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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE (CO 304)

REAL TIME SMART ATTENDANCE SYSTEM
FINAL PROJECT REPORT

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INDEX

I. INTRODUCTION

Face recognition is a method by which a machine can identify a face from a video or camera and recognize one's face, extract its features ,and recognize one's identity. There are other methods of identification like NFC, bluetooth, biometric, etc. but all of them have their own disadvantages. One the other hand face detection and recognition is the cutting edge technology which is under research and a lot of industries are using it. It has a wide area of application in this digital world be it security, identification or attendance. This method can be used in education sectors like schools and colleges to take students' attendance or even in the industrial center to mark the daily attendance of the employees or staff. The traditional method of marking attendance is by manually calling out each and every student's name and marking their "P" in front of their names. The problem with this method is that it's time-consuming and has room for error. The authors present an alternative and effective method to record students' attendance quickly and efficiently. This method detects near-frontal faces from a photo, video or a webcam using viola and jones method and then saving their facial features and training using LBP algorithm. These features are stored in a .yml file along with the student details which are used to train the data. Finally, LBPH algorithm detects new faces from webcam or video, extracts it's facial features and compares them to the existing ones. If the face is recognized it marks the attendance of the student with the current time and date.

A. Background and Related Work

In the early 1960's began the first of all attempts to successfully apply facial recognition techniques for authorisation. Certain areas of the face were chosen like eyes, ears, noses , mouth and marks were made on them. A reference point was set and ratios and distances were computed as well as compared to the set reference. Then in the 1970's Harmon and Lesk created a system that contained twenty-one markers like lip thickness and hair color but on the contrary to the expectations this turned out to be more difficult to automate due to manual intervention. Finally, the first fully automatic facial recognition algorithm used a very generic technique that compared the input face with a set face that had pre-defined features and patterns compared with the set face.

II. LITERATURE REVIEW

In the past, in the organisations and workplaces, the attendance was taken by the teachers or by any other responsible authority manually. This human based approach is imbibed with the problem that it requires extensive time, and also the manual process has good chances of incurring human mistakes and errors in many of the cases. To overcome that problem, various techniques like Fingerprint Sensor, NFC, RFID (Radio Frequency Identification), and Bluetooth attendance were introduced in the past years. But these techniques were not the best possible solution to the problem since it was not possible to achieve a fail-proof attendance mechanism using these techniques. Each technique had its own set of problems which didn't allow them to become the optimal mechanism of the problem.

The second research journal "Face Recognition Based Attendance Marking System" (Senthamil Selvi, Chitrakala, Antony Jenitha, 2014) is based on facial recognition techniques and to address the problems that were there in the previous approaches. The proposed system uses the webcam of the computer of the user to capture his/her images. There is a database provided for the comparison of input images with it for the marking of attendance if a match of the image is found. The proposed system marks the attendance on a highly secured server and it takes care that none can mark the attendance of any other person. Classification of skin technique is chosen as the face detection algorithm to further uplift the accuracy and efficiency of the detection process. This system requires a standalone computer which will need a constant power supply to work. This system can be operated by the staff members in an organisation only who need to mark their attendance only one time at the start of the day unlike the student attendance system where attendance has to be taken in every single lecture/period.

The Attendance System based on Fingerprint scanning is used in many institutes and industries. A portable fingerprint device is used in the class which is passed to the students. Each student has to place their finger on the sensor during the lecture to mark their attendance. This process occurs completely without the involvement of any professor. This method of taking attendance is very accurate. The disadvantage of using this method of attendance is that the device itself is costly and that passing the device in the class during the lecture would distract the students as well as the professor when he is teaching. Also, the recent pandemic situation should prevent the students from placing their fingers in the same scanning area. Iris scanning is another method for attendance in the branch of biometric authorization which is highly accurate. In this method, the system stores the image of the iris, is extracted, stored and finally matched. The disadvantage of this method is that the equipment will be costly and the maintenance cost will be high. Also there will be difficulty in laying transmission lines and making the device available to so many places

at once many times during the day. Instead the authors provide an attendance system using facial recognition which only requires one-time investment in installing cameras in the classroom and good lighting conditions for the same. This method is fast, secure, and reliable.

Face detection is a technology of human-computer interaction where a computer identifies a person's id from the input data. This input data can be in the form of pictures or videos or through webcams. Face recognition technology analyses the face images to extract facial features using different technologies and techniques. In different spaces they formulate face recognition as a 2 class problem. The cases are: (i) Dissimilarities between faces of the same person, and (ii) Dissimilarities between faces of different people. The PCA-based algorithm is compared with an SVM-based algorithm on a difficult set of images. The performance was measured for both identification and verification scenarios. For verification, the equal error rate is 13% for PCA and 7% for SVM. The identification performance is 54% for PCA versus 77-78% for SVM.

III. RESEARCH METHODOLOGY

The present authors have used Viola and Jones for face detection, LBP for training images and LBPH for face recognition. The method works by analyzing face images and creating cumulative histograms which are feature-vectors converted to histograms. The distance between histograms is used to identify the presence of a face and its identity. There is a five-step process involved in the system. First, the four parameters-Radius, Neighbours, Grid X, Grid Y are initialised. Next, the system needs to be initialized by feeding it a set of training images of faces with an ID (may a number or name). Next, when a face is encountered, it extracts features from it and creates the feature vectors for it. Next, a cumulative histogram is created from all the histograms. The final step is that if a face is presented to the system, it will repeat all the above steps and the cumulative histogram is compared with earlier histograms and the image and the image is detected.

