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Smart Attendance System Using Facial Recognition

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Abstract: When done manually the attendance system is a difficult process. The system described can replace many traditional atten- dance methods which are done manually and can save time. A good way is to do it by facial recognition. Fake attendance prob- lem can also be saved by this system. This system detects faces of the registered people. This contains a simple GUI that is easy to use. The core of the system has broadly two stages i.e Face detection and face recognition. After this the attendance of the recognized students are marked in the database. This system will hence maintain a good and efficient record of the students.

I. INTRODUCTION

A. Face Detection (Initial Phase)

First stage is to detect faces in the image and this consists of to remove effects like the background etc. Viola and Jones face detector uses Haar-like features with Ada boost algorithm to train the classifiers. Har-like features may degrade quality as checked in real world applications.Hence, they will be needing a high com- putation power and might require costly annotation mainly in the training stage. The two more popular approaches are the regres- sion methods and template fitting method. However, most of them available face detection and face alignment methods ignore the correlation between the two. However, there are still limitations in this work. From those previous experiments, we choose a new approach which integrates these two tasks using unified cascaded.

B. Face Recognition(Final Phase)

After face detection there is the need to pull out the vectors from the face that are useful. We have used Siamese Neural Network that finds how similar two comparable things are (e.g. faces). It con.tains two identical sub-networks, which has got the parameters as well as weights.The first sub network's input is an image, fol-lowed by a sequence of convolution, pooling, fullyconnected lay- ers and finally a feature vector. Siamese network come in one shot learning. One-shot learning is a technique where it learns from only one training example per class. Open-CV which is a compter vision libraray came up with a method called Local Binary Pat- terns (LBP) based on Haar classifier.This method however cannot remove noise hence it is rarely or not used. Because of these lim- itations , approaches exploiting deep learning have been gradually developed instead .So, here we are using two convolution layers with rec tified linear unit (ReLU) activation for extracting the features .The accuracy noted in this is 97.73% .

II. PROPOSED SYSTEM

The architecture of this face recognition based attendance sys- tem is shown in the below mentioned diagram. The working of this smart attendance system is very simple and easy to understand. To bring this system into work, we will be needing some hardware. Firstly, it requires a high definition camera which has to be fixed in the classroom at a goof location from where the whole class can be covered in the single camera frame. After the camera has clicked the picture further enhancements are done by various methods. Af- ter enhancement, the picture will be given for detecting the faces of students in which the face detection algorithm comes into play. Then after detection of faces, each student's face will be cropped from that image, and all those cropped faces will be compared with the faces in the database. In that database, all students' informa- tion will be already maintained with their image. By comparing the faces one by one, the attendance of students will be marked on server.

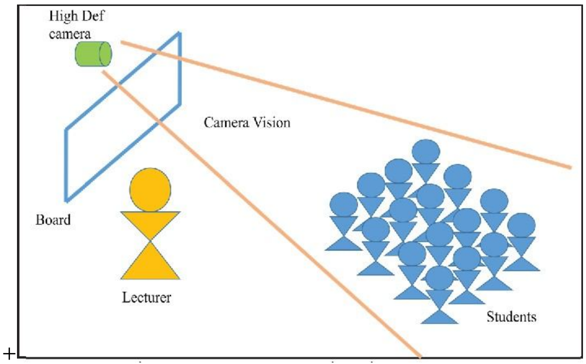

Fig 1. Basic architecture of the system

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III. IMPLEMENTATION

A. Face Detection

Face detection is used to detect face in the given faces, or we can detect the faces in the given video. Face localization is used to search or locate the given face and align features as eyes, nose, chin ,mouth to be used for feature extraction . Feature extrac- tion is used to extract the important feature of the image which are used to identify the image easily form several number if im- ages(ex nose, mouth etc).Feature matching and classification uses a face based on training set of pictures from a database of about 50 pictures. Face recognition generates a result of positive or nega- tive based on referenced image. This task becomes difficult based on number of faces in a image.opencv uses to types of classifiers one is haarcascade and another one is lbp(local binary pattern) .In this Face detection is done by using haar cascades of opencv. Face detection haarcascade is used to detect the face and this detected region is given to the embedding generator.

