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FACE RECOGNITION BASED ATTENDANCE SYSTEM

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Abstract - Automatic face recognition (AFR) technologies have made many improvements within the changing world. Smart Attendance using Real-Time Face Recognition may be a real-world solution which comes with day to day activities of handling student attendance system. Face recognition-based attendance system may be a process of recognizing the scholars face for taking attendance by using face biometrics supported high-definition monitor video and other information technology. during this face recognition project, a ADP system are ready to find and recognize human faces fast and precisely in images or videos that are being captured through a surveillance camera. Numerous algorithms and techniques are developed for improving the performance of face recognition but the concept to be implemented here is Deep Learning.

It helps in conversion of the frames of the video into images, so that the face of the student can be easily recognized for their attendance so that the attendance database can be easily reflected automatically.

Index Terms - face recognition, machine learning Classifiers, attendance system.

1. INTRODUCTION

Humans often use face to acknowledge individuals but advancement in computing capability over the past few decades now enable similar recognitions automatically. Face recognition technology is one in every of the smallest amount intrusive and fastest growing biometric technologies. It works by identification of humans using the foremost unique characteristics of their faces.

Face recognition has characteristics that other biometrics don't have. Facial images may be captured from a distance and any special action isn't required for authentication. thanks to such characteristics, the face recognition technique is applied widely, not only to security applications but also to image indexing, image retrievals and natural user interfaces. Biometrics systems have proven to be a vital security tool, during which bulk matching of enrolled people and watch lists is performed daily.

The importance of developing a replacement solution to boost the performance of face identification methods has been highlighted and Machine Learning is one in every of the foremost promising paradigms that may be accustomed achieve it. Face recognition technology has also been used for both verification and identification of scholars during a classroom. This project is aimed toward developing a less intrusive, cost effective and more efficient automated student attendance management system using face recognition, leveraging Python language.

2. MOTIVATION

In the recent years, Image processing which deals with extracting useful information from a digital image plays a unique role in the advent of technological advancements.

It focuses on two tasks:

- Improvement of pictorial information for human interpretation
- Processing of image data for storage, transmission and representation for autonomous machine perception.

Also, people have began to use image capturing devices never as before with the appearance of smart phones and electrical circuit television. Since the applying of image processing is vast, extensive work and research are ending in utilizing its potential to and to form new innovative applications. face recognition has been the earliest of the appliance derived from this technology, which is one among the foremost fool proof methods in human detection. Face may be a typical multidimensional structure and desires good computational analysis for recognition. Biometrics methods are used for the identical purpose since a protracted time now. Although it's effective, it's still not completely reliable for purpose of detecting an individual.

3. PROBLEM STATEMENT

Attendances of every student are being maintained by every school, college and university. Empirical evidences have shown that there is a significant correlation between students attendances and their academic performances. There was also a claim stated that the students who have poor attendance records will generally link to poor retention. Therefore, faculty had to maintain proper record for the attendance. The manual attendance record system is not efficient and requires more time to arrange record and to calculate the average attendance of each student. Hence there is a requirement of a system that will solve the problem of student record arrangement and student average attendance calculation. One alternative to make student attendance system automatic is provided by facial recognition.

4. OBJECTIVES

The objectives of this project are as follows:

- To design and develop software that will transform the old and manual attendance process and checking attendance of the scholars into a computerized attendance system using face recognition.
- To propose a system that may speed up the slow, tedious process of attendance management
- To develop a system that minimizes the employment of the paper in checking the attendance.
- To develop an algorithm that detects the face.

- To develop another algorithm that recognizes the face.

5. BASIC INFORMATION ABOUT PROJECT

- **Face Detection**

Face detection is that the process of identifying and locating all the current faces during a single image or video irrespective of their position, scale, orientation, age and expression.

- **Face Recognition**

Face Recognition is that the task of identifying an already detected face as a known or unknown face and in additional advanced cases telling exactly whose face it's.

- **Difference between Face Detection and Face Recognition**

Face detection answers the question, Where is the face? It identifies an object as a "face" and locates it in the input image. Face Recognition on the other hand answers the question who is this? Or whose face is it?.

