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ATTENDANCE SYSTEM BASED ON FACE RECOGNITION USING LBPH

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Abstract:

In the traditional system, it is hard to be handle the attendance of huge students in a classroom. As it is time-consuming and has a high probability of error during the process of inputting data into the computer. Real-Time Face Recognition is a real-world solution which comes with day to day activities of handling a bulk of student's attendance. Face Recognition is a process of recognizing the students face for taking attendance by using face biometrics. In this project, a computer system will be able to find and recognize human faces fast that are being captured through a surveillance camera. Numerous algorithms and techniques have been developed for improving the performance of face recognition but our proposed system uses Haar cascade classifier to find the positive and negative of the face and LBPH (Local binary pattern histogram) algorithm for face recognition by using python programming and OpenCV library. Here we use the tkinter GUI interface for user interface purpose.

Keywords: - Haar cascade classifier, LBPH algoritham

I. INTRODUCTION

The technology aims in imparting tremendous knowledge oriented technical innovations these days. Machine Learning is one among the interesting domain that enables the machine to train itself by providing some datasets as input and provides an appropriate output during testing by applying different learning algorithms. Nowadays Attendance is considered as an important factor for both the student and the teacher of an educational organization. With the advancement of the Machine learning technology the machine automatically detects the attendance performance of the students and maintains a record of those collected data. In general, the attendance system of the student can be maintained in two, different forms namely, Manual Attendance System (MAS) Automated Attendance System (AAS). Manual Student Attendance Management system is a process where a teacher concerned with the particular subject need to call the students name and mark the attendance manually. Manual attendance may be considered as a time-consuming process or sometimes it happens for the teacher to miss someone, or students may answer multiple times on the absence of their friends. So, the problem arises when we think about the traditional process of taking attendance in the classroom. To solve all these issues, we go with Automatic Attendance System (AAS). There are so many advantages using this technology. Some of them are as follows –

- Automation simplifies time tracking, and there is no need to have personnel to monitor the system 24 hours a day. With automated systems, human error is eliminated.
- A time and attendance system using facial recognition technology can accurately report attendance, absence, and overtime with an identification process that is fast as well as accurate.
- Facial recognition software can accurately track time and attendance without any human error
- Facial biometric time tracking allows you to not only track employees but also add visitors to the system so they can be tracked throughout the worksite.

1.1 Drawbacks of various Attendance systems:

Types of the Attendance systems	Drawback
RFID-based	Fraudulent usage
Fingerprint-based	Time consuming for students to wait and give their attendance
Iris-based	Invades the privacy of the user
Wireless-based	Poor performance if topography is bad

There are two phases in Face Recognition Based Attendance System: -

1.2 *Face Detection*:
Face Detection is a method of detecting faces in the images. It is the first and essential step needed for face recognition. It mainly comes under object detection like for example car in an image or any face in an image and can use in many areas such as security, bio-metrics, law enforcement, entertainment, personal safety, etc.

1.3 *Face Recognition*:
Face Recognition is a method of identifying or verifying a person from images and videos that are captured through a camera. Its Key role is to identify people in photos, video, or in real-time.

II. LITERATURE SURVEY

There were many approaches used for dealing with disparity in images subject to illumination changes and these approaches were implemented in object recognition systems and also by systems that were specific to faces. Some of the approaches as follows: -

A method for coping with such variations was using gray-level information to extract a face or an object from shading approach [1]. The more reason gray scale representations are used for extracting descriptors instead of operating on color images directly and also gray scale simplifies the algorithm and reduces computational requirements. Here in our case, color is of limited benefit and introducing unnecessary information could increase the number of coaching data required to attain good performance [2]. Being an ill-posed problem, these proposed solutions assumed either the item shape and reluctance properties or the illumination conditions [3]. These assumptions made are too strict for general beholding, and so, it didn't persuade be sufficient for face recognition.

The second approach is the edge map [4] of the image which could be a useful object representation feature that's insensitive to illumination changes to certain event. Edge images might be used for recognition and to realize similar accuracy as gray level pictures. The edge map information approach owns the advantage of feature-based approaches, like invariance to illumination and low memory requirement. It integrates the structural information with spatial information of a face image which can be done by grouping pixels of face edge map to line segments. After thinning the edge map, a polygonal line fitting process is applied to come back up with the edge map of a face [5] [6] [7] There is one another approach through which the image disparities because of illumination differences are handled; it's by employing a model of several images [8] of the identical face which is taken under various illumination conditions. During this kind of approach, the pictures captured may be used as independent models or as a combined model-based recognition system [9] [10].

Smart Attendance Monitoring System: A Face Recognition based Attendance System for Classroom Environment [11] proposed an attendance system that overcomes the problem of the manual method of existing system. It is face recognition method to take the attendance. The system even captures the facial expression lighting and pose of the person for taking attendance.

Class Room Attendance System using the automatic face recognition System [12] a replacement approach a3D facial model introduced to spot a student's face recognition within a classroom, which can be used for the attendance system. Using these analytical researches will help to produce student's recognition in automated attendance system. It recognizes face from images or videos stream for record their attendance to gauge their performance.

RFID based attendance system is used to record attendance, need to place RFID [13]and ID card on the card reader based on the RFID based attendance to save the recorded attendance from the database and connect the system to the computer, here RS232 is used. The problem of fraudulent access is going to be rise from this method. For instance, someone like every hacker will authorize using ID card and enters into the organization.

III. METHODOLOGY

- Haar Cascade Classifier
- Local Binary Patterns Histogram

These two methodologies come under OpenCV. OpenCV comes with a trainer and as well as a detector. So, if you want to train your classifier for any object then you can use this classifier called Haar Cascade Classifier.

3.1 Haar Cascade Classifier:

Detecting objects with the help of Haar cascade classifiers is an effective method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. Object Detection comes under machine learning based approach where a cascade function is trained from lots of positive and negative images.