1) Requirements

a) Any operating system that will support OpenCV and Python (Windows, Linux, MacOS)
b) Python
c) OpenCV-Python
d) Haar Cascades Data File
e) i3 or higher core processor (CPU)/ 2.1 GHz or higher
f) Photo images for testing

B. Understanding Haarcascade

It is based upon the Haar Wavelet technique which analyze pixels of the image into squares by function. This has been using ma- chine learning techniques to get a higher degree of accuracy from what is called “training data”. This had used “integral image” con- cepts to compute the “features” detected. Haar Cascades use the Adaboost learning algorithm which selects a small number of im- portant features from a large set of give features to give an efficient result of classifiers.

Let’s Load the Required XML Classifiers.

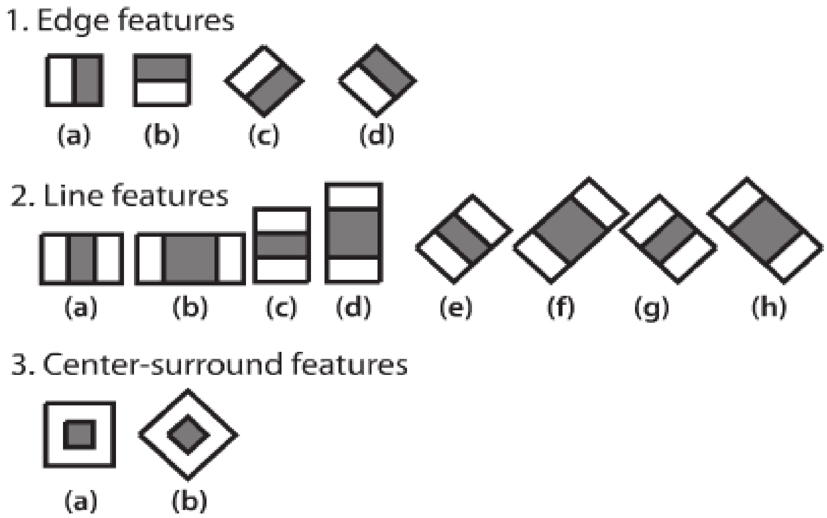

Fig 2. Har-like feature Face detection

cv2.CarscadeClassifier("haarcascade_frontalface_default.xml") eye_cascade = cv2.CascadeClassifier("haarcascade_eye.xml")

C. Face Recognition

In Face recognition stage, faces in raw pictures are detected and aligned by Multi-task CNN. In this case we use pre-trained FaceNet model to extract features and feed forward to an SVM classifier for Recognition Process.

1) Multi-Task Convolution Network(MTL Convolution Net- work)

The all round pipeline Multi-Task is shown in

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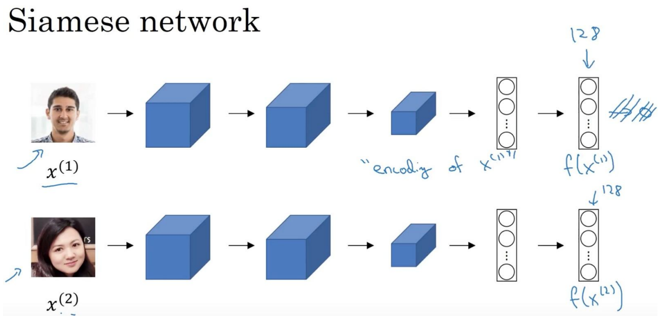
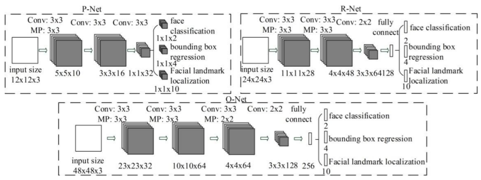


An image is initially reduced to different scales to make an Im- age pyramid, which is the feed to the following three-stage Cas- caded framework along with CNN architecture.



