Attendance Management Using Facial Recognition

Rajath S Bharadwaj, Tejus S Rao, Vinay T R

Abstract: ***Facial recognition technologies have undergone large-scale upgrades in performance in the last decade and such systems are now popular in fields such as security and commerce. This work details a real-time automated attendance system which will mark attendance of students and employees alike. The proposed system is a real-world solution to handle day-day activities of an organization such as a college. The main task is using Principle Component Analysis in recognizing the faces of the detected person with high accuracy. The automated system maintains the attendance records of student as manual management of ledgers is a very tedious task. The system enrolls the subject's face into the database against the subject's ID (unique) and Name. The system then allots attendance to the recognized faces in the database.***

Indexed Terms: Face Detection; Face Recognition; Histogram; Local Binary Patterns

I. Introduction

One of the foremost reminiscences everyone has about college is the morning roll call that the lecturers would in person call upon our names, and we tend to reply in affirmation to prove our attendance. It's a long and tedious routine in educational institutions and several people have manipulated the manual attendance system. Attendance being a very important side of administration might usually become a time constraint, repetitive job, loaning itself to inaccuracies. Organizations need to keep a track of individuals inside the organization like staff and students to maximize their performance. Managing student's attendance at lecture periods has become a tough challenge. The ability to work out the attendance proportion becomes a significant task as manual computation produces errors, and wastes a great deal of our time.

The basis of developing an automatic attendance management system is to computerize the standard method of taking attendance. The existing techniques and methodologies to detect and recognize faces fail to overcome primal issues such as scaling, pose, illumination, rotation and occlusions.

The proposed system strives to outgrow the constraints of the existing systems and provides features such as detection of faces, extraction of features, detection of extracted features and analysis [1] of student's attendance. The system's correctness in detecting and recognizing faces will be more due to use of larger number of features (shape, color, LBP, wavelet, Auto correlation, etc.) [5] of the face.

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II. LITERATURE SURVEY

A. Summary of Approaches

1) Biometric scan

i. Students fingerprints are scanned and stored in the database.
ii. To mark their attendance the students must use the biometric system before every class.
iii. A central system holds all the data and is responsible for managing all student records.

2) ID card swipe system

i. College ID cards are fitted with RFID chips which are scanned by readers installed in each classroom.
ii. The cards are scanned before each class to mark the student's attendance.
iii. The server is updated every ten minutes
iv. Every teaching faculty gets a list of all the students who were present after every class is over.
v. An online portal allows access to students to view their current attendance.

B. Existing algorithms

1) Eigen face

i. This algorithm extracts the necessary information from an image and efficiently encodes it.
ii. To obtain variations, a number of pictures of a single person is taken.
iii. For the set of images of faces, eigenvectors and its co-variance matric is calculated and stored[7].
iv. Since every image represents an eigen vector, the data set helps produce variety for the system.
v. A representation of these eigen vectors is called eigen faces.

Fig1: Example of Eigen Faces

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2) Line Edge Map

i. One of the popular methods is using the Line Edge Maps algorithm.
ii. In this method line matching is done to map the features [5][9] of the face.
iii. This algorithm mainly uses the most prominent features of the face; mainly the eyes, nose and mouth having high characteristics.
iv. The color images are converted to greyscale to observe and extract the similarities in the faces.
v. Sobel edge detection algorithm is made use of to encode the greyscale images into binary edge maps.[9][10]
vi. This technique was developed by studying how we human beings remember others people's faces (remembering face's prominent features).

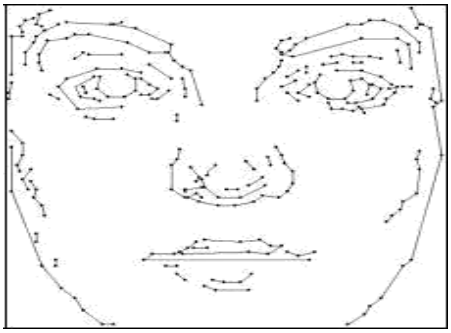


Fig2: Example of Line Edge Mapping

3) Histogram of oriented gradients (HOG)

i. This technique can be applied to detecting objects as well as faces.
ii. All images used are converted to greyscale and every pixel in this image in assigned an integer.
iii. Every pixel compares its value to its neighboring pixels.[1]
iv. The primary motive is to find the dark regions of the face in the image.
v. The direction pointing to that dark region will have a white arrow pointing towards it.
vi. This treatment is done for each pixel of the picture.