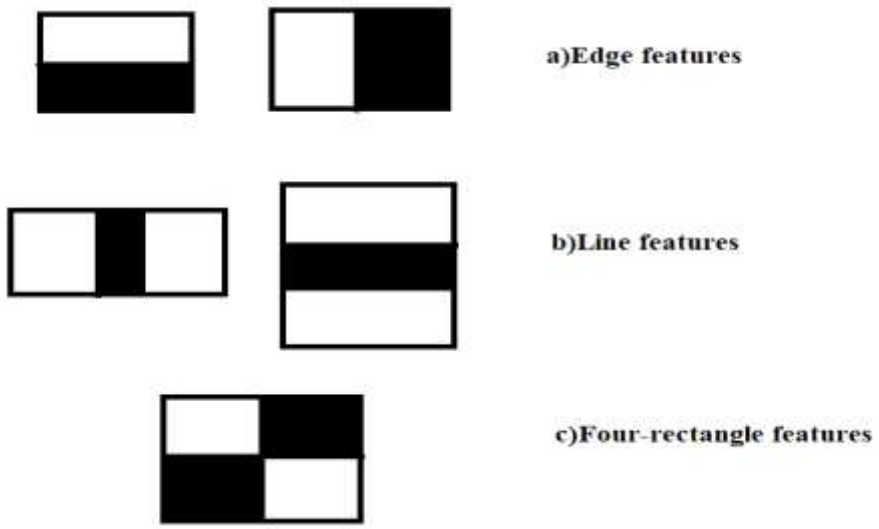
Now what are these positive and negative images?

A classifier (namely cascade of boosted classifiers working with haar like features) which is trained with many samples of a specific object (i.e., a face or a car), called positive example. So, whatever you want to detect if you train your classifier with those kinds of values. For example, if you want to detect face then you need to train your classifier with number of images which contain faces. So, these are called positive images which contain the object which you want to detect.

Similarly, we want to train the classifier with negative images that means the images which doesn't contain object that you want to detect. For example, if we want to detect the face then the image which doesn't contain the face is called negative image. In the same way if the image contains face or number of faces then it is called positive images.

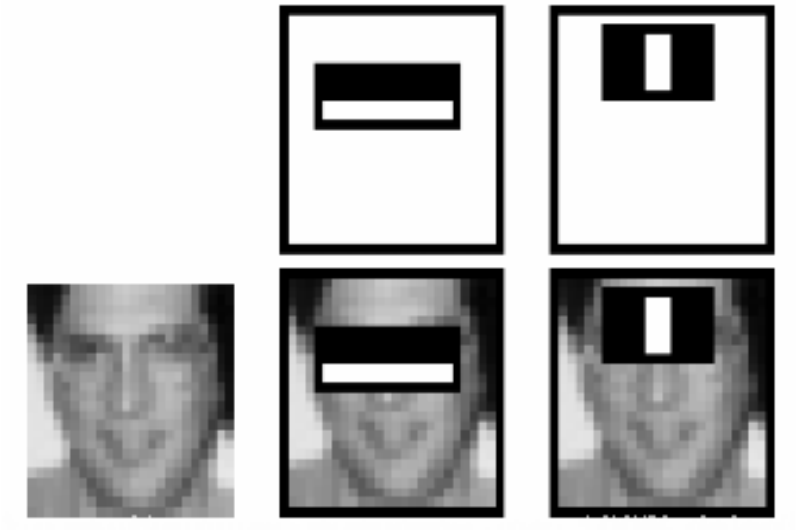
After a classifier is trained it can be applied to the region of interest in an input image and classifier outputs 1 if the region is likely to show the object or 0 otherwise.

Here we will work with face detection. Initially, in order to train the classifier, the cascade function needs a lot of positive images (images which contains faces) and negative images (images without faces). Then we need to extract features from it. For this, we use Haar features shown in the below image are used. They are just like our convolutional kernel. Each feature is claimed to be one value which is obtained by subtracting the sum of pixels under the white rectangle from the sum of pixels under the black rectangle.



Now to calculate lots of features, all possible sizes and locations of each kernel are used. (Just imagine how much computation it needs? Even a 24x24 window results over 160000 features). In order to calculate each feature, we need to find the sum of the pixels under white and black rectangles. To get over from it, they introduced the integral image. Calculation depends upon the size of the image if How large your image, it reduces the calculations for a given pixel to an operation involving just four pixels. Nice, isn't it? It makes things super-fast.

But among all these features most of them are irrelevant that we calculated. For example, consider the image below. The top row shows two good features. In the first feature it focuses on the region of the eyes which is commonly darker than the region of the nose and cheeks. When comes to the second feature it focuses on the property that the eyes are often darker than the bridge of the nose. But if it is applied to cheeks or any other place is irrelevant that you can observe in the image. By using **Adaboost** we select the best features out of 160000+ features.



In the same way, we have to apply each and every feature on all the training images. It finds the best threshold for each and every feature which will classify the faces to positive and negative. Obviously, there will be errors or misclassifications. We only select the features with minimum error rate because they are the features that most accurately classify the face and non-face images. (The process is not as simple as this. Each and every image is given an equal weight in the beginning. After each classification, there will be a change in weights in which weights of misclassified images are increased. Then the same process is done again. New error rates and new weights are calculated. The process will be continued until the required accuracy or error rate is achieved or the required number of features is found).

The final classifier is obtained by weighted sum of these weak classifiers. It is then called weak classifier because it alone can't classify the image, but together with others forms a strong classifier.

