Face Recognition Based Attendance System

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Abstract*—Face recognition, fingerprint recognition, and other biometric authentication methods are gradually becoming the most promising means for identifying a person's face. We can use them in our phones, laptops, offices, and other devices. However, pupils' attendance is still taken manually, which takes a long time and is extremely inefficient. To preserve that valuable time, we needed an automated operating attendance system that eliminated all of the drawbacks of collecting attendance on paper. We're putting together a system that's both efficient and dependable. Using OpenCV, we created a face recognition-based attendance system. We can apply our attendance system anywhere, not just for students. For face detecting and recognizing, the Haar Cascade algorithm is utilized.

Keywords — OpenCV, Face Recognition, Face Detection, Attendance, LBPH algorithm, Haar Cascade

INTRODUCTION

Human face is the most significant component of the human body for identifying a person. Face recognition is another type of biometric recognition that maintains all of a person's facial traits as distinct face prints in order to uniquely identify them. Biometric face recognition has received a lot of traction among researchers due to its versatility and usefulness. Also its contact free procedure, that is why it outsmarts all other recognitions like fingerprint, iris print and palm print. Face recognition technology is also able to detect a person from far away, without coming in physical contact with anyone. The photo that has been captured will be keep in the database. After that we can use this project in many ways like face recognition systems will be used in crime related reports. To identify the persons in all scenarios such as change of the illumination, pose, age, and so on, we need a very huge dataset and complicated attributes.In recent years, Significant progress has been made in the field of biometric like face recognition systems till date. There has been enormous progress in the field of facial recognition during the last decade. Many facial recognition algorithms today work well even with a limited number of faces in pictures. Although, these types of methodologies had been testing under very limited and very controll lightined conditioning, very proper faces pose and usually non-blurred images. Face recognition-based attendance systems will be based on the technology of face recognition and it will be very useful for teachers as it will provide a very convenient way of marking attendance of the students for teachers. Face recognition is done by LBPH and the Haar Cascade algorithm is utilize for face detecting, attendance-based systems can be used by teachers for their convenience.

I. LITERATURE REVIEW

R. C. Damale and B. V. Pathak [1]paper, computer vision and ML based face recognition system is proposed. They have trained a module with a lot of images. For helping in face recognition SVM, MLP and CNN are implemented as a classifier. The SVM, MLP and CNN nearly achieve the testing precision of about eighty seven percent, eighty six percent and ninety eight percent respectively.

Second paper is written by 4 authors. They have [2] proposed a system for face recognition using the LBPH algorithm. First, a database is created by enrolling students. They are taking several images of students using cameras. Then the images are converted into grayscale by using the LBP algorithm and after that a histogram is generated. A video stream is given to the system by which the LBPH algorithm matches the live image which is taken by using camera streams along the images present in the database. When a face is detected successfully, attendance is marked.

S. Dev and T. Patnaik [3] proposed a system which the requirements i.e is required for the face recognition.The addition of Gabor filters considerably increases the system's accuracy.. Three algorithms are used for face recognition: KNN, CNN, and support vector machines. KNN algorithm (of 99.27%)has proved to have the highest accuracy by using CNN has low computational complexity and algorithm name SVM is used to prove to be less efficient.

S. S. Pawaskar and A. M. Chavan [4] proposed a system of using different algorithms like haar cascade along with another one, LBPH which is mostly utilize for the object and the image detection along with the record of the attendance through this system.

M. N. Adji And R. Hartanto [5] proposed an attendance system by face recognition using the Haar cascade algorithm. Face images are captured using a camera. To determine the location of the face it is performed by a haar algorithm for image detection.It basically draws a box around the faces of the person to whom we want to detect his face .Using different types of the algorithms they have done it . After they have stored the data in the cloud to determine the location of the face. Using Haar Cascade algorithm face detection is done. When the image of the face had been made it would now make or draw a box which is covering the whole face as an Region Of Interest (ROI). Extraction of image features was performed using the LBPH algorithm. Compare the detected faces with all the faces in the database to observe the one closest to the identified face. We have used CSV file format for storing the database.It is used to present the names and directories in the database format.