The main components used in this approach are OpenCV which is a computer vision library Tkinter that is responsible for the GUI part of the project. The OpenCV library helps in building vision applications efficiently and quickly using easy-to-use computer vision tools. It contains over 500 functions that covers almost all of the areas of computer vision. For face recognition, OpenCV tools are being used and the interface (GUI) is designed using Tkinter library. Input face is taken using a computer webcam or a .mp4 video file. The frontal face is extracted from the image/frames taken from the webcam or the video then converted to grayscale and stored in the images folder. The LBP algorithm is performed on the images, and the data of cumulative

histograms are stored in a .yml file. When a user requests for recognition, the frontal face i s extracted from the webcam or the video file, and the cumulative histogram is again created for the test face, and it is matched with the stored data for finding the minimum distance between the histograms (also known as ‘confidence’ measurement).

A. Data Pre-processing

The face region is extracted from several images and pre-processed for further processing. This preprocessing step involves converting the image to grayscale. This ensures that the Haar Cascade classifier works efficiently as this classifier works only on grayscale images, and they are easier to analyze and reduces the complexity of the model to a great extent.

Fig 1. Conversion To GrayScale Image

As we chose face recognition based system, ID of every individual is required i.e. we have to take the images of individuals in different angles, different expressions and create a training dataset which is used by LBPH(Local Binary Pattern Histogram) classifier to recognize individuals. The ID (a numeric or a string value) will be entered before capturing the image and after recognition the ID along with the name associated with the image will be displayed on the screen and the attendance will be updated in the .csv file in background.

B. The Viola-Jones Algorithm

It was first developed by Paul Viola and Michael Jones, in 2001 which allows the detection of image features in real-time.

Even though the algorithm is very old and outdated,outdated, it still works perfectly for real-time face detection. This algorithm along with other algorithms is used in today's smartphones to unlock the phone using face recognition.

Detection:

This algorithm was best designed for frontal faces. Thus, it detects faces facing the camera or screen better than faces looking downward or upward, looking sideways etc. It is always easier to work with less complex forms of data, so the obtained images are then converted into grayscale before detection.

Viola-Jones outlines a box as shown in Figure 2 and then searches for a face within this box. It is searching for haar-like features for detecting a face.

Fig 2. Face Detection

Many types of boxes try to detect face-like features. Data from all of these boxes together and then the algorithm tries to detect where the face is in the given image.

Haar-like Features

Haar-like features are named after a Hungarian mathematician, Alfred Haar in the 19th century.

Figure 3 shows various boxes that are partitioned in some way with a light and dark side. This is how the algorithm determines facial features from a given image. For example, the eyebrows will always be darker than the forehead which is identified as an edge feature or the nose is always darker than the surrounding which can be represented as a line feature.

The 3 types of Haar-like features are as follows:

- Edge features
- Line-features
- Four-sided features

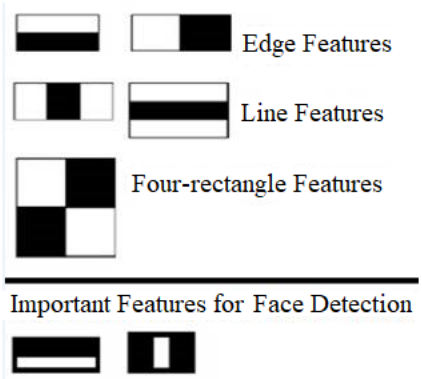

Fig 3. Haar-like Features

During the process of an image, each feature is identified and given its own value known as the "delta" value. It is calculated by subtracting the average of the White area from the average of the Black Area. For ideal conditions, the value of "delta" is 1 but in real-life scenarios the closer the delta value is towards 1, the more chances that a feature has been discovered.

$$\Delta = \text{dark} - \text{white} = \frac{1}{n}\sum_{\text{dark}}^{n} I(x) - \frac{1}{n}\sum_{\text{white}}^{n} I(x)$$

An image can be represented as a matrix (grid). Each of the squares represents a pixel and has its own pixel value. For example, consider the 4x4 grid in Figure 4. In real life, there would be a much larger grid for a certain feature. The numbers represent how light or dark a pixel is. The higher the number, the darker the pixel. Thus, the numbers are higher on the right side than on the left side.

Fig 4. GrayScale values of each pixel

Now, for calculating the value of "delta" add up the numbers on the left side (White Side) and subtract it from the sum of numbers on the right side (Dark Side).

So for Figure 4, the value of our feature is →

(0.6+0.8+0.8+0.6+0.6+0.8+0.8+0.9)-

(0.1+0.2+0.2+0.3+0.2+0.1+0.2+0.1)

B - W= 0.74-0.18

= 0.56

Integral Image

Previously we calculated the "delta" (value of the feature). In reality, these calculations would be much more complex cause in real life the algorithm will be dealing with more no of pixels

The integral image allows us to perform calculations effectively and quickly. So, for calculating the value of a feature for every feature or grid the current algorithm will take 0(n2) time which is a lot.

To reduce the time taken to calculate the value for various features, the Integral Image method is used. In this method the sum of all the boxes to its left is taken to calculate the value of an individual box Refer to the image below.