6. LITERATURE SURVEY

Bhattacharya proposed an approach during which an automatic attendance management system aims at solving the problems of manual methods of existing systems. they need used the concept of face recognition to implement a system that marks the attendance of a specific person by detecting and recognizing the face. These systems perform satisfactorily with different facial expressions, lighting and pose of the person. there's room for improvement since these systems sometimes fail to acknowledge every face student present within the classroom. they need made the device portable for straightforward use even when the sessions are on, without disturbing the category. They expected that there would be a future scopes to form a more compact ergonomics to form it a more user-friendly product to create a control in building a more healthier academic environment.

Kassem proposed a model within which their main aim is to develop a attendance monitoring system using RFID. They aimed to reinforce the university's monitoring system taking under consideration factors like reliability, time saving, and simple control. The proposed system consists of a mobile RFID solution in a very logical context. They also talked about the benefits and drawbacks of the proposed RFID system. They urged that this method will be used for other applications like payment systems, access control and quality tracking.

Sawhney proposed a approach within which they used a sensible and auto attendance management system. This smart attendance system is mostly executed with the assistance of biometrics. Face recognition is one in every of the biometric methods to enhance this method. Being a chief feature of biometric verification, biometric identification is being employed enormously in several such applications, like video monitoring and CCTV footage system, an interaction between computer & humans and access systems present indoors and network security. By utilizing this framework, the matter of proxies and students being marked present although they're not physically present can easily be solved. the most implementation steps utilized in this kind of system are face detection and recognizing the detected face. This paper proposes a model for implementing an automatic attendance management system for college kids of a category

by making use of face recognition technique, by using Eigenface values, Principle Component Analysis (PCA) and Convolutional Neural Network (CNN). After these, the connection of recognized faces must be conceivable by comparing with the database containing student's faces. This model could be a successful technique to manage the attendance and records of scholars. this method is geared toward providing a major level of security. Hence, a highly pro-efficient attendance system for classroom attendance is developed which may perform recognition on multiple faces at one instance. Also, there's no requirement of any special hardware for its implementation. A camera, a PC and database servers are sufficient for constructing the smart attendance system.

Rathod proposed a approach for Automated Attendance System using Machine Learning. Automated systems involving use of biometrics like fingerprint and iris recognition are well developed within the recent years however, it's intrusive and value required for deployment on large scale gets increased substantially. to beat these issues, biometric feature like automatic face recognition will be used which involves the phases like image acquisition, face detection, feature extraction, face classification, face recognition and eventually marking the attendance. The algorithms like Viola- Jones and HOG features together with SVM classifier are wont to acquire the specified results. Various real time scenarios are considered like scaling, illumination, occlusions and pose. the matter of redundancy in manual records and keeping attendance is solved by this technique. qualitative analysis is finished on the premise of PSNR values. This attendance management

system estimates the attendance of every student by continuous clicking of images for a few fundamental quantity and finds the most effective localized image for processing. The system allows the teacher to test student's attendance automatically with none extra cost and energy whereas the proposed system needs very elementary things such as; camera, laptop or laptop computer and native network. This methodis secure, reliable and straightforward to use. the general system is implemented in MATLAB.

Poornima proposed Attendance Monitoring System using biometric identification with Audio Output and Gender Classification. This paper aimsin presenting an automatic attendance System- AUDACE. this technique automatically detectsthe coed within the class room and marks the attendance by recognizing their face. this method is developed by capturing real time human faces within the class. The detected faces are matched against the reference faces within the dataset and marked the attendance for the attendees. Finally, the absentee lists are said aloud through voice conversion system for confirmation. Secondly, the system is trained to classify the gender of the scholars present within the class. This paper focuses on developing an automatic attendance system with audio output in lecture or classroom session by which the lecturer or faculty can record student's attendance. It saves time and energy, especially if it's a lecture with huge number of scholars. This attendance system shows the employment of biometric identification technique for the aim of student attendance and for the further process this record of student is employed in exam related issues. it's out of the question to spot faces having similar countenance. The system

is extended to reply to the presence of newcomers within the classrooms. Also, means to mark attendance without the intervention of teachers in an exceedingly classroom i.e. automatically marking attendance at the start of each hour will be implemented. It is extended to video surveillance to detect frauds at crowded areas like bus stands, theatres, railway stations wherein by face recognition techniques, the identity of the culprits will be found.