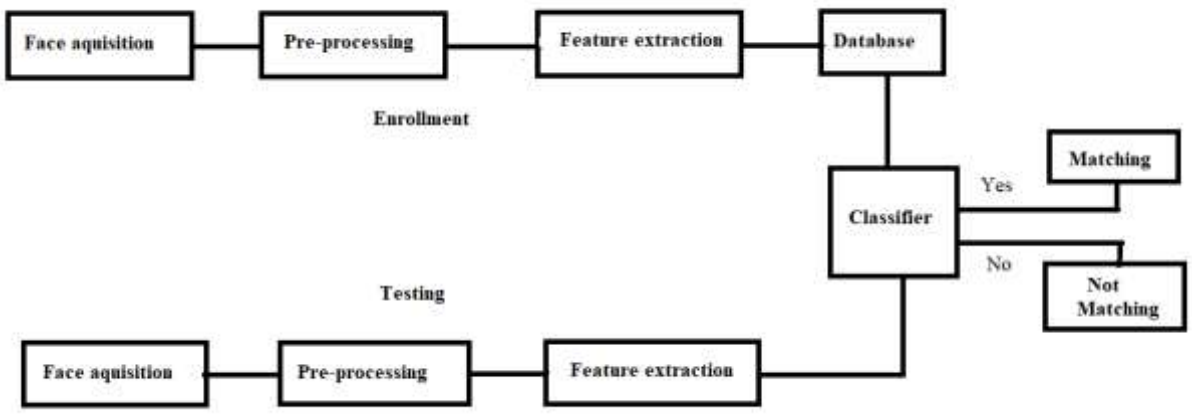
3.2 Local Binary Patterns Histogram:

Local Binary Patterns Histogram algorithm (LBPH) is for face recognition. It is based on local binary operator, and it is one of the best performing textures descriptor. The need for facial recognition systems increasing day by day as per today's busy schedule. They are being used in entrance control, surveillance systems, smartphone unlocking etc. In this article, we will use LBPH to extract features from an input test image and match them with the faces in system's database.

Local Binary Patterns Histogram algorithm was proposed in 2006. It is based on local binary operator. It is widely used in facial recognition due to its computational simplicity and discriminating power. The steps involved to achieve this are:

- creating datasets
- face acquisition
- feature extraction
- classification

3.2.1 Steps involved in LBPH:



- Suppose consider an image which having dimensions N x M.
- For every region in an image we have to divide it into regions of same height and width resulting in m x m dimension
- Local binary operator is used for every region. The LBP operator is defined in window size of 3x3

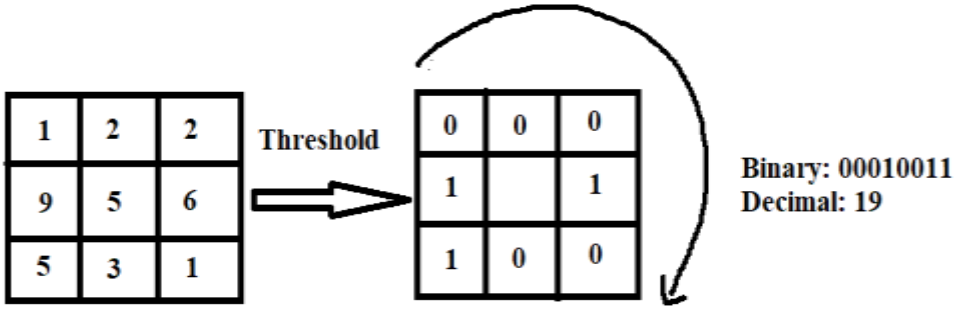
$$LBP(x_c, y_c) = \sum_{p=0}^{P-1} 2^p s(i_p - i_c)$$

Here '(Xc,Yc)' considered as central pixel with intensity 'Ic'. And 'In' being considered as the intensity of the neighbor pixel

- It compares a pixel to its 8 closest pixels, by setting median pixel value as threshold.

$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases}$$

- If the value of neighbor is greater than or equal to the central value it is set as 1 otherwise it is set as 0.
- Thus, we obtain a total of 8 binary values from the 8 neighbors.
- After combining these values, we get an 8 bit binary number which is translated to decimal number for our convenience.
- The obtained decimal number is said to be the pixel LBP value and its range is 0-255.



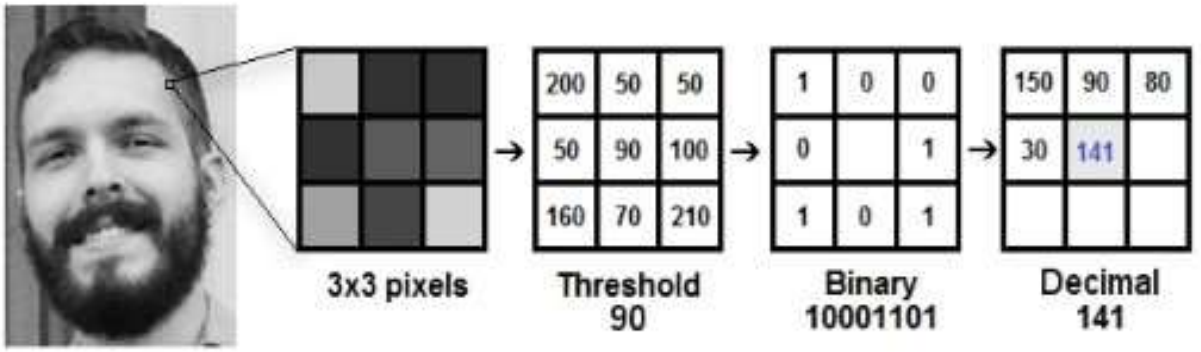
- After the generation of LBP value histogram for each region of the image is created by counting the number of similar LBP values in the region.
- After creation of histogram for each region all the histograms are merged to form a single histogram and this is known as feature vector of the image.
- Now we compare the histograms of the test image and the images in the database and then we return the image with the closest histogram.
- We can use various kinds of approaches to compare the histograms (calculate the distance between two histograms), for example: **Euclidean distance**, **chi-square**, **absolute value**, etc.
- The Euclidean distance is calculated by comparing the test image features with features stored within the dataset. The minimum distance between test and original image gives the matching rate.