In a paper of [6] authors have suggested a facial recognition for the attendance system which is based on principal component analysis. A single image of each person's face is clicked. After that image is transferred to a grayscale image and stored in the database.After entering class, the camera is placed over the whole face and it will change the face into gray scale and after that it is submitted to the next part. For extracting features we are using fisher face method. Face recognition is accomplished by comparing all received variables to previously recorded values in the database. If the quality is compatible, the face is recognized and the name connected to that face is presented. The face data.xml file is filled with information when the face is recognized.

In [7]th paper the authors have developed an attendance management system using Raspberry Pi and face recognition. For facial recognition, he employed the LBP algorithm. The image of your face is taken as you face the camera. The area of interest, also known as the ROI, which is the human face, is detected and trimmed as the initial processing step. The Haar feature-based Cascade method can be used to do this. The LBP technique is then used to draw out the image's features, and the extracted features are compared to the trained dataset. A servo motor will open the gate for the recognized scholar if the scholar's face is recognised then the attendance results are saved in a MySQL database, which the web server can access.

In [8]th paper the authors have created an automatic attendance system that uses facial recognition and has a built-in two-tier authentication mechanism. For face detection, a faster R-CNN algorithm is used. The system is drawn to work in a lecture room with two cameras on opposing ends, such that at least one of the cameras captures every student. Each student has a unique ID that is used to identify them in the database. When a student meets the two-tier authentication process required criteria, their corelative ID's are there.

II. METHODOLOGY/EXPERIMENTAL

A. *Components/Materials/Flowchart/Block/ Diagram/Theory*

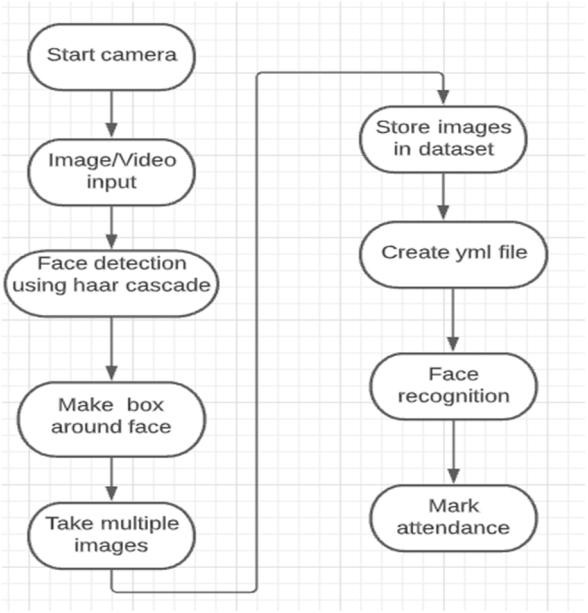


Fig. Block Diagram

Face Detection: It finds and extracts faces (size and location) in images so that the face recognition algorithm can use them. The Haar Cascade approach was used to recognise faces in the image. This is an object detection technique which will detect face in images and real time videos.

Face Recognition: The algorithm of face recognition is important for discovering features that best describe the image once we have retrieved facial images , cropped, scaled, and usually converted to grayscale. The approach used to recognize human faces is called the Local Binary Pattern Histogram. It is well-known for its performance and ability to distinguish a person's face from both the front and side.

Function	**Task done**
VideoCapture()	For starting the camera
cvtColor()	Input image is converted into a specified format, e.g., grayscale, hsv, etc.
detectMultiScale()	Detects different-sized items in the provided image.
cv2.imwrite()	To save the images into the dataset
cv2.face.LPBHFaceRecognizercreate()	Used to load the recognizer.
import cv2	To import the OpenCV module

III. RESULTS AND DISCUSSIONS

This project is a facial recognition system that accepts student ID cards and photos as input. Train your photos using the Haar cascade method and generate a YML file. To recognize the face, the LBPH algorithm corelate the histogram of the

trained image with the image from the video stream. When our face is acknowledge, the presence is automatically marked in the CSV file. The entire process basically starts with capturing a frame from the input video stream. The Haar Cascade algorithm forms a frame around the student's face and begins capturing the student's image. Photos are converted to grayscale before being saved to the dataset. The model is then trained using these images and the LBPH algorithm is used to generate a yml file. Then the tracking process begins. The LBPH algorithm is used for facial recognition. After matching the face with one of the faces in the dataset, the presence is recorded, and if they do not match, it is unknown.