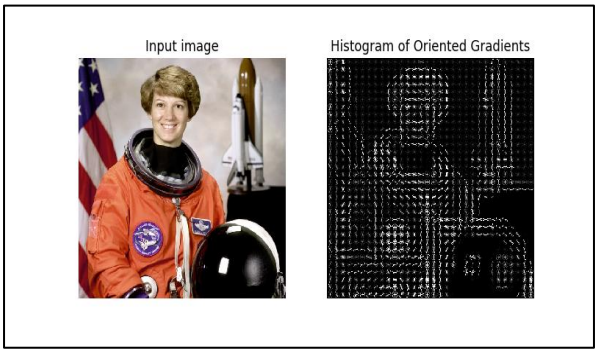


Fig3: Example of Histogram

III. APPLICATIONS

A. Institutions

Institutions have the traditional way of marking attendance where call out each student name to check if they are present. This method of roll call is time consuming and tedious. By using Facial Recognition, the process of taking attendance can be significantly improved to save time and provide a hassle-free way to automatically mark attendance. Since the number of students in an institution are more, using an automated system improves the productivity and standard of the college.

B. Companies

In most companies, employees have the practice of using their biometrics or ID card to log their time of entry and exit. During the peak hours the number of people entering and exiting the office are generally high. This causes congestion in the workplace and people queue up to and await their turn. Facial Recognition systems provide a more convenient way of managing this process of attendance. Employees don't have to worry about logging their time as it's an automatic process. The system will note the time of entry and exit when an employee enters or exits the office.

C. Prison

In prisons, everyday a head count of the prisoners is done to check if all inmates are present. Using facial recognition to automate this process of doing head count the increases the efficiency and reliability is improved. The security also increases as tabs can be kept on each prisoner at all times.

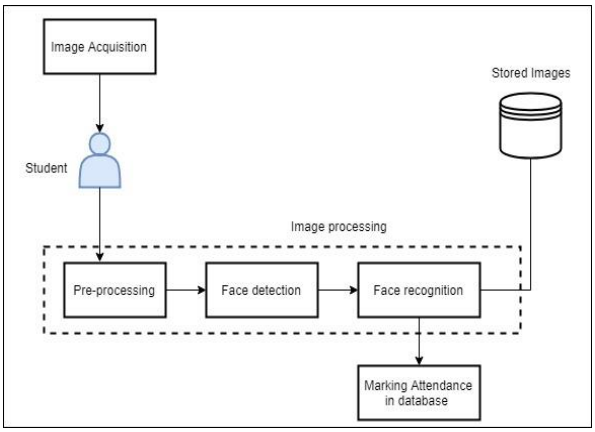


Fig4: Activity diagram of system

IV. SYSTEM DESIGN

A. Activity diagram

The System process can be separated into three working modules. They are face representation, feature extraction and classification. The first and foremost task is modelling a face. The way is face is represented determines the next two steps. The image acquired is transformed to match the positions of images already present. In feature extraction the features of the face are mapped as histograms with gradients [3][4] and they are stored as binary values. The final step is recognizing a familiar face. The system compares

the face seen in the camera with records that are already stored.

B. Data Flow Diagram

The above diagram shows how the flows in the system. Images from a live stream are passed as input to the system. These images are converted to greyscale as LBPH works with images in greyscale. From the greyscale images features of the face are extracted. Features refer to the gradients in the face. The features are then compared with existing records to check if there is a match. If the face matches it is displayed and output is in the form of attendance being marked for the person whose face was recognized.

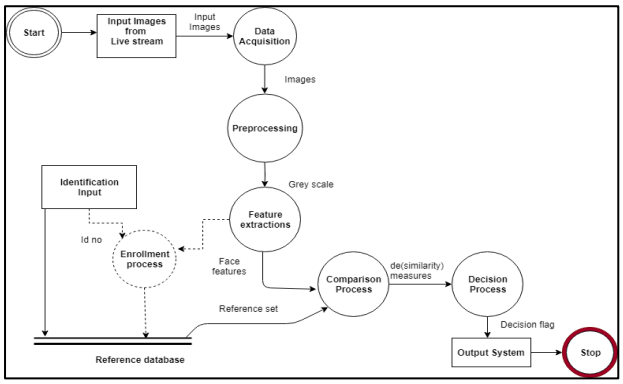


Fig5: Flow of data in the System

V. IMPLEMENTATION

A. Algorithm

Fig6: Images stored in greyscale

1. LBPH algorithm:

LBPH stands for Local Binary Pattern Histogram, a basic algorithm that's used to detect faces from the front side. It is used for object as well as face detection. The LBP operator helps to get local features by Local Binary Pattern acts [7]. The local special arrangement of the face is shortened by these LBP acts. The LBP operator divides the face in the image into pixels. Every pixel is associated with 8 neighbor pixels that surrounds it [8]. Each pixel value is then compared with the surrounding neighbor pixel values. The equation is for this is:

$$LBP(x_c,y_c) = \sum_{n=0}^{7} s(i_n - i_c)2^n \quad (1)$$

Where

i_c - It's the value of the center pixel

(x_c, y_c), i_n - It's value of eight surrounding pixels.