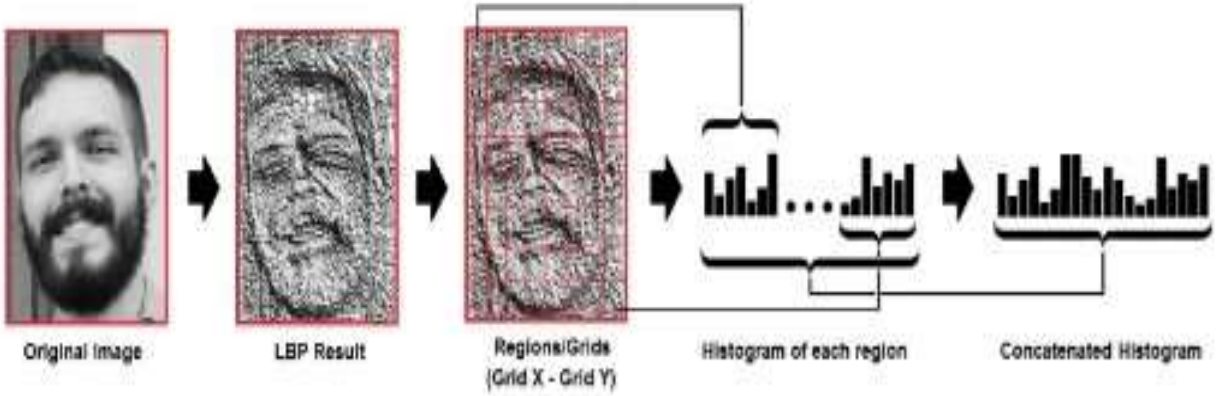
$$d(a,b) = \sqrt{\sum_{i=1}^{n} |a_i - b_i|^2}$$

- As an output we get an ID of the image from the database if the test image is recognized.

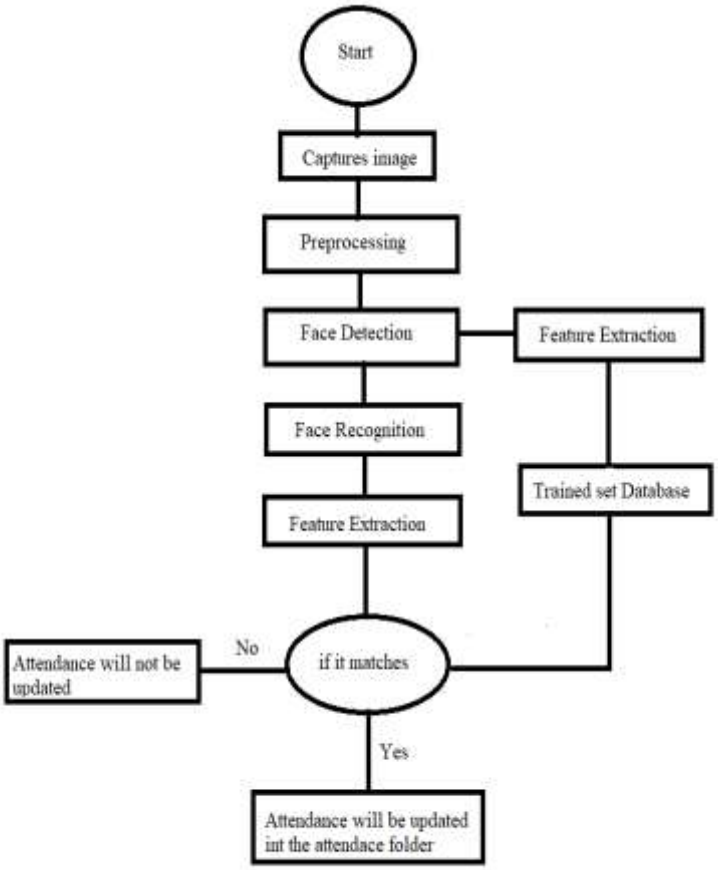
- LBPH can recognize both side and front faces and it is not affected by illumination a variation which means that it is more flexible