Explanation of all the steps is as follows:

1. *Start Camera*

The first step is to start the webcam and get the video stream as the input for the system. After starting the video, the main task is to detect the human face in it so that the images of the face can be taken, stored, and then used for face recognition.

2. *Face Detection*

For detecting the face , the haar cascade approach is used. This object detection technique can operate in real-time.

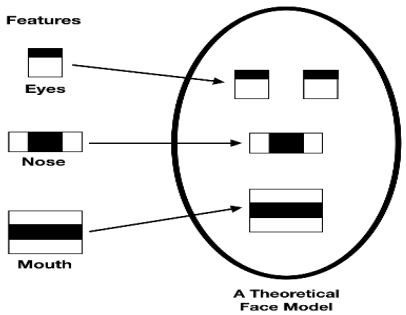


Fig. Haar cascade feature(a)

It is a machine learning method which entails training a cascade function with a huge number of pictures. This is a machine learning source used to train the cascading function with numbers of photos.

To train the classifier, this technique requires a immense number of both positive (photos with faces) and negative (images without faces). Then it invites you to extract the features from it. The total number of pixels under the white rectangle by the total number of pixels beneath the black rectangle yields a single integer for each feature.

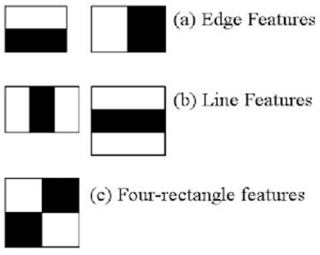


Fig. Haar cascade features(b)

All kernel sizes and positions will be utilized to calculate a high number of features 160000 different properties were offered by a 24x24. These qualities are critical in the context of face detection.

Some fundamental examples of these characteristics are:

- The region around the eyes is often darker than the area around the cheekbones.
- The area surrounding the nose is brighter than the area surrounding the eyes.

Given these rectangular sections and their accompanying difference of sums, it is feasible to construct features that may be used to categorize different regions of a face. The AdaBoost method is then applied on a full dataset of features to choose which ones correlate to picture facial areas

Fig. Haar cascade

We register a student into the system using Student Id and name and then start face detection process to generate the dataset.

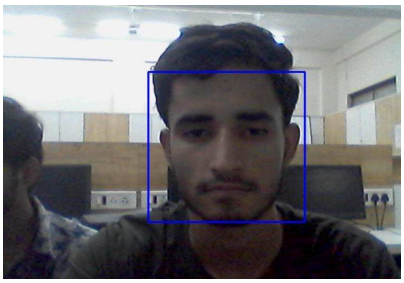


Fig. Face detection

After face detection is done a StudentDetails.csv file is generated which contains the name of the student and ID.

Fig. StudentDetails.csv

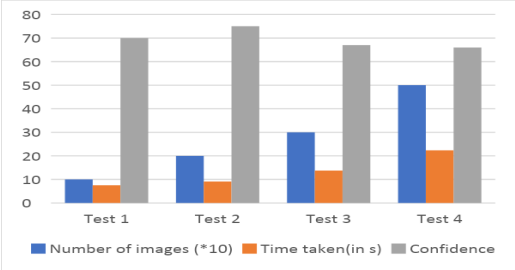
3. *Create Dataset*

The next step performed by the system is to store the images into the dataset folder so that a histogram can be generated based on all those images.

Fig. Created Dataset

In the dataset a total of 200 images will be saved because at 200 images the system works perfectly as on 200,little time is required , and we are getting the level of confidence that is best . If images are increased, then the confidence rate decreases, and the time taken increases a lot. As a result, the 200 image is the best option for this system which is plausible. We may calculate the confidence level of the photos by multiplying Tp (total positive images) and Tn (total negative images) by the total number of images.