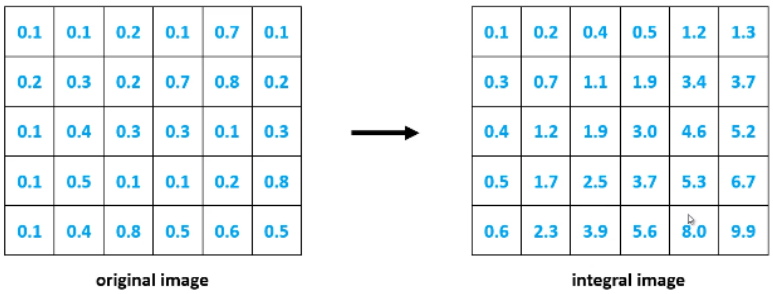

Fig 5. Converting image

So, to calculate the delta of the highlighted portion of the pixel matrix, as shown in the figure below:

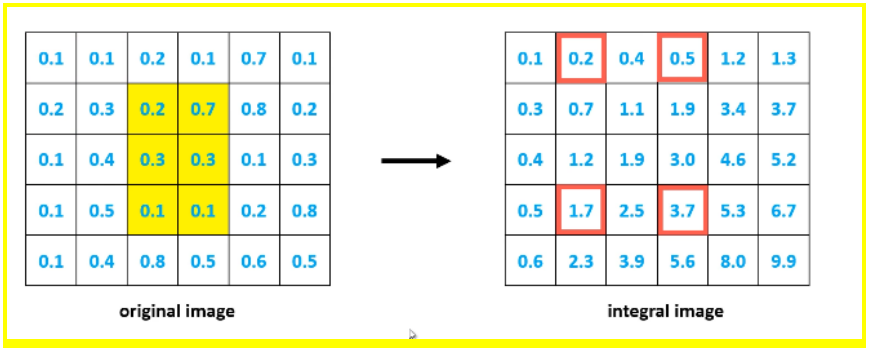

Fig 6. Performing operation in O(n)

Look at the four corners of the feature, → 3.7-0.5+0.2-1.7=1.7

So, we can achieve 0(1) running time for handling Haar-features which is way better than the traditional method which has $O(n^2)$ complexity.

Training Classifiers

The machine is trained to identify these features. The information is fed and subsequently trained to learn from the information to predict. The algorithm sets a minimum threshold value which helps it decide whether something can be classified as a feature or not.

The algorithm is given non-facial images that help it understand and differentiate between the two classes. Some images given to it may look similar to features on a face. The algorithm itself determines which features belong to a face and which don't.

Adaptive Boosting (AdaBoost)

The algorithm learns from the images it is supplied and determines the false positives and true negatives in the data This makes it more accurate.

The algorithm looks at all the possible positions and combinations of the features. Only after this a highly accurate model will be attained. Training can be complex and take a bit of time as all the different possibilities and combinations need to be checked for every single image.

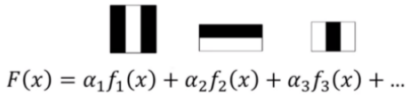

Fig 7. AdaBoost

In the above Figure 7. f1, f2 and f3 are the features, and a1, a2, a3 are the respective weights of the features. All of the features are known as a weak classifier and F(x) is known as a strong classifier. One weak classifier is not good by itself, so a strong classifier is attained when there is a combination of two or more weak classifiers. Thus, as weak classifiers keep adding on it becomes stronger and stronger. This is known as an ensemble, which is the most important feature in the front.

Like this, an important feature is found which is used to make a prediction.

For example, the model gives us 3 out of 5 true positives and 2 out of 5 true negatives.

In the next step, it doesn't look for the second-best feature, but one that complements the current best feature. Thus, it increases the importance of these images that it got wrong as false negatives, and it finds the next best feature that would fit these images. In a way, it increases the weight of

these images on the overall algorithm. Therefore, as more new features are added, it would come down to one image at the end that would be given a higher weight. Once this algorithm is optimised and is able to calculate all positives and negatives correctly, the next step: cascading is done.

Cascading

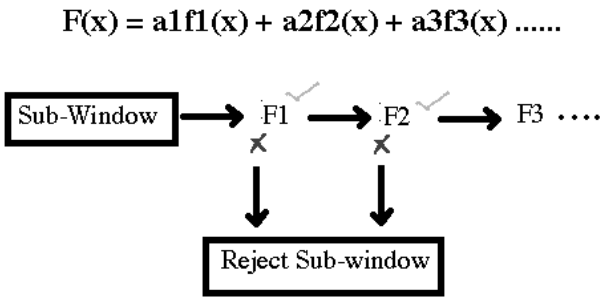

Fig 8. Cascading

This method increases the speed and accuracy of the model. It is started by picking up a sub window and inside it, the best feature is taken and seen if it is present in the image within the subwindow. If it is present the next best or the second-best feature is taken in the sub window and analyzed similarly. But if the feature is not present within the subwindow it is immediately discarded then and there. This cycle continues for all the features and rejects the sub window which doesn't have the feature. So, using cascading speeds up the process a lot and in turn, delivers the results faster.

C. LBPH(Local Binary Pattern Histogram)

LBPH is one of the oldest, computationally less complex and one of the most accurate facial recognition algorithms which is also equipped with the feature of image compression. Basically, the LBPH algorithm evaluates data patterns and expresses it as a collection of histograms(cumulative histogram) to differentiate between different faceprints.