Rishi proposed an approach towards bluetooth attendance monitoring system will allow the school and staff to freely move to class without carrying physical attendance register and mark the attendance of the scholars sitting inside the classroom with just a faucet. during this approach a model is proposed using the fundamental concepts of web applications and app development field which can be deployed so as to attain the proposal and supply the implementation of the identical. it'll help the college members to allow their maximum percentage of lecture time to the scholars. this technique also allows the benefit to college in terms of roll calling and proxy attendance as this approach automatically takes the attendance of the scholars with the assistance of the bluetooth mac identification. When the college activate the system for the actual hour of lecture, the bluetooth tracks the mac identity of the scholars mobile and identify the particular student supported the previous stored database. the coed will be ready to get their attendance details together with many other educational benefits related to the actual lecture.

Rashid proposed the fingerprint based attendance system in which a portable device capable of taking students fingerprint is moved inside the classroom. The advantage of this approach is that attendance will take at lecture time without the instructor's intervention and this system guarantees the marking of full proof attendance. But the problem with the approach is that if we pass the device during lecture time, then there may be distracting of attention of both teacher and student.

T. Lim proposed Radio Frequency Identification (RFID) based attendance system in which each student has one unique identity card. That card will be swapped in a machine to put attendance. Swap machine is directly connected to a system that stores attendance related details. The limitation of the RFID approach is that unauthorized person also can put the attendance.

Jun Iio proposed Mobile device and web application based system. While the lecture goes on, a mobile device running the applying which has been developed during this study for registration of scholars is passed around among participants, one by one. When the participants of lecture get the device, he or she fined his/her ID and name from the screen of the device by clicking the item which is found by the user, a screen for every person is appeared. But the matter with the approach is that if we pass the device during lecture time, then there is also distracting of the classes.

Nazare Kanchan Jayant face recognition based attendance system. the downside with finger print based attendance system is that the fingerprints of scholars are difficult to scan and time progresses; there is also difference within the fingerprints which will not be suitable for fingerprint based attendance system. that the solution to above

drawback is face recognition based attendance system because the face is most protected a part of the body and doesn't undergo much over an entire lifetime of an individual's being. However, face recognition are often done automatically from a camera placed somewhere within the classroom. Face Recognition System hasn't required active participation from students to place the attendance. With the assistance of the camera after we capture a face that face are going to be stored in a very device with minimum dimensions, hence the space required for storage is additionally less.

SYSTEM ANALYSIS

1. SOFTWARE REQUIREMENTS

- **Python**

Python Libraries:

- **GUI – tkinter :** Python's de facto standard GUI
- **Numpy** : NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.
- **Pandas** : Pandas is an opensource library that allows to you perform data manipulation in Python
- **OS Module** : The main purpose of the OS module is to interact with the operating system. The primary use for it is to create folders, remove folders, move folders, and sometimes change the working directory
- **Image Module** : The Image module provides a class with the same name which is used to represent a PIL image. The module also provides a number of factory functions, including functions to load images from files, and to create new images.
- **Open CV** : It is a library of Python bindings designed to solve computer vision problems

2. MINIMUM HARDWARE REQUIREMENTS

- RAM: 1 GB RAM and more
- Processor: Any IntelProcessor
- Hard Disk: 6 GB and more
- Speed: 1GHZ andmore
- Web cam

3. SYSTEM ARCHITECTURE

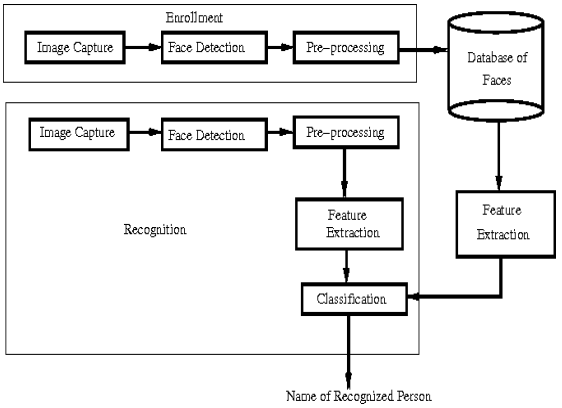

Fig 1: System Architecture

Initially in the enrollment phase, the image of the student is captured and was detected. The image after being detected was pre-processed by training the data sets.