Number of Images	Time Taken (sec)	Confidence Level (%)
100	7.52	70%
200	9.10	75%
300	13.78	67%
500	22.34	66%



4. *Training Model*

The next step of this process is to use the photographs we've acquired to train our model. The model will be trained using the LBPH algorithm. The histogram formed by training on those 200 photos is stored in the 'yml' file.

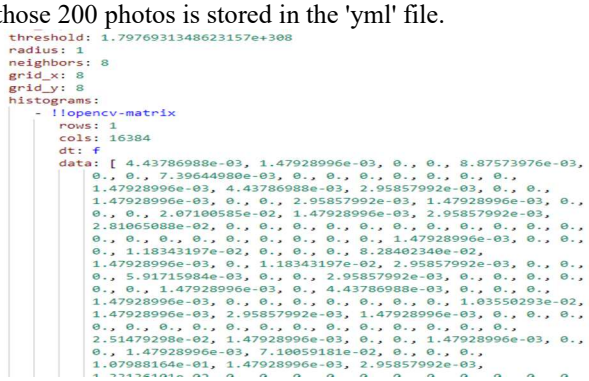


Fig. YML File

5. *Face Recognition*

The LBPH algorithm is implemented for face recognition. using a binary integer generated by thresholding the vicinity of each pixel, Individual pixels in an image may be recognized with the Local Binary Pattern textured operator. The face image can be described by a simple data vector that uses LBP in combination with the histogram. This is also known as the LBPH method. LBPH has 4 parameters.

Radius: The radius is used to determine the radius around the center pixel and create a circular LBP. Normally set to 1.

Neighbor: Establish CLBP. More points are earned the higher the cost. Essentially, it is set to 8.

(Raster X): number of parallel cells in one direction. The dimension of the resultant feature of the vector increases with the number of cells in the grid and the fineness of the grid. As well, it's set to 8.

Grid Y: Number of cells placed vertically. The more cells in the raster and then the finer raster the higher the dimension of the feature. Normally set to 8.

LBPH only considers local properties of required elements. In face recognition, the LPBH algorithm simply looks at face, eye, and mouth features. The first and most crucial stage in the LBPH algorithm is to create an intermediate picture that emphasizes the key facial characteristics of the source image in order to better represent it.

The matrix's center value must then be found in order for it to serve as the threshold value. In order to characterize the new values of the 8 neighbors, this value will be introduced.

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

Each neighbor of the core value has a newly produced binary value. A value of 1 was assigned to values that were equal to or greater than the threshold value, and a value of 0 was assigned to values that were less than the threshold value. A local binary operator is used in each zone. The LBP operator is specified using a 3x3 window.

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

The center pixel'(xc,yc)' has an intensity of 'ic'. And 'ip' stands for the surrounding pixel's intensity. When comparing a pixel to its 8 nearest neighbor's, we use the median pixel value as a threshold value, If a neighboring pixel's value exceeds or is equal to the center pixel, it is set to 1,otherwise it is set to0.

Fig. Extracting pixel values from input image

The matrix will now only contain binary values (ignoring central pixel value)

The binary value we got is:

0	1	1	1	0	0	0	0

Converting the binary value into decimal value:

$0 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 112$

After that, the binary value will be transformed into a decimal integer and assigned to the matrix's centre value, which represents a pixel from the original picture.

127	141	147
125	112	145
123	136	144

After this process is finished, we will have a new image that more accurately captures the original image's features.

Fig. Converting Input image to LPBH image

If we utilize the picture created on the right , we can now use the two parameters Grid X and Grid Y. To generate a large number of grids from a single image, each region's histogram may now be retrieved.

Because we're working with a gray scale image each histogram will have approximately 256 places to record the happening of each pixel intensity. To train an algorithm, the following data is used. The training dataset's images will each be represented by a unique histogram. As a result we will continual the processes to generate a histogram that reflects an input image. For computation, the LBP histograms from each sub-region are combined into a single histogram with additional features such as:

$$H_{i,j} = \sum_{x,y} I\{f_l(x,y) = i\} I\{(x,y) \in R_j\}, i = 0,\ldots,n-1, j = 0,\ldots,m-1.$$

where:

Variable n represents the number of the separate labels formed by the LBP operator.