Steps in LBPH algorithm:

1. *Parameters: LBPH has four parameters:*

- Radius: In the matrix of pixels it defines how far around the central pixel, in a circular fashion, the pixels are to be considered for evaluating the value of the central pixel. In most cases it is set to one.
- Neighbours: It refers to the number of sample points to build a circular LBP. The more sample points considered, the higher will be the computational cost. It is generally fixed to 8.
- Grid X: It refers to the number of cells in the horizontal direction. More number of cells will result in a finer grid and higher dimensions of the resulting feature vector. It is generally fixed to eight.
- Grid Y: It refers to the number of cells in the vertical direction. More number of cells will result in a finer grid and higher dimensions of the resulting feature vector. It is generally fixed to eight.

2.Training the Algorithm: To begin with the training process many images of an individual with an ID (can be a numeric or a string value) is provided as a dataset. Eventually, this ID is used by the algorithm to map an individual faceprint with his/her face. It must be taken care that the ID of all images of the same person must be the same.

3. Applying LBP Operation: Then after receiving images from the dataset there is a need to form an image that describes the features of input images in a way that LBPH algorithm can work on it in a better way. For this purpose sliding window technique is used which takes into consideration the already defined radius and neighbors.

The image below shows the procedure:

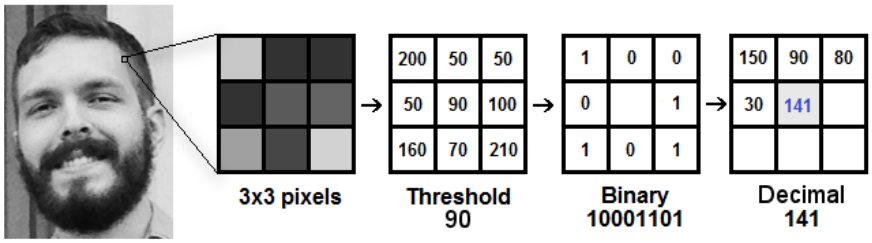

Fig 9. Allotting grayscale values to each pixel

- Let there be a facial image in grayscale.

- Obtain a part of this image as a matrix of 3x3 pixels.
- It is represented as a 3x3 matrix containing the intensities of each pixel (0-255).
- The value of the central pixel in the 3x3 matrix above is set as the threshold value.
- Taking into consideration each of the pixel values of all the neighbors, value '1' is assigned if the value being considered is greater than equal to the chosen threshold value and '0' otherwise.
- After the above process the cells contain only the binary values. These values are taken in a straight line to create the binary value for the central pixel i.e. 10001101 in our case.
- The central pixel is alloted this obtained binary value after converting it to decimal.
- This marks the end of LBP procedure and we get our expected result as the output.

4. *Extracting the Histograms*: In the image (generated in the last step), Grid X and Grid Y parameters are used to divide the image into grids, as shown in the following image:

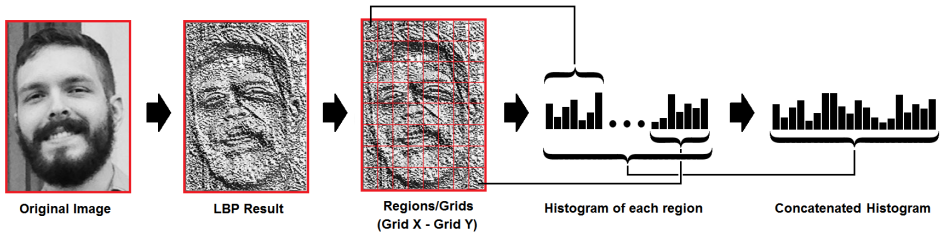

Fig 10. Extracting features from the image

- As the image is in grayscale, each histogram will contain only 256 positions (0-255) representing the occurrences of each pixel intensity.
- Then, each histogram is concatenated to form a cumulative histogram for each image. In this case, there will be 16,384 positions in the cumulative histogram. The cumulative histogram represents the final facial characteristics of the original image.

5. *Performing the Face Recognition:* With the algorithm already trained, each histogram created represents each image from the training dataset. When an image is provided to the algorithm for recognition all the above mentioned steps are repeated to get the cumulative histogram for the new image.

- The newly created cumulative histograms are compared with existing cumulative histograms to output the closest cumulative histogram.
- The Euclidean distance technique is used to calculate the distance:

$$D = \sqrt{\sum_{i=1}^{n}(hist1_i - hist2_i)^2}$$

- The algorithm outputs the ID and the name from the image with the closest histogram. The algorithm also returns the calculated distance, which is used as a 'confidence' measurement.
- The 'confidence' value is set manually for comparison. If the returned 'confidence' value is less than the specified value the image is considered to be tracked else it remains untracked.

D. Data Analysis Techniques

Data analysis is the process of modelling, transforming and cleaning data to obtain useful information for decision-making.

1. Data Transforming
    a. Data is transformed into a better image with sharp difference between boundaries and faces and enhancing the facial features for identification. In our system firstly the image is converted into grayscale. It is easy to work on a grayscale image and it gives as good accuracy as the colored images and also because less information is required to be provided for each pixel and for efficient working of Haar Cascade classifiers.