3.2.2 Let us consider an example [14]:-





3.3 System Flow Diagram:



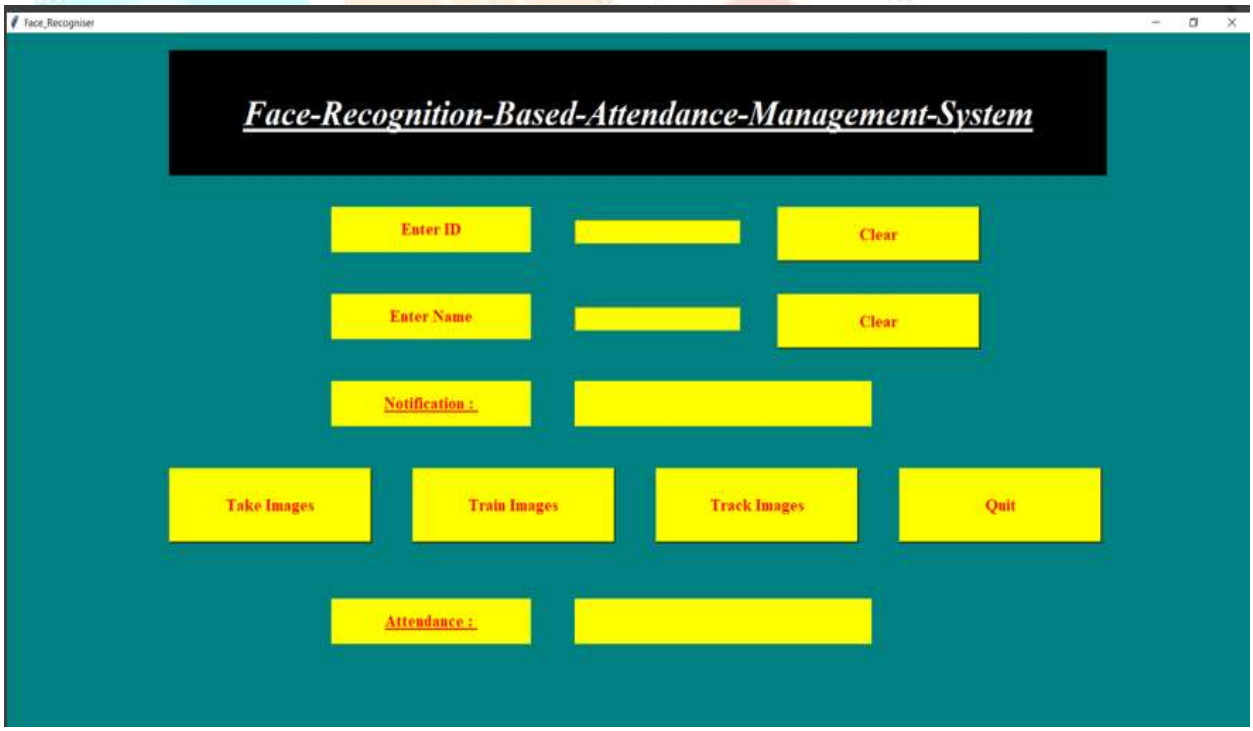
Step 1: First of all, it captures the input image
Step 2: After capturing the image it will preprocess the image and coverts the image into gray scale Image.
Step 3: By using Haar Cascade Classifier face detection will be done and extracts features from the image and then stored in trained set database.
Step 4: Similarly face recognition is done by using Local Binary Patterns Histogram.
Step 5: And then extracted features will be compared with the trained data set.
Step 6: If it matches attendance will be updated in the attendance folder.
Step 7: If not matches attendance will not be updated in the attendance folder.

3.4 How our Proposed System works?

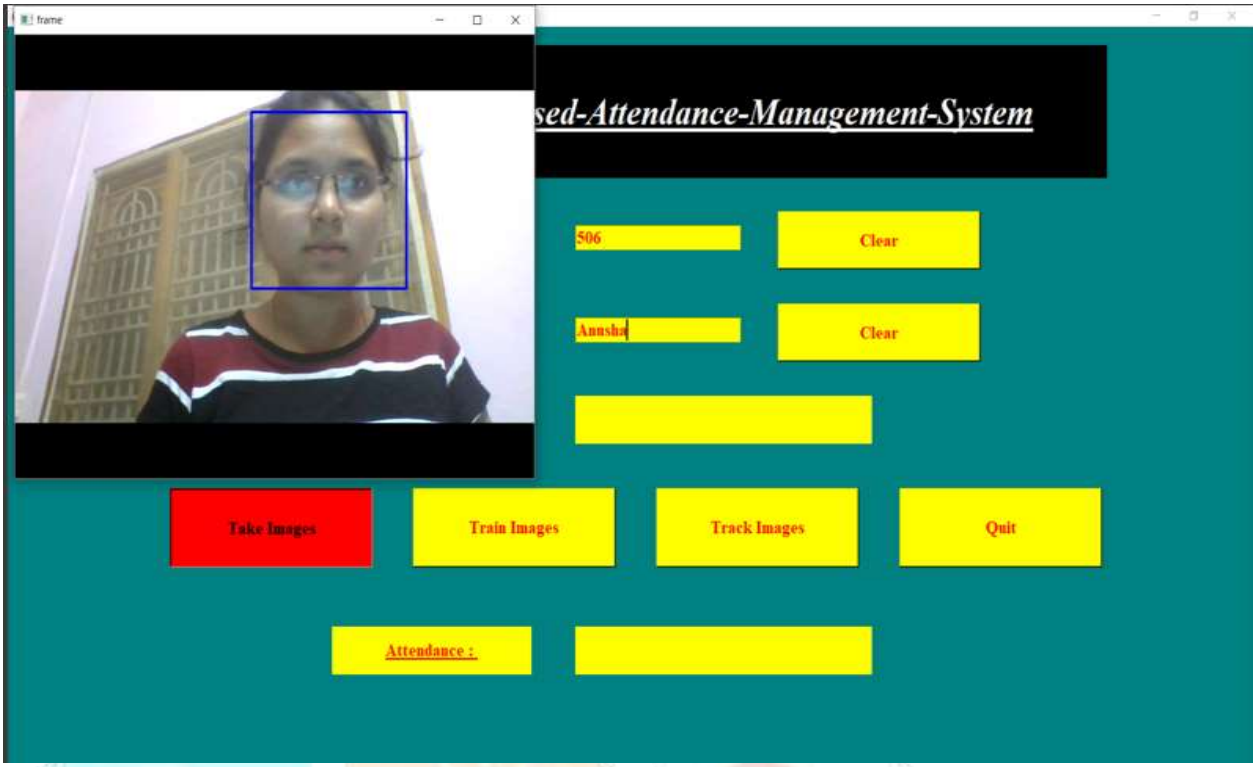
When we run the program, a window is opened and asks for Enter Id and Enter Name. After entering respective name and id fields then we have to click Take Images button. By clicking the Take Images button, a camera of running computer is opened and it starts taking image samples of person. This Id and Name is stored in Student Details folder and file name is saved as Student Details.csv. It takes 60 images as sample and stores them in Training Image folder. After completion it notifies that images saved. After taking image samples in order to train the image samples we have to click Train Image button. Now it takes few seconds to train the machine for the images and creates a Trainner.yml file and stores them in TrainingImageLabel folder. Now all initial setups are done. After completion of take images and Train images we have to click Track images button which is used to track the faces. If the face of particular student is recognized by the camera then Id and Name of person is shown on Image. Press Q (or q) for quit this window. After coming out of it, attendance of particular person will be stored in Attendance folder as csv file with name, id, date and time and it is also available in window.

