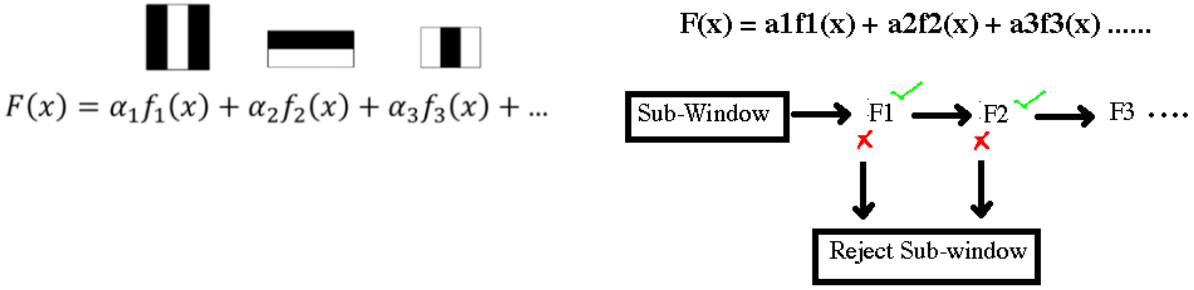

Figure 7: Ensemble strong classifier representation

consider an equation F(x) as depicted in Figure 7 representing the success rate with weak classifiers $f_1, f_2, f_3, \ldots f_n$ and $a_1, a_2, a_3 \ldots a_n$ weight respectively. F(x) is the strong classifier made of several weak classifiers resulting in ensembling. Adaptive boosting is carried out to improve true positives and then cascading is carried out as shown in figure to improve the accuracy at an optimal speed

IV. Implementation and Results Details

The proposed automated face recognition system mainly consists of four modules. The function and the operation of each module is depicted in Figure 8.

- Capture the image of Students
- *Face recognition and detection*
- Database Development
- Post Processing

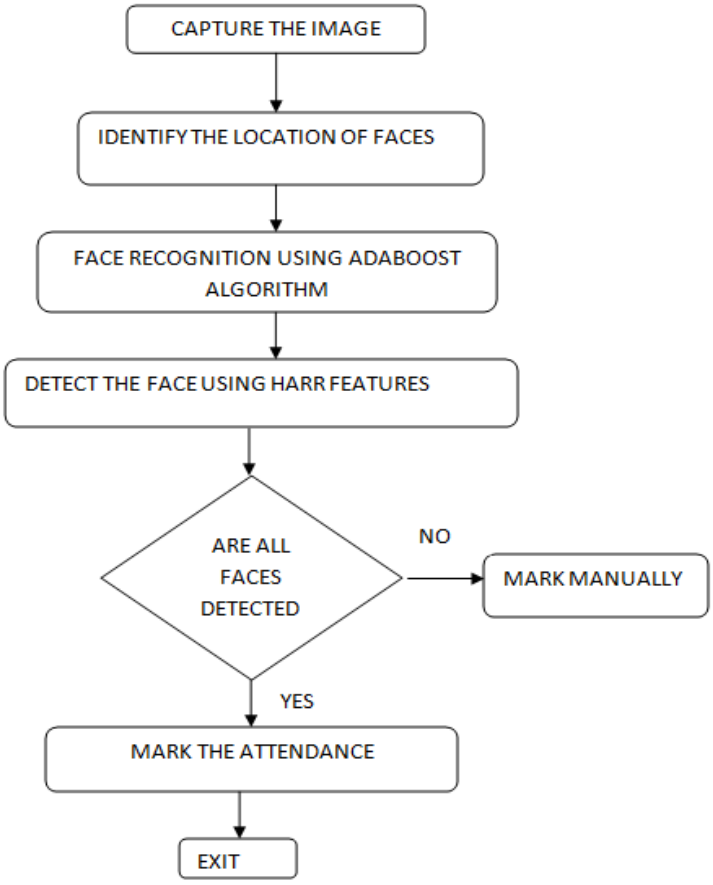

Figure 8: Flow diagram of the proposed system

A. Image capture:

Initially, cameras are placed at the entrance of the classroom to capture the frontage image of the students and preprocess the image for facial recognition.

B. Face recognition and detection:

Predicting and recognising acts as one of the important aspects of the shape prediction system. Identify and locate the landmark features of the face such as eyes, nose and the jaw line to recognise the facial features of the face. Haar feature based classifier discovered by Paul Viola and Michael Jones is the most effectively used face detection method adopted in our work. The classifier is trained with both positive and negative images.Facial features are extracted and the facial landmark detection is applied for the detection of face.The most commonly used AdaBoost face recognition algorithm is used to train the facial features for labelling. OpenCV is mainly used to detect facial landmarks. We have used Haar cascades along with AdaBoost classifier of OpenCV for face detection and recognition.

D. Database development:

We detect the facial features of each face in the training dataset and crop them or

eliminate the image if alignment of face is not proper. It is then stored in a separate folder with the same file names as training images. Later this folder is considered for face recognition. Stored images are enhanced later using the preprocessor techniques if required. One thousand individual images of students are stored in separate folders in such a way that all features of the face are visible against the name of the student.

E. Post Processing:

Finally, recognised and detected faces of the students are stored in the database and attendance will be provided for the students using the automated facial recognition system developed for attendance marking.