2. Data Modelling
    a. Data is modelled using HOG(Histogram of Oriented Gradients) techniques in which the image is converted to histograms and then to feature vectors. This ensures that a model is created which compares different faces with already established histogram/feature vectors and recognises the face and links it to the specific person using specified Name and ID.

E. Data Validation

As the data and dataset are self obtained and self-created specific needs for any validation process or technique is required. Student details and images will be self obtained using GUI created and computer's webcam resp. and will be stored in .csv files and in .jpg format resp. If during detection any image is not recognised, it will be stored in the 'ImagesUnknown' folder.

IV. EXPERIMENTAL DESIGN

The proposed system has been implemented with the help of three necessary steps: 1. Capture the images along with the specified name and ID of the student. 2. Train the images using the LBP operation and store the trained data in a .yml file. 3. Detect the trained images using the LBPH algorithm and automatically mark the attendance in a .csv file.

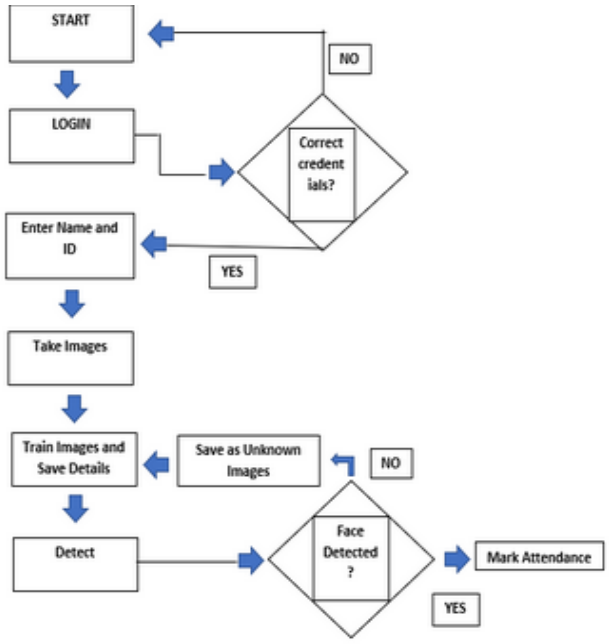

Fig. 11. Flowchart depicting working of the project

A. Datasets

The datasets in the software are self obtained and include ID, Name and Images of students in different poses and vibrations. These images are obtained using the computer's webcam(they can also be captured through .mp4 video) and faces will be detected using Haar feature-based cascade classifiers.

Various images for each student having a unique student id will be captured at regular time frames. The entered ID of the student will be further used to train and recognise the images for individual students.

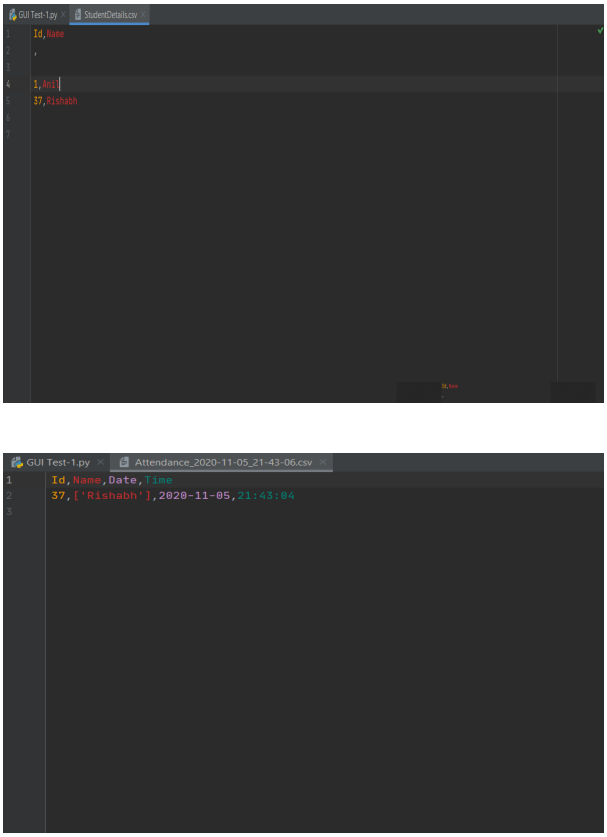

Fig 12. Glimpse of Datasets

B. Research Variables

1. Dependent Variable/s:
    a. Is the student present in the classroom or not on that day(Nominal)?

2. Independent Variable/s:
    a. Lighting Effects:
        i. It refers to the lighting conditions in which the photograph has been taken.

    b. Face position of the student:
        i. It refers to the face position of the student captured in the photograph.

    c. Camera Angle:
        i. It refers to the angle of the camera adjusted while taking a photograph.

    d. Face Features:
        i. It refers to the change in the features of the face that can happen over time such as the growth of a beard, any wound on the face etc.

    e. Dressing of the student:
        i. It refers to any clothing that can cover the face area to any extent like a cap, scarf or a mask that has been worn during the capture of a photograph.