IV. SAMPLE OUTPUT:

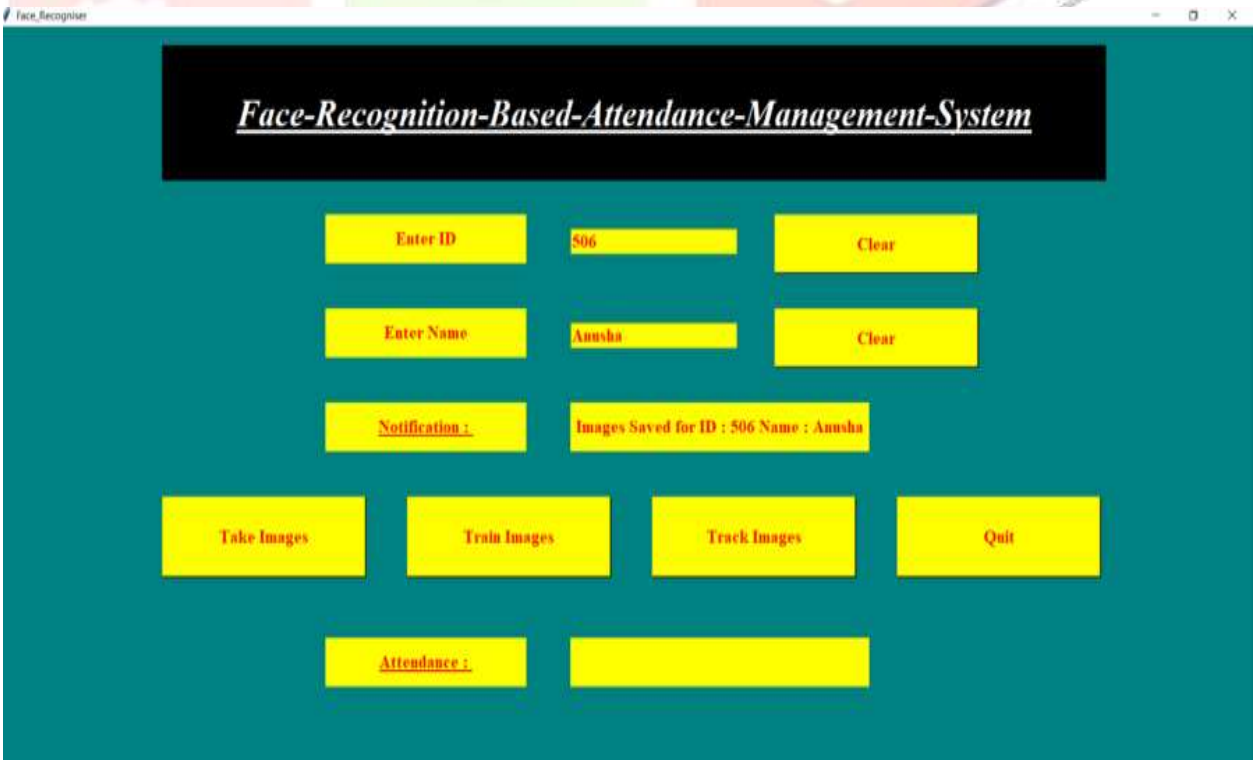
1. Front view



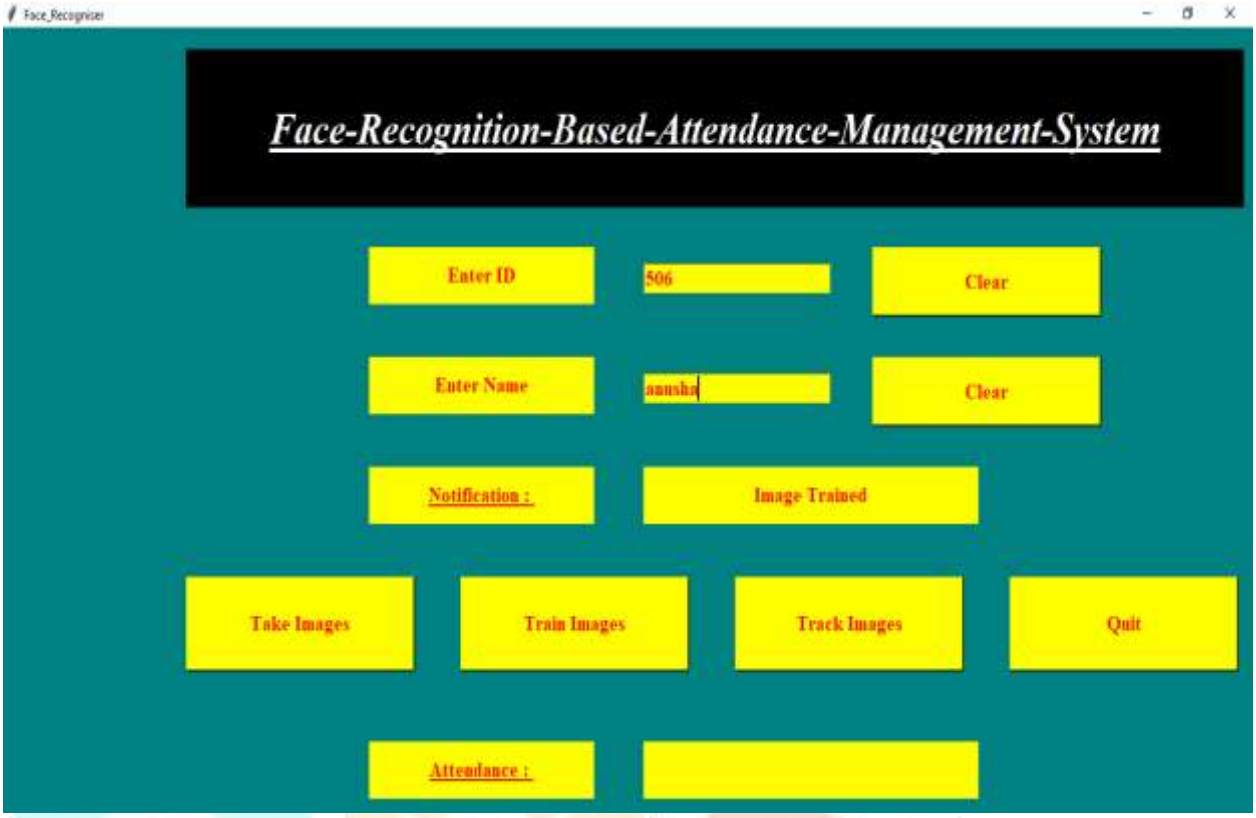
2. Captures image of particular student