Number of sub-regions is represented by m.

and I{} is defined as follows:

$$I\{A\} = \begin{cases} 1, & \text{A is true} \\ 0, & \text{A is false.} \end{cases}$$

So, all we have to do is to spot the picture that precisely matches the input image is differentiate the histograms and return the image with the most similar histogram.

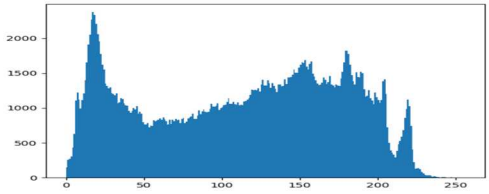


Fig. Histogram of an Image

We may use a variety of ways to compare the histograms such as the utilizing Eucledian's distance formula, chi-square , absolute value and so on to the distance between the 2 histograms. We will use the Eucledian's distance in the following example, which is determined using the formula:

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

The program merely outputs the id and name of the student with the closest histogram if the face is found. The computed distance will also be returned by the algorithm, which may be used as a 'confidence' evaluation.

Then, using a threshold and 'confidence,' we can see if the algorithm recognizes the image correctly. We may deduce that the algorithm is properly recognizing if the confidence is higher than the provided threshold because we are subtracting the results from 100 for better comprehension. If the confidence level is too low, the image will be labeled as unknown and keep in the Unknown Images folder.

Person	**Confidence level (%)**
Tejas	75%
Atharv	77%
Pritti	72%
Vishal	71%

The system can work in conditions such as low light and can also detect and recognize the face. Here is the table in which some features of the system are mentioned:

Features	**Results**
Detection of single face	Yes
Low light face recognition	Yes
Detection of Multiple faces	Yes
Recognition in mask/veil	No
Recognition in Bright Light	Yes

6. Attendance Record

As soon as we stop the face recognition process, an attendance file will be automatically generated by the system which will contain the id, name, date, and time at which each and every student was detected. When the database properly matches the students' attendance, this csv file contains the attendance information.

	A	B	C	D
1	Id	Name	Date	Time
2	1	['Shravan']	03-01-2022	19:30:57
3	2	['Somanshu']	03-01-2022	19:32:37
4				
5				

Fig. Attendance record

IV. LIMITATIONS

Face recognition-based systems have a key flaw: their accuracy isn't 100 percent. There is always the possibility of making a mistake. The system's data processing may take some time, which will become a problem throughout the lesson. The system would require a certain amount of storage depending on the quality of the input data. If the data obtained is of extremely high quality and requires a huge quantity of

storage space, this might be highly troublesome, especially for events with a big estimated audience. If the image quality isn't good enough, the cameras may be fooled into thinking the person being scanned isn't the same as the one in the photo.

V. FUTURE SCOPE

We can improve this project by taking a large number of kids' images and then after that store all the images in the cloud. It will increase the confidence of the system. It can create the technology to use in ATM Machines. Using facial recognition technology, the approach might potentially be used to identify voters during elections.

VI. CONCLUSION

This system provides a very effective form of attendance management in the classroom that may fully replace previous manual techniques. This method is incredibly safe, trustworthy, precise, and effective. It is not necessary to employ specialized hardware to set up the system in the classroom. It is quite simple to make using a camera and a computer. Some of the algorithms that can recognise faces in the veil must be employed to improve the system's performance. The solution will also save time, minimize administrative workload, and replace traditional stationery with electronic equipment, reducing the number of human resources required for a task. It will create a system but there will always be a room for development.

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Firstly, we would definitely like to show our gratitude to the college and our beloved guide for providing us with the chance to work on a project about facial recognition. It was a fantastic experience from which we gained a lot of knowledge. It allowed us to test our abilities and piqued our curiosity in the subject of facial recognition. Thanks especially to Deepali Joshi mam for her patience and understanding. She is really encouraging and supports subjects that we are interested in. She was a great source of inspiration for us, and we owe her a debt of gratitude. This group had a great atmosphere, and we all tried our hardest.