2) *Level 1:* A complete convolutional network is used, called proposal Network(P-net) to result the proposed window and their bound- ing box regression vectors. Then using the estimated bounding box regression vectors to calibrate the candidates. After that, em- ploying non-maximum suppression (NMS) to merge highly over- lapped candidates. For every candidate window, P-CNN estimates the offset between it and the nearest truth i.e., the bounding boxes left top, width, and height. The learning objective is formulated as a regression problem, and the Euclidean loss is employed for each sample

a) *Stage 2:* All candidates are send to following CNN, known as Refine Network (R-Net), which in turns rejects a large number of false candidates, performs calibration with bounding box regres- sion, and NMS candidate merge.

b) *Stage 3:* This stage is identical to the second stage, but in this stage, out aim is to describe the face in more detailed manner . In particular, the network will output five facial landmarks positions. Similar to the bounding box regression task, facial landmark de- tection is formulated as a regression problem:

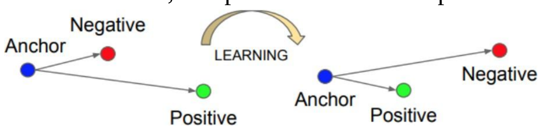
If $x^{(i)}, x^{(j)}$ are the same person, $\|f(x^{(i)}) - f(x^{(j)})\|^2$ is small.
If $x^{(i)}, x^{(j)}$ are different persons, $\|f(x^{(i)}) - f(x^{(j)})\|^2$ is large.

3) *FaceNet Model*

$$d(x^{(1)}, x^{(2)}) = \|f(x^{(1)}) - f(x^{(2)})\|_2^2$$

To compare the two images x1 and x2, we compute the distance d between their encoding f(x1) and f(x2). If it is less than a thresh- old (a hyperparameter), it means that the two pictures are the same person, if not, they are two different persons.

a) We can apply gradient descent on a triplet loss function which is a loss function using three images: an anchor image A, a positive image P(same person as the anchor), as well as a negative image N (different person than the anchor). So, we want the distance d(A, P) between the encoding of the anchor and the encoding of the positive example to be less than or equal tothe distance d(A, N) between the encoding of the anchor and the encoding of the negative example. In other words, we want pictures of the same person to be close to each other, and pictures of different persons to be far from each other.



The problem here is that the model can learn to make the same encoding for different images, which means that distances will be zero, and unfortunately, it will satisfy the triplet loss function. For this reason, we are adding a margin alpha (hyperparameter), to prevent this from happening, and to always have a gap between A and P versus A and N.

4) *Triplet loss function*

$$L(A,P,N) = \max\left(\|f(A)-f(P)\|^2 - \|f(A)-f(N)\|^2 + \alpha,\ 0\right)$$

The max means as long as d(A, P) — d(A, N)+ alpha is less than or equal to zero, the loss L(A, P, N) is zero, but if it is greater than zero, the loss will be positive, and the function will try to minimize it to zero or less than zero.

The Cost function is the sum of all individual losses on differ- ent triplets from all the training set.

Cost function: $J = \sum_{i=1}^{n} L(A^{(i)}, P^{(i)}, N^{(i)})$

5) *Training Set:* The training set should contain multiple pictures of the same person to have the pairs A and P, then once the model is trained, we'll be able to recognize a person with only one picture

a. *GUI Development:* GUI setup

Implementation of GUI involves basically two parts

i) First the layout of the GUI components

ii) Second the programming of the GUI components

Initially first we have to create the PY file which provide the in- stallation and proper guide to run these GUI tools.the PY file pro- vides a framework for implementation of the important function. These functions will launch the GUI.