C. Face Detection and Extraction

At first, after logging in, TakeImages() is called where “Name” and “ID” is entered into the GUI, then the computer’s webcam is accessed for the image capturing process. Next, all the face positions and vibrations are extracted from the webcam frame by frame, capturing multiple images of the student. The haarcascade_frontalface_default.xml file is loaded as the classifier. The classifier gives the outputs as "1" if the region is likely to show the object (i.e., face), and "0" otherwise. Also, after capturing the images in all the poses and positions the entered Name and the ID of the student is updated in the "StudentDetails.csv" file. The classifier is originally designed in such a manner that it can be "resized" to find the objects of interest at different sizes. This way is considered to be way more efficient than resizing the image itself. After the face is detected, it is clipped into a grayscale image i.e in our case into an image of 158x158 pixels. This process is repeated for each and every image captured.

D. Learning and Training

TrainImages() function which performs the LBP algorithm on the training set. The TrainImages() function implementation is done in four steps:

1. Load the saved images.
2. Perform LBP on them and create an intermediate image that has better-highlighted facial features.
3. Create a histogram from each pixel of feature-vectors and eventually build a cumulative histogram of an image by combining all the histograms.
4. Save all the information in a .yml file.
    a. Feature-Vectors
    b. Histogram
    c. Cumulative Histogram.
    d. Person Names
    e. Person ID numbers

TrainImages() function initialises LBPH algorithm where all the images along with ID and names of persons are fed to the function. The images are trained using the LBPH algorithm which creates feature-vectors of each pixel in an image and creates a histogram of magnitude vs degree of the feature-vector and at the end creates a cumulative histogram of the picture by combining all the histograms created of each pixel, and all the above information is stored in a .yml file which will be further used for recognition of faces using OpenCV's LBPH functions.

E. Recognition and Identification

TrackImages() function, which implements the recognition phase of the LBPH program. First, the LBPH algorithm is initialised, and all the stored data is read from the .yml file using OpenCV functions. The path of the haar cascade file is given, and the classifier is initialised. Student details are fetched from the Students.csv file and webcam of the computer is initialised to capture the faces. A .mp4 video can also be used to provide the faces for recognition. A rectangle surrounds all the detected faces in the webcam or in the video. Data from the webcam is read, and faces are predicted using the LBPH algorithm. ID and confidence value is returned by the predict function. If confidence value is greater than the threshold value (50 in our proposed system), then

the image is considered to be successfully recognised, and the attendance of the student is marked in Attendance.csv file along with time and date of attendance. Attendance notification is also given about all of the students that have been recognised, and a general statement of image recognition is also given. If the confidence value is greater than 50 the ID is given the value 'unknown' and image is not considered recognised. In case the confidence value is greater than 75, the image goes to the 'ImagesUnknown' folder where it gets saved in .jpg format. The naming format of unknown images is 'Image'Image_Number.jpg.

V. EXPERIMENTAL RESULTS AND DISCUSSIONS

The step of the process of the experiment are given below:

1. Face Detection: Login into the software to access GUI

Begin:

//Name and ID of the student is entered in the GUI

//The captured image is converted to grayscale and facial features of face are extracted

//Stores the GrayScale images

//Updates the student.csv file with students Name and ID

//Using LBP, extract the feature vectors and cumulative histogram

//Once done training, face recognition step will be done

End;

2. Face Recognition: LBPH algorithm is used

Begin:

// Find the faceprint information of the matching face from the database.

// store the details in a .csv file with corresponding Name, ID and system time that marks the attendance for individual students with the file name same as the current date in the 'Attendance' folder.

//If fails to recognise the image sends it to the 'ImagesUnknown' folder

End;

TABLE 1: DESCRIBES THE OPENCV FUNCTION USED IN THE PROPOSED SYSTEM AND ITS EXECUTION RESULTS.

Test data	**Expected Result**	**Observed Result**	**Pass/ Fail**
TakeImages( )	Loads the installed webcam and starts capturing. Loads the HaarClassifier Cascade files for frontal face. Initiates the Face extracting Frame work.	Camera started. Get ready for Extraction.	Pass Pass Pass
TrainImages()	Starts the LBP Algorithm	Trainner.yml	Pass
TrackImages()	Cumulative histogram of input image is compared with stored cumulative histogram.	Closest histogram	Pass

Fig. 13. Training Images

TABLE 2: FACE DETECTION AND RECOGNITION RATE

Face Orientations	**Detection Rate**	**Recognition Rate**
O^0 (Frontal face)	98.7 %	95%
18º	80.0 %	78%
54º	59.2 %	58%
72º	0.00 %	0.00%
90º (Profile face)	0.00 %	0.00%

Enormous experiments were performed to test the validity of the proposed system. Multiple images(in most cases 61) were captured. Fig. 10 shows a sample binary image detected by the TrainImages( ) function using LBPH algorithm. From table 2. it can be inferred that as the face angle with respect to the camera increases, face detection and recognition rate decreases.

VI. VALIDITY THREATS

Factors which affects and reduces internal validity:

1. History: All the events that take place between the 1st and 2nd measurements contribute to this segment. The economic recession of 2010 is a good example.
2. Maturation: It refers to the processes that are within-subjects which act as a function of the passage of time.
3. Testing: It is the consequences of taking a test on the results of taking another test.
4. Instrumentation: All the changes done in scorers, observers and instruments are accounted for in it.
5. Selection of subjects: It includes selection of selection criteria for the formation of bias groups. Randomisation(Random assignment) of group membership is a possible solution against these kinds of threats.