This image will be stored in the database. Later, in the recognition phase, the face that was captured will be detected and again trained against the features that were extracted during enrollment.

After the features were extracted, they were classified and the name of the student will be displayed.

SYSTEM DESIGN

1. USECASE DIAGRAM

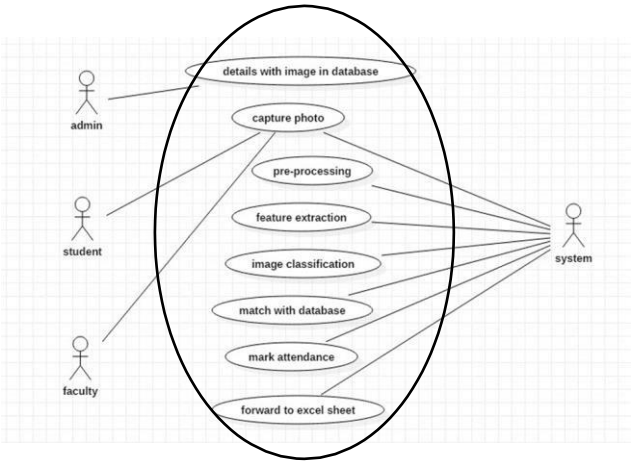

Fig 2: Use Case Diagram

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions (use cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system called actors. Each use case should provide some observable and valuable result to the actors or other stakeholders of the system.

The actions followed by “details with image database” are the use cases. The connections in line which action should be done by which actor.

2. CLASS DIAGRAM

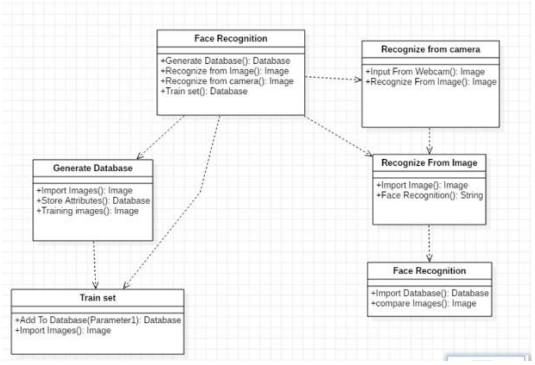

Fig 3: Class Diagram

The above diagram represents the class diagram of attendance monitoring using face recognition. class diagram is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. A class is a description of a group of objects all with similar roles in the system, which consists of Structural features called attributes and Behavioral features called operations. In this project,

- Face recognition
- Recognize from camera
- train set
- Generate Database
- Recognize from Image are classes.

  The content specified within these classes are called operations.

3. OBJECT DIAGRAM

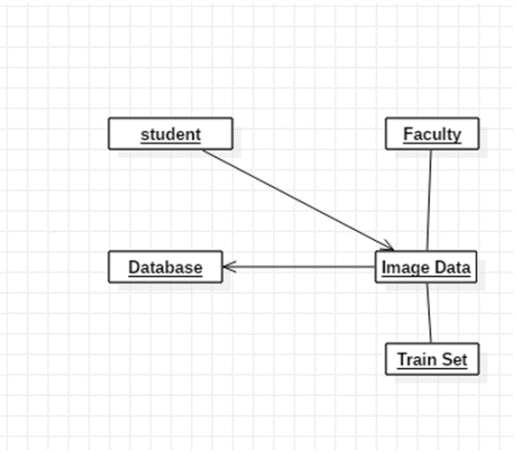

Fig 4: Object Diagram

The above diagram represents the object diagram of attendance monitoring using face recognition. Object is an instance of a particular moment in runtime, including objects and data values. A

static UML object diagram is an instance of a

class diagram; it shows a snapshot of the detailed state of a system at a point in time, thus an object diagram encompasses objects and their relationships at a point in time. It may be considered a special case of a class diagram or a communication diagram.