b) *Implementation of GUI1) Layout the GUI Components:* IT is possible to create a PY file that contains all the command that con- tain how to layout the components. It is easy that we use GUIDE to layout the components and save then in one PY file.

c) *Programming of GUI Components:* In this the program- ming part is done.once we have the UI file

IV. DATABASE MANAGEMENT

In this the database which we are using is Mongodb. In this the data(which is images) are stored in objects.when ever we take a image for detection we compare it with all the images in our database by using Mongodb compare commands. since the database is currently in the PC .we are using the images with IDs so that it can be easy for comparing in database. In the PC we create a parent directory and in that parent directory we create sub directories which are based on the ID of the images and those im- ages are saved in their respective collections(named by their IDs). The object contains the attributes such as name , date, attendance.

1) *Command to Insert Data in MongoDB:* This is how to add the entries. For eg db.pa.insert({"name":"bhavesh","attendance":0})
2) *CSV file Generation:* After the application is closed, an excel file is generated. This excel file contains the attendance of all the student.

V. IEXPERIMENT RESULT

A record in MongoDB is a document, which is a data struc- ture composed of field and value pairs. MongoDB documents are similar to JavaScript Object Notation objects but use a vari- ant called Binary JSON (BSON) that accommodates more data types. The fields in documents are akin to the columns in a rela- tional database, and the values they contain can be a variety of data types, including other documents, arrays and arrays of documents, according to the MongoDB user manual.

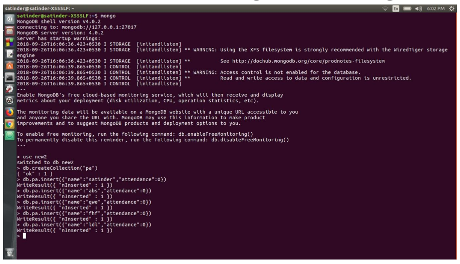


Fig 3. Entering into the database

In this section, we first evaluate the effectiveness of the features extracted from FaceNet. Then, we conduct experiments to point out accuracies of the model on datasets (e.g., training, validating, and testing). Regarding the test dataset, there are two subsets taken into account, namely known and unknown ones. The former is from our private data, while the latter is collected from the LFW dataset . By using only the former, we evaluate the model on a closed set (only containing registered identities), but by combining both two ones, we have an open set (containing not only registered identities but also unregistered identities).

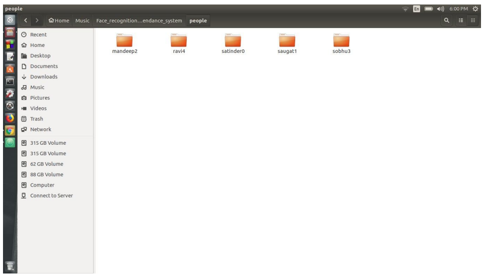


Fig 4. Folders containing anchor images

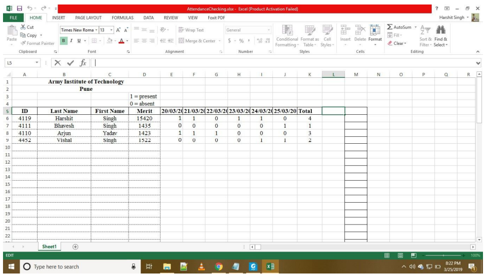


Fig 5. Final Attendance

VI. CONCLUSION

There may be various types of lighting conditions, seating ar- rangements and environments in various classrooms. Most of these conditions have been tested on the system andsystem has shown full accuracy for most of the cases. There may also exist students portraying various facial expressions, varying hair styles, beard, spectacles etc. All of these cases are considered and tested to obtain a high level of accuracy and efficiency. Thus, it can be concluded from the above discussion that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system. This system can be implemented for better results regarding the management of attendance and leaves. The system will save time, reduce the amount of physical work done by the administration the and electronic apparatus and reduces the amount of human resource required for the purpose.
Hence, a system with expected results has been developed but there is still a room for improvement.