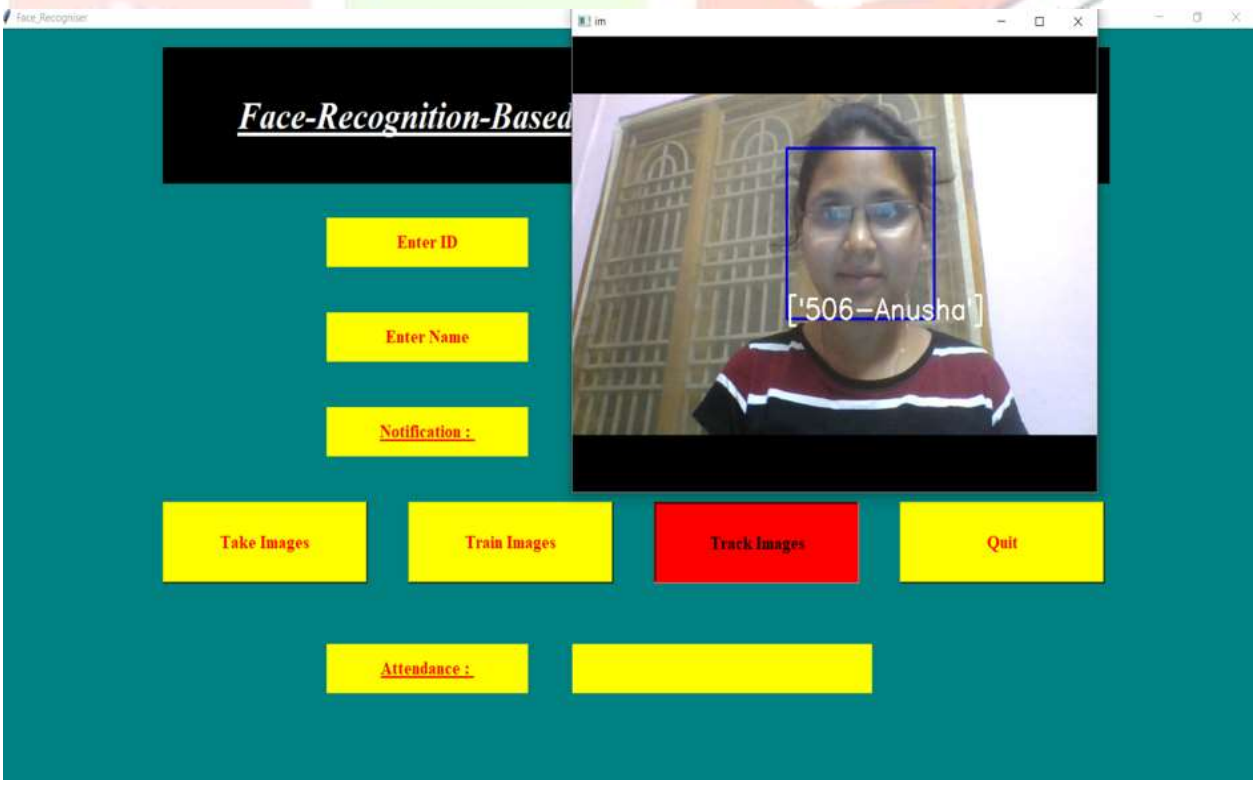
3. A notification message displayed like image saved for particular student with id and name