The objects in this diagram are:

- Student
- Database
- Imagedata
- faculty
- trainset

which were the instances taken from the class diagram.

4. ACTIVITY DIAGRAM

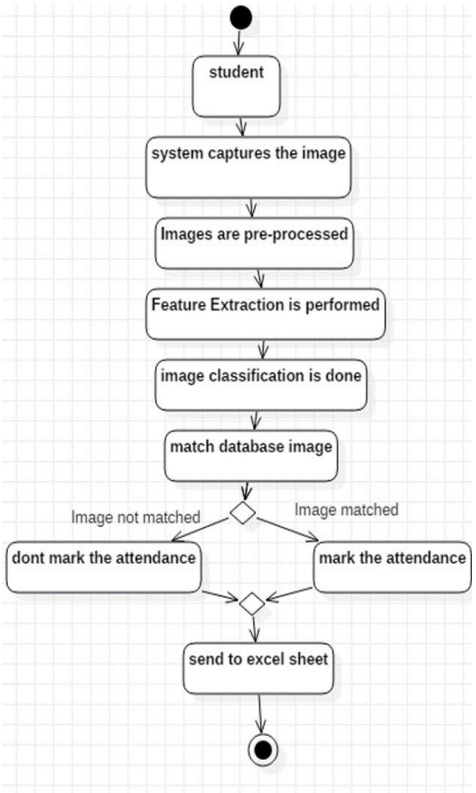

Fig 6: Activity Diagram

Activity diagram is used to describe the dynamic aspects of the system. Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another. This flow can be sequential, branched, or concurrent. Activity diagrams deal with all type of flow control by using different elements such as fork, join, etc.

5. SEQUENCE DIAGRAM

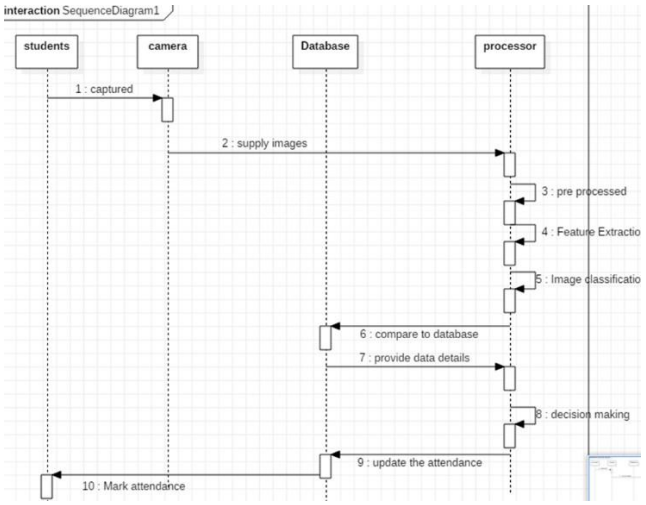

Fig 7: Sequence Diagram

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the logical view of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios.

Messages, written with horizontal arrows with the message name written above them, display interaction. Solid arrow heads represent synchronous calls, open arrow heads represent asynchronous messages.

IMPLEMENTATION

In this project, we will use different approaches for face detection and face recognition. we will discuss about them briefly in this module

1. FACE DETECTION ALGORITHM

For face detection, we use HAAR Cascades classification. This Cascade could be a machine learning process where a large amount of knowledge is first trained with images with faces and pictures without faces. Initially, it calculates the pixels of the world.

For example, consider the figure

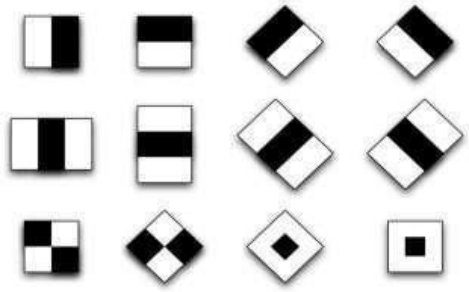

Fig.8: The HAAR features are the difference between the sums of pixels of the dark region and sum of pixels of the light region.