6. Selection-maturation interaction: It refers to the selection of comparison groups which leads to confounding results.

Factors which reduces external validity:

1. Reactive or interaction effect of testing: A pretest tends to increase or decrease the sensitivity to the external factors of the person being tested.
2. Effects of interaction experimental variables and selection biases.
3. Multiple treatment interference: If multiple treatments are given to the same kind of people being tested it becomes tedious to the after effects.

VII. CONCLUSION AND FUTURE WORK

For recording the attendance of individual students along with the current time and date, the authors use an attendance system using facial recognition which can be used in educational institutes. The system takes attendance by observation from cameras installed inside the classrooms. The experiments performed by the authors show lesser training time of images, quick face detection, and recognition, easy to use GUI, and quick marking of attendance as compared to alternate or traditional attendance systems. In further work, authors intend to make face recognition better in different lighting conditions and in the case where students face features that change with time like growing a beard, a scar on the face, wearing a mask,muffler, or cap, etc. Also, the interaction among the systems i.e. users, administrators, and the students can be improved. The same system can also be used in different industrial fields like theft detection, mobile-based face recognition, real-time security monitoring, etc.

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IX. PROJECT PAPERS-SUMMARY

Research Paper 1 (Implemented)

https://www.researchgate.net/publication/331979904_FACE_RECOGNITION_BASED_ATTENDANCE_SYSTEM_USING_MACHINE_LEARNING

Key Algorithms Used: Face geometry based methods, Feature Invariant methods, Machine learning.

Face Detection Algorithm : Viola and Jones framework which makes use of Integral Image and AdaBoost learning algorithm as classifier that gives better results in different lighting conditions to achieve a better detection rates.

Pre-Processing Techniques: Histogram equalization of the extracted face image and is resized, Histogram Equalization is the most common Histogram Normalization technique. This improves the contrast of the image by making it more clear as it stretches the range of the intensities in an image.

Face Recognition Algorithms: LBPH classifier to recognize individuals

Summary:

Face Based Attendance Management System using Machine Learning thus proved to be time saving and cost effective. In real time scenarios LBPH outperforms other algorithms with better recognition rate and low false positive rate. SVM and Bayesian also prove to be better classifiers when compared to distance classifiers. The future work is to improve the recognition rate of algorithms when there are unintentional changes in a person like a tonsuring head, using a scarf, or having a beard. The system developed recognizes faces having an angle variation which has to be improved further.

Research Paper 2

http://ethesis.nitrkl.ac.in/7301/1/AUTOMATED_Mallik_2015.pdf

Face Detection Algorithms : Skin based color detection-various color models which detect skin of people like rgb,hsv,ycbcr.

Face Recognition Algorithms : PCA(Principal Component Analysis)

Summary:

The face detection and recognition algorithms were studied thoroughly taking a number of the tests from different varying conditions images. For face detection a combination of RGB and HSV model algorithms is used. For face recognition principal component analysis method is used. Attendance of the student is marked using the recognized face of every individual student and the data is stored in an attendance sheet. The attendance of every student marked automatically by recognizing their face with the face present in the database

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Research Paper 3

https://eudl.eu/pdf/10.4108/eai.13-7-2018.159713

Face Detection Algorithm :HOG,

Face Recognition Algorithm :Deep Metric Learning

Data Pre processing Technique : The 128 key facial points are extracted for each image given input which are highly accurate and these 128-d facial points are stored in a data file for face recognition.

Summary :-

To maintain the attendance record with day to day activities is a challenging task. The conventional method of calling the name of each student is time consuming and there is always a chance of proxy attendance. The following system is based on face recognition to maintain the attendance record of students. The daily attendance of students is recorded subject wise which is stored already by the administrator. As the time for corresponding subject arrives the system automatically starts taking snaps and then applying face detection and recognition technique to the given image and the recognized students are marked as present and their attendance updated with corresponding time and subject id. We have used deep learning techniques to develop this system, histogram of oriented gradient method is used to detect faces in images and deep learning method is used to compute and compare facial features of students to recognize them. Our system is capable of identifying multiple faces in real time.

Research Paper 4

https://www.sciencedirect.com/science/article/pii/S1319157818309406

Face Detection Algorithm: Viola and Jones

Face Recognition Algorithm: PCA(Principal Component Analysis),LBPH(Local Binary Pattern Histogram)

Summary :

This paper proposes an Android based course attendance system using face recognition. The system asked every registered student to capture his/her face image and QR code displayed at the front of the classroom using his/her smartphone. The captured image was then uploaded to the server for face recognition and attendance process. To achieve a good face recognition accuracy and efficient processing time, a classifier was only used to perform face recognition in a certain course. The experimental result shows that the proposed attendance system achieved face recognition performance of 97.29% by employing LDA and only needed 0.000096 s for face recognition process in the server. For future work, the investigation of the use of Bluetooth

devices for measuring the distance between student's smartphones and Raspberry Pi located in the classroom, to ensure students attend in a course, will be considered to minimize the possibility of cheating performed by students in the attendance process.

Research Paper 5

https://www.sciencedirect.com/science/article/pii/S2590005619300141#tbl1

Face Detection Algorithm: Haar Algorithm

Summary :-

In conclusion, in our research, after preprocessing the input face images using some advanced image processing techniques such Contrast Adjustment, Bilateral Filter, Histogram Equalization, so as to have better image features and the same advanced image processing techniques will be applied to the training/template face images plus an image blending method to ensure high quality training/template face images. The preprocessed input face image will be divided into k2 regions, then the LBP code will be calculated for every pixel in a region of the input face image by comparing the center with the surrounding pixel. If the surrounding pixel is greater than or equal to the center pixel, then it is denoted as binary 1, else it is denoted as 0.