VIII. REFERENCES

[1] R. C. Damale and B. V. Pathak, "Face Recognition Based Attendance System Using Machine Learning Algorithms," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 414-419, doi: 10.1109/ICCONS.2018.8662938.

[2] A. Arjun Raj, M. Shoheb, K. Arvind and K. S. Chethan, "Face Recognition Based Smart Attendance System," 2020 International Conference on Intelligent Engineering and Management (ICIEM), 2020, pp. 354-357, doi: 10.1109/ICIEM48762.2020.9160184.

[3] S. Dev and T. Patnaik, "Student Attendance System using Face Recognition," 2020 International Conference on Smart Electronics and Communication (ICOSEC), 2020, pp. 90-96, doi: 10.1109/ICOSEC49089.2020.9215441.

[4] S. S. Pawaskar and A. M. Chavan, "Face Recognition based Class Management and Attendance System," 2020 IEEE Bombay Section Signature Conference (IBSSC), 2020, pp. 180-185, doi: 10.1109/IBSSC51096.2020.9332212.

[5] R. Hartanto and M. N. Adji, "Face Recognition for Attendance System Detection," 2018 10th International Conference on Information Technology and Electrical Engineering (ICITEE), 2018, pp. 376-381, doi: 10.1109/ICITEED.2018.8534942.

[6] T. A. Kiran, N. D. K. Reddy, A. I. Ninan, P. Krishnan, D. J. Aravindhar and A. Geetha, "PCA based Facial Recognition for Attendance System," 2020 International Conference on Smart Electronics and Communication (ICOSEC), 2020, pp. 248-252, doi: 10.1109/ICOSEC49089.2020.9215326.

[7] O. A. R. Salim, R. F. Olanrewaju and W. A. Balogun, "Class Attendance Management System Using Face Recognition," 2018 7th International Conference on Computer and Communication Engineering (ICCCE), 2018, pp. 93-98, doi: 10.1109/ICCCE.2018.8539274.

[8] R. Mehta, S. Satam, M. Ansari and S. Samantaray, "Real-Time Image Processing: Face Recognition based Automated Attendance System in-built with "Two-Tier Authentication" Method," 2020 International Conference on Data Science and Engineering (ICDSE), 2020, pp. 1-6, doi: 10.1109/ICDSE50459.2020.9310090.

[9] Jacob, I. Jeena. "Capsule network based biometric recognition system." Journal of Artificial Intelligence 1,2019.

[10] Kirtiraj Kadam, Manasi Jadhav, Shivam Mulay, Tushar Indalkar, "Attendance Monitoring System Using Image Processing and Machine Learning", International Journal of Advance Engineering and Research Development, 2017.

[11] Rajat Kumar Chauhan, Vivekanand Pandey, Lokanath M, "Smart Attendance System Using CNN", International Journal of Pure and Applied Mathematics,2018.

[12] Mayank Yadav, Anmol Aggarwal, "Motion based attendance system in real time environment for multimedia application", 2018.

[13] Wei Wu, Chuanchang Liu, Zhiyuan Su, "Novel Real-time Face Recognition from Video Streams", International Conference on Computer Systems, Electronics and Control, 2017.

[14] Changxing Ding, Dacheng Tao, "Trunk-Branch Ensemble Convolutional Neural Networks for Video-Based Face Recognition", IEEE transactions on pattern analysis and machine intelligence, 2018.

[15] Aziza Ahmedi, Dr Suvarna Nandyal, "An Automatic Attendance System Using Image processing", The International Journal of Engineering and Science, 2015.

[16]Yohei Kawaguchi, Tetsuo Shoji, "Face Recognition-based Lecture Attendance System", "3rd AER", 2005.

[17] B. Kavinmathi, S.Hemalatha, "Attendance System for Face Recognition using GSM module", 4th International Conference on Signal Processing and Integrated Networks", 2018.

[18] Ketan N. Mahajan, Nagaraj V. Dharwadkar," Classroom attendance system using surveillance camera", International Conference on Computer Systems, Electronics and Control",2017.

[19] E.Varadharajan, R.Dharani, S.Jeevitha, "Automatic attendance management system using face detection", 2017.