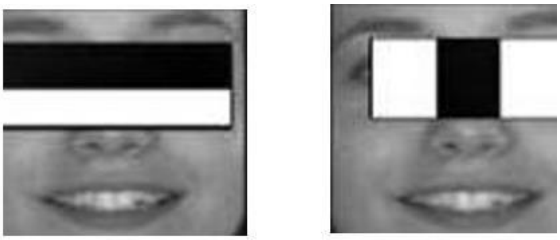

Fig 9(a) (b)

Feature Extraction

The eyes region within the image 9(a) is darkened and also the below region is lightened. So, the sum of pixels is calculated. The lightened region is taken into account to be a feature used for detection. So , the nose part is taken into account to be a feature used for detection. From image 9(b) the eyes region is lightened, and also the nose bridge is darkened. So, the sum of pixels is calculated, and therefore the eyes part is employed as a feature for detection. during this way, many features are trained by using this method, of a face to the machine. Now by finding all the pixel numbers of the faces, the detection is finished. Consider a 24*24 window where we get 160000 features. it's difficult to calculate all those features. But suppose if we take only 4 features of any image and train the cascade the computation is best. But if a feature appears where the cascade isn't trained then the issue in detection increases. So, this problem is achieved by "Ada Boost".

Ada Boost classifier

The Ada Boost classifier is trained on each feature of the image within the training data. for every feature, there'll be a threshold value where it classifies the pictures with face and pictures without a face. All features cannot detect exactly. So, by considering features with a minimum threshold rate, the detection are going to be easy. This classification process is finished several times, and every one the classification weights with the minimum threshold are noted. Now, the classifier with a lower rate is again combined with the feature having a minimum threshold and also the process is sustained until required accuracy is obtained. in keeping with a survey 200 features of a picture gives 95% accuracy in

detection. this is often a time-consuming process. So, the opposite way is first to acknowledge the part which isn't a face. By eliminating that region number of features are going to be reduced. an idea called Cascade where the features are grouped into different stages is introduced. If there are 200 features rather than applying all features, a classifier is first trained on some features within the first stage. If it passes, then remaining features are tested within the second stages on the identical classifier and this process continues. But because of anybody feature, if the primary stage fails, discard it. Remaining features aren't considered. So, we take another classifier, and during this way the classification is completed.

2. FACE RECOGNITION ALGORITHM

LBPH ALGORITHM:

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number

It was found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we can represent the face images with a simple data vector. .As LBP is a visual descriptor it can also be used for face recognition tasks.

The steps followed in the LBPH algorithm are as follows:

- **Parameters**: the LBPH uses4 parameters:
  - Radius: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.
  - Neighbors: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.
  - Grid X: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.
  - Grid Y: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

Training the Algorithm: First, we want to coach the algorithm. To do so, we want to use a dataset with the facial images of the people we wish to acknowledge. we'd like to also set an ID (it could also be variety or the name of the person) for every image, that the algorithm will use this information to acknowledge an input image and provides you an output. Images of the identical person must have the identical ID.

Applying the LBP operation: Applying the LBP operation: the primary computational step of the LBPH is to make an intermediate image that describes the initial image during a better way, by highlighting the facial characteristics. To do

so, the algorithm uses an idea of a window, supported the parameters radius and neighbors.