This process will be repeated for each and every pixel of all other regions, to get the binary pattern so as to construct the feature vector of the input face images. For every region, a histogram with all possible labels is constructed. These constructed histograms with all its bins represent a pattern and contain the number of its appearance in the region. The feature vector formed is then constructed by concatenating the regional histograms to one big histogram, which is unique for each individual, and is compared with the template face images to recognize faces. This method improves the LBP code and our experiment results show that our method is very accurate and robust for facial recognition systems that can be implemented in a real-life environment. It is also important to state that our research does not address the issue of occlusion and mask faces in facial recognition, but addressing these issues could be a perfect future work of this paper.

Research Paper 6

https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78:

Face Detection: HOG(Histogram Of Oriented Gradients)

Face Recognition: Face landmark estimation

Summary:

1. Encode a picture using the HOG algorithm to create a simplified version of the image. Using this simplified image, find the part of the image that most looks like a generic HOG encoding of a face.
2. Figure out the pose of the face by finding the main landmarks in the face. Once we find those landmarks, use them to warp the image so that the eyes and mouth are centered.
3. Pass the centered face image through a neural network that knows how to measure features of the face. Save those 128 measurements.
4. Looking at all the faces we've measured in the past, see which person has the closest measurements to our face's measurements. That's our match!

Research Paper 7

https://arxiv.org/pdf/1812.00408v3.pdf

Image Processing Techniques: Format transformation, Haar-like face detection, and histogram equalization.

Major Algorithm: 1. Haar-Like Face Detection Algorithm
2. "Eigenface" Recognition Algorithm

Summary:-

In this paper, they presented and released a large-scale multi-modal face anti-spoofing dataset. The CASIA-SURFdataset is the largest one in terms of number of subjects,data samples, and number of visual data modalities. We Believe this dataset will push the state-of-the-art in face anti-spoofing. Owing to the large-scale learning, we found that traditional evaluation metrics in face of anti-spoofing (i.e.,APCER, NPECR and ACER) did not clearly reflect the util-ity of models in real application scenarios. In this regard,we proposed the usage of the ROC curve as the evaluation metric for large-scale face anti-spoofing evaluation. Fur-thermore, we proposed a multi-modal fusion method, which performs model-dependent feature re-weighting to select the more informative channel features while suppressing the less informative ones. Extensive experiments have been conducted on the CASIA-SURF dataset, showing high gen-eralization capability of models trained on the proposed dataset and the benefit of using multiple visual modalities.

Research Paper 8

https://arxiv.org/ftp/arxiv/papers/1302/1302.6379.pdf

Summary :-

Face recognition from image or video is a popular topic in biometrics research. Many public places usually have surveillance cameras for video capture and these cameras have their significant value for security purposes. It is widely acknowledged that face recognition has played an important role in surveillance systems as it doesn't need the object's cooperation. The actual advantages of face based identification over other biometrics are uniqueness and acceptance. As the human face is a dynamic object having a high degree of variability in its appearance, that makes face detection a difficult problem in computer vision. In this field, accuracy and speed of identification is a main issue. The goal of this paper is to evaluate various face detection and recognition methods, and provide a complete solution for image based face detection and recognition with higher accuracy, better response rate as an initial step for video surveillance. Solution is proposed based on performed tests on various face rich databases in terms of subjects, pose, emotions, race and light.

Research Paper 9

https://www.intechopen.com/books/face-recognition-semisupervised-classification-subspace-projection-and-evaluation-methods/face-recognition-issues-methods-and-alternative-applications

Summary :

Face recognition, as one of the most successful applications of image analysis, has recently gained significant attention. It is due to availability of feasible technologies, including mobile solutions. Research in automatic face recognition has been conducted since the 1960s, but the problem is still largely unsolved. Last decade has provided significant progress in this area owing to advances in face modelling and analysis techniques. Although systems have been developed for face detection and tracking, reliable face recognition still offers a great challenge to computer vision and pattern recognition researchers. There are several reasons for recent increased interest in face recognition, including rising public concern for security, the need for identity verification in the digital world, face analysis and modelling techniques in multimedia data management and computer entertainment. In this chapter, we have discussed face recognition processing, including major components such as face detection, tracking, alignment and feature extraction, and it points out the technical challenges of building a face recognition system. We focus on the importance of the most successful solutions available so far. The final part of the chapter describes chosen face recognition methods and applications and their potential use in areas not related to face recognition.

Research Paper 10

https://link.springer.com/chapter/10.1007/978-3-642-72201-1_9

Summary :-

Two of the most important aspects in the general research framework of face recognition by computer are addressed here: face and facial feature detection, and face recognition — or rather face comparison. The best reported results of the mug-shot face recognition problem are obtained with elastic matching using jets. In this approach, the overall face detection, facial feature localization, and face comparison is carried out in a single step. This paper describes our research progress towards a different approach for face recognition. On the one hand, we describe a visual learning technique and its application to face detection in complex backgrounds, and accurate facial feature detection/tracking. On the other hand, a fast algorithm for 2D-template matching is presented as well as its application to face recognition. Finally, we report an automatic, real-time face recognition system.