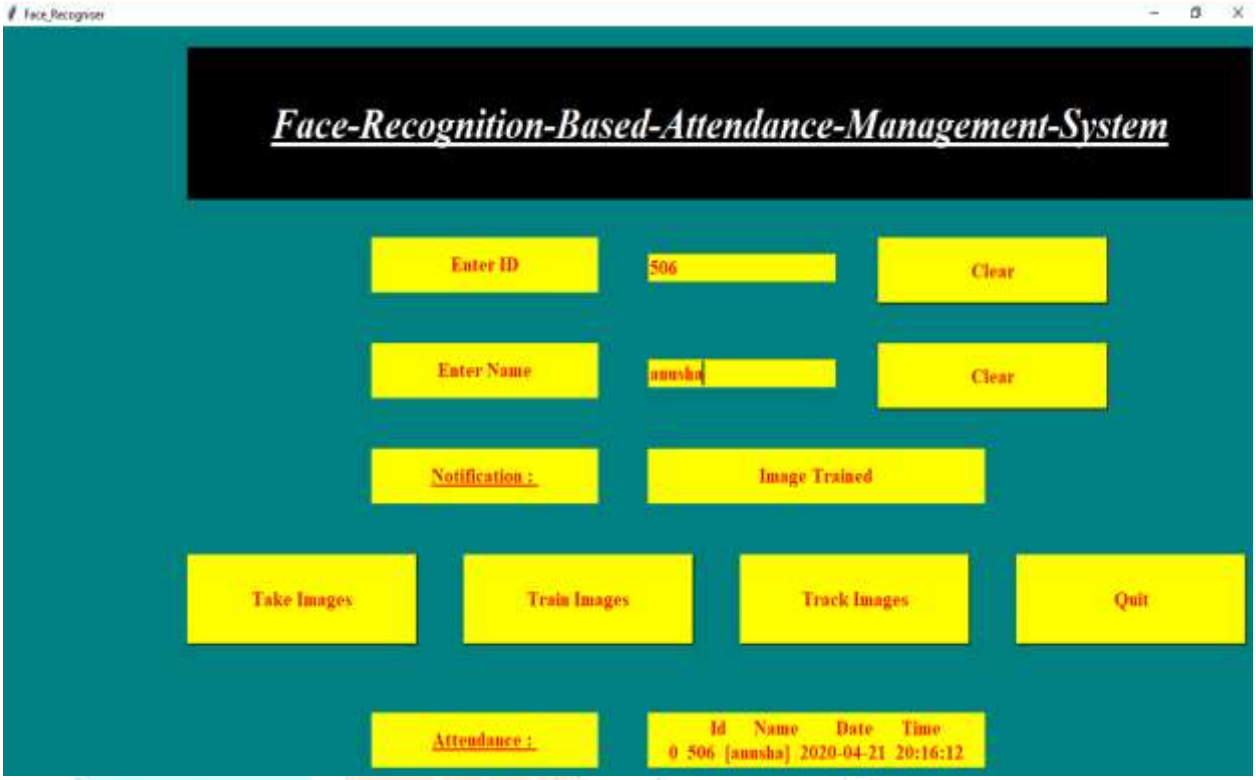
4. Clicking on Train image button, it displays a notification message like “Image Trained”



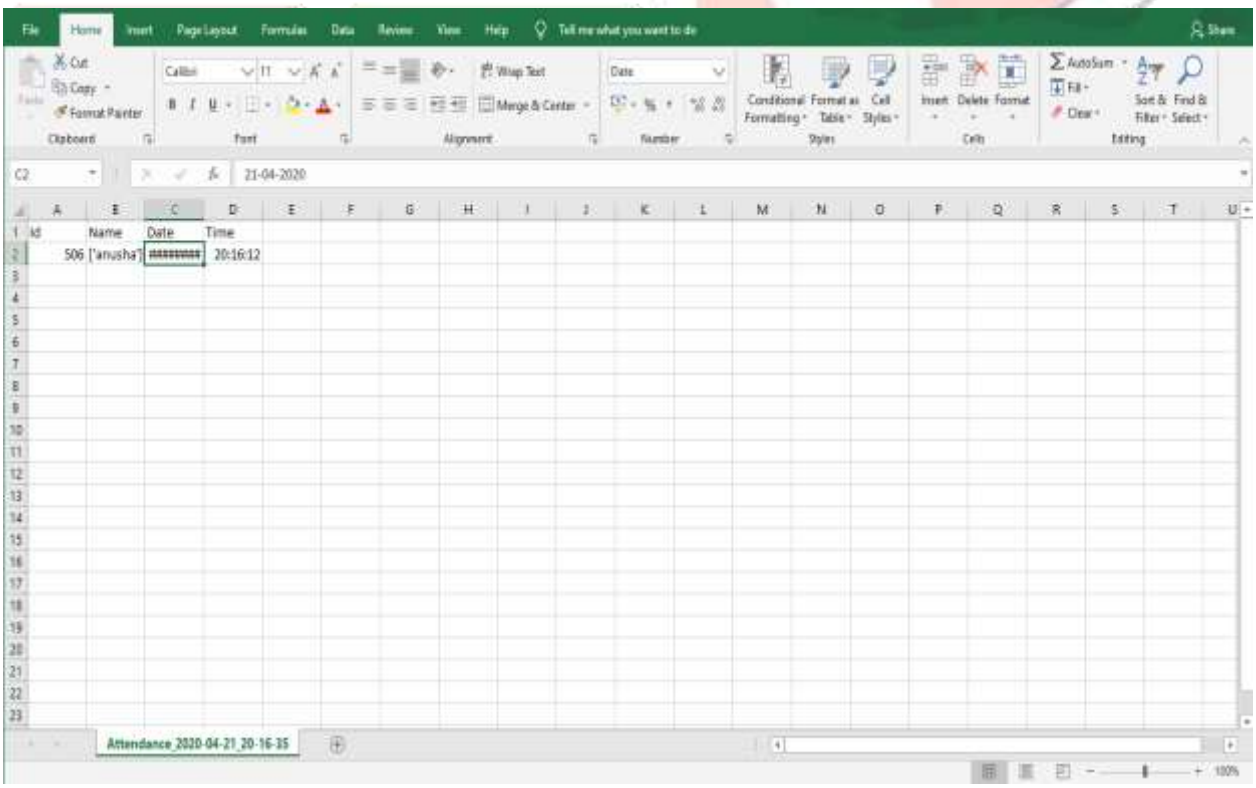
5. On clicking the track image button, it recognizes the face (which is already trained) and displays the name and id of the particular person.



6. On clicking quit button, attendance is updated as shown in the attendance bar.



7. Attendance of particular student is updated in the "Attendance folder".



V. CONCLUSION:

We have implemented an attendance management system for student's attendance. It helps to reduce time and effort, especially in the case of large number of students marked attendance. The whole system is implemented in Python programming language. Facial recognition techniques used for the purpose of the student attendance. And also, this record of student attendance can further be used mainly in exam related issues like who are attending the exams and who are not attending. On this project, there is some further works remained to do like installing the system in the classrooms. It can be constructed using a camera and computer.

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