The image below shows this procedure:

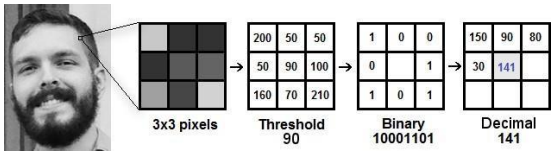

Fig. 11: Pictures depicting the LBPH procedure

- Suppose we have a facial image in grayscale.
- We can get part of this image as a window of 3x3 pixels.
- It can also be represented as a 3x3 matrix containing the intensity of each pixel (0~255).
- Then, we need to take the central value of the matrix to be used as the threshold.
- This value will be used to define the new values from the 8 neighbors.
- For each neighbor of the central value (threshold), we set a new binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold.
- Now, the matrix will contain only binary values (ignoring the central value). We need to concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101).
- Then, we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image.
- At the end of this procedure (LBP procedure), we have a new image which represents better the characteristics of the original image.
    - As we have an image in grayscale, each histogram (from each grid) will contain only 256 positions (0~255) representing the occurrences of each pixel intensity.
    - Then, we need to concatenate each histogram to create a new and bigger histogram. Supposing we have 8x8 grids, we will have 8x8x256=16.384 positions in the final histogram. The final histogram represents the characteristics of the image originalimage.

Performing the face recognition: In this step, the algorithm is already trained. Each histogram created is used to represent each image from the training dataset. So, given an input image, to find the image that matches the input image we just need to compare two histograms and return the image with the closest histogram. To compare the histograms, we can use euclidean distance. It is provided by the OpenCV library.

Code

Training phase

```
def TrainImages():
    recognizer = cv2.face_LBPHFaceRecognizer.create()
    harcascadePath = "haarcascade_frontalface_default.xml"
    detector =cv2.CascadeClassifier(harcascadePath)
    faces,Id = getImagesAndLabels("TrainingImage")
    recognizer.train(faces, np.array(Id))
    recognizer.save("TrainingImageLabel\Trainner.yml")
    res = "Image Trained"
    message.configure(text= res)
```

The above code trains the model using images and labels.

Before training, it needs to isolate face from background, which is done using pretrained model from

haarcascade_frontalface_default.xml

finally, it will give notification “Image Trained”

Tracking phase

```
def TrackImages():
    recognizer = cv2.face.LBPHFaceRecognizer_create()
    recognizer.read("TrainingImageLabel\Trainner.yml")
    harcascadePath = "haarcascade_frontalface_default.xml"
    faceCascade = cv2.CascadeClassifier(harcascadePath);
    df=pd.read_csv("StudentDetails\StudentDetails.csv")
    cam = cv2.VideoCapture(0)
    font = cv2.FONT_HERSHEY_SIMPLEX
    col_names =  ['Id','Name','Date','Time']
    attendance = pd.DataFrame(columns = col_names)
    while True:
        ret, im =cam.read()
        gray=cv2.cvtColor(im,cv2.COLOR_BGR2GRAY)
        faces=faceCascade.detectMultiScale(gray, 1.2,5)
        for(x,y,w,h) in faces:
            cv2.rectangle(im,(x,y),(x+w,y+h),(225,0,0),2)
            Id, conf = recognizer.predict(gray[y:y+h,x:x+w])
            if(conf < 50):
                ts = time.time()
                date = datetime.datetime.fromtimestamp(ts).strftime('%Y-%m-%d')
                timeStamp = datetime.datetime.fromtimestamp(ts).strftime('%H:%M:%S')
```

The above code takes images from web cam and recognizes the person and gives roll no as output.

Student name is retrieved from excel sheet using the student roll no and displays details in the window

If the student is unknown, it will save the image in the unknown folder. Else, it will create a excel sheet

with that date and time and marks the attendance.

CONCLUSION & FUTURE SCOPE

The project that was done will accomplish the following benefits:

- Maintains Overall Records
- Get rid of pen and paper system
- Proxy attendance is eliminated
- Saves time
- Less mistakes
- Virtual classroom

The system we've got developed has successfully, ready to accomplish the task of marking the attendance within the classroom automatically and output is obtained in an excel sheet as desired in real-time. we've implemented an attendance system for a lecture, section or laboratory by which an educator or a teaching assistant can record students' attendance. It saves time and energy, especially if it's a lecture with huge number of scholars. Automated Attendance System has been envisioned for the aim of reducing the drawbacks within the traditional (manual) system. This attendance system demonstrates the utilization face detection and face recognition techniques in classroom. this method cannot only merely help within the attendance system, but also improve the goodwill of an establishment.

Need to improve accuracy for future scope and requirements such as working with high resolution images and for rapid results.

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