V. RESULTS OBTAINED:

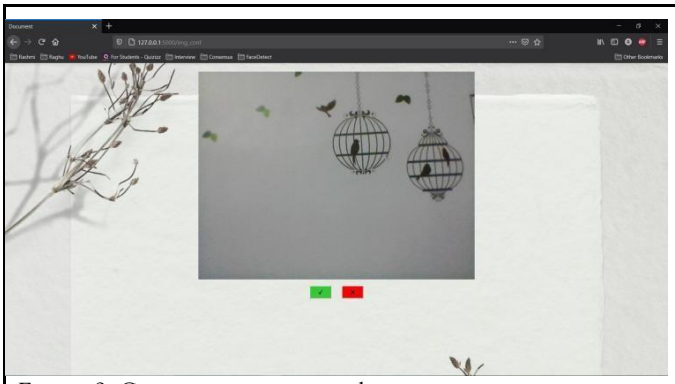

Figure 9: Capture image using web camera

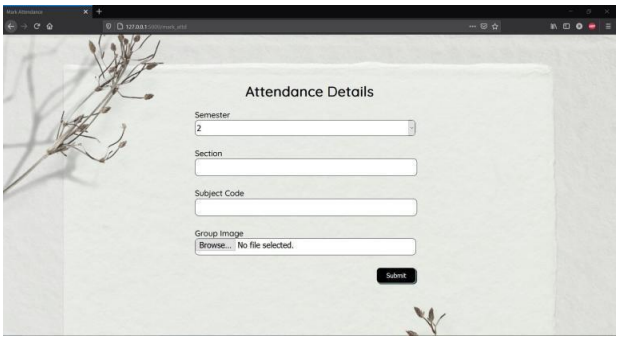

Figure 10: Mark attendance using faculty login

To mark attendance, the captured and saved image is uploaded as shown in Figure 9 and Figure 10 by filling the form which sends the image to the back-end where face detection and recognition takes place using OpenCV.

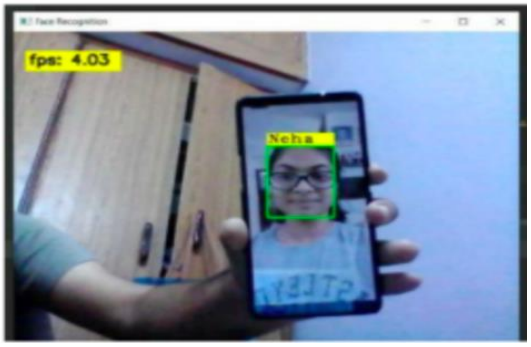

Figure 11 : Face detection and recognition

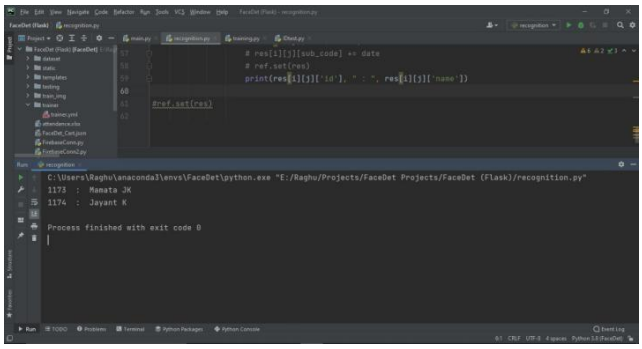

Figure 12 :Accuracy of the Result obtained

Figure 11 shows face detected and name of face recognized are shown in the terminal during the testing phase as shown in Figure 12. This is achieved using the OpenCV library. The image of the class is captured using a mounted Ip camera or plug-in camera and is temporarily stored in the

system which is uploaded later to cloud.

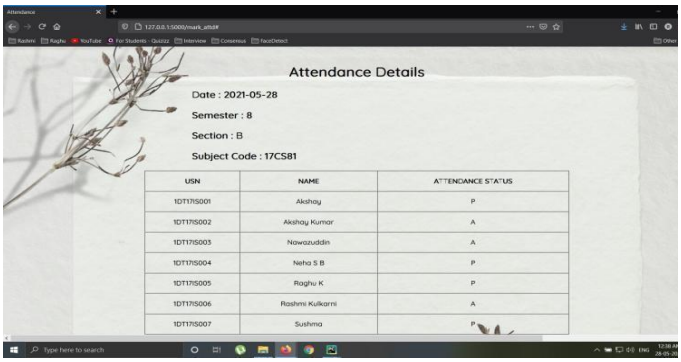

Figure 13. Collective attendance detail of class

The Figure 13 is the display of attendance after the recognized faces are compared with the data in the database and attendance is marked present to the faces recognized and absent for faces that are not recognized

V. CONCLUSION

In this paper, we provide a smart attendance system using face recognition. Course instructors need not mark the attendance manually that takes a lot of time compared to an automated system. Proxy attendance normally given by students is avoided too. The accuracy of face recognition is 98%. The rest 2% varies due to alignment or lighting issues and low resolution of training images. The usage of AdaBoost algorithm helps to produce a strong classifier and collects the weak classifiers to discard. Cascading process used in classification helps to improve the accuracy of the face detection system at an optimal speed.

In future, the dataset can be further strengthened by adding more images of students with varying resolution to assist in the training phase so as to improve the face recognition scheme. We can solve the alignment problem by placing the camera at a correct angle which allows us to view all the faces clearly and assist us to obtain good training images. Enhanced Image registration techniques can be adopted to reduce false positives.

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