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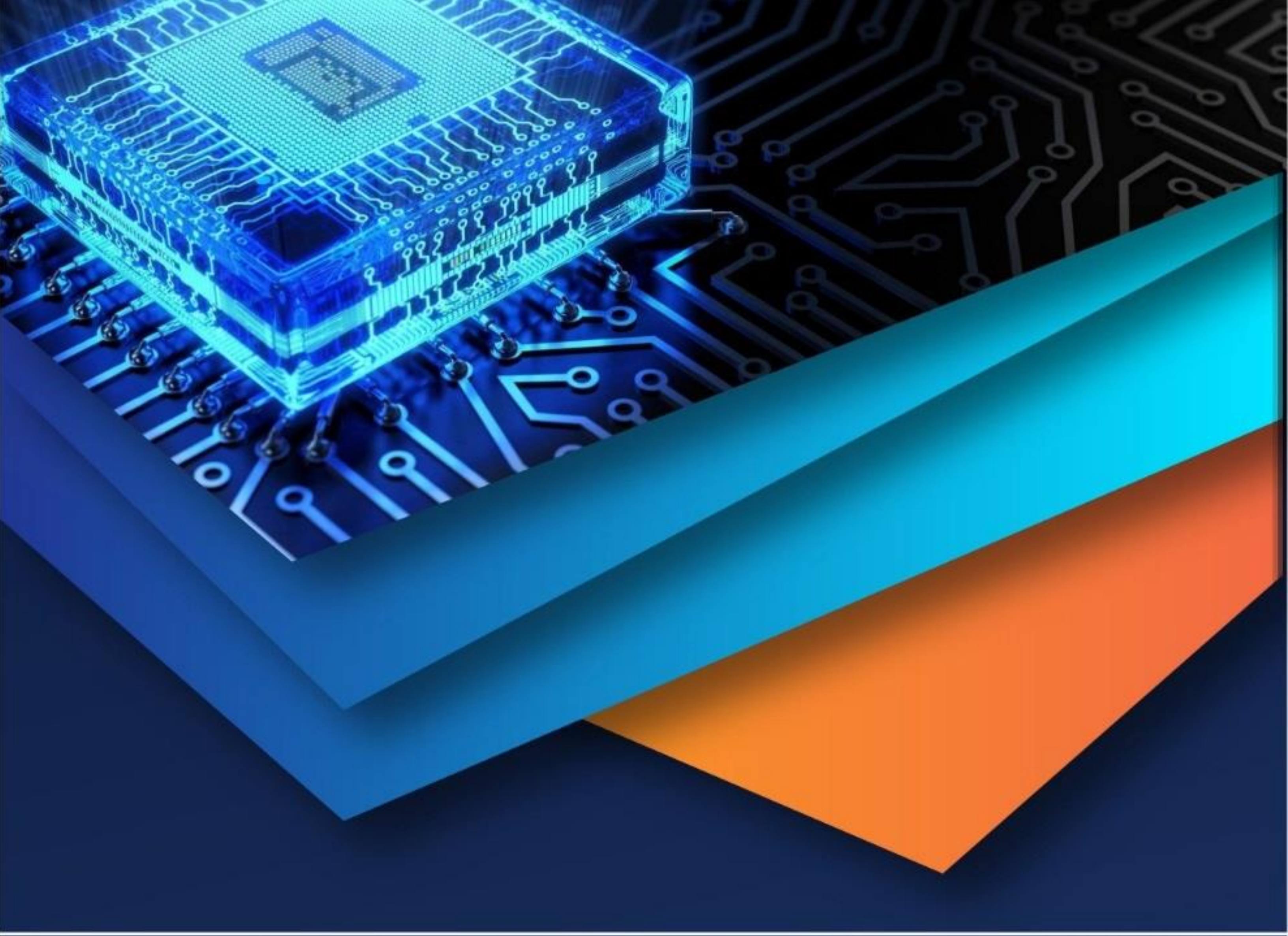

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