2. The Face Recognition Algorithm

Input: A person's face.
Output: Attendance is marked for recognized faces.

Initialization

1. Open the camera cv2.VideoCapture(0)
2. Import the face classifier LBPHFaceRecognizer_create()
3. Read the trained data from the file recognizer.read('trainer.yml')

GPU Part

1. Image is captured frame by frame img = cap.read()
2. Face in the frame is converted to greyscale gray = (img, cv2.COLOR_BGR2GRAY)
3. All faces are detected in the frame faces = face_cas.detectMultiScale()
4. for coordinates of face:

1) values inside frame are read roi_gray = gray[y:y + h, x:x + w]

2) values are compared with stored values confidence = recognizer.predict(roi_gray)

5. if confidence<85:

face matching with the values is recognized attendance is marked dataEntry(name,class_count)

6. else:

face is not recognized id = 'Unknown'

B. Processes involved

1. Pre-Processing Images

The system captures around 50 images of every individuals face. The images are converted into grey scale as LBPH operates using images in greyscale and the images are stored in a folder. The stored images will be saved with a name and ID unique to that person.

2. Face Detection

When a person appears in front of the camera, the camera detects that a face is present and a frame appears around the face. The entire frame is converted to greyscale as LBPH works only on greyscale images. A scale factor is used to compensate for multiple faces present in front of the camera.

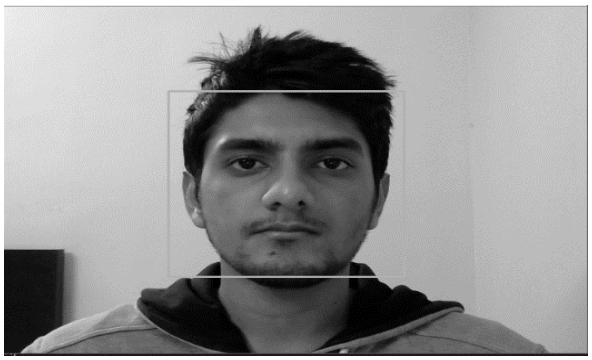


Fig7: Frame around detected face

3. Feature Extraction

The LBPH algorithm makes use of binary values and stores the data in a file. The binary values are different for each face. The Region of Interest (ROI) [12][13] are parts of the face from where features are extracted. Information about the gradients in the face is captured. The image of a person's face is divided cells comprising of 8 pixels. Each pixel present has a gradient and compares itself with its neighbor pixels.

Fig8: Example of features

4. Face Recognition

In the comparison module, face recognition process is carried out. When a face is detected by the camera it checks the corresponding values of the current visible face with values stored in the file. If the values are a match, then the face is recognized and the name associated with that face is displayed.

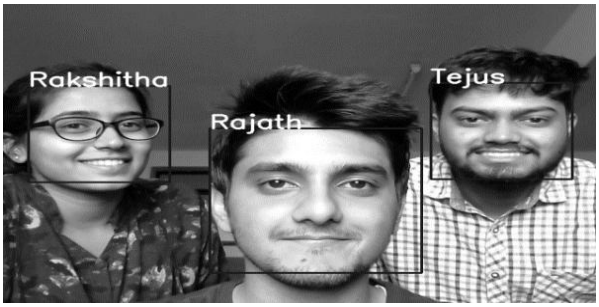
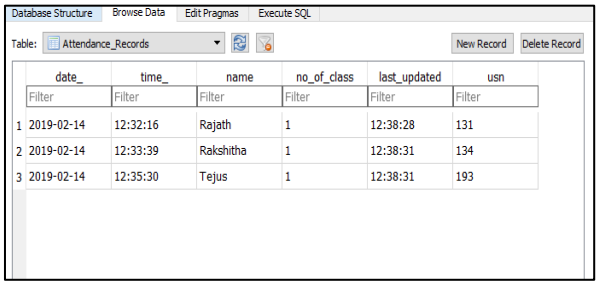


Fig9: Faces recognized

C. Database

Database holds the name and ID of all people whose attendance will have to be marked. As and when a face is detected and matched with the existing records, the attendance is automatically updated in the database. Every time a face is recognized, the number of times that personis present increases by a count of 1. There is also a column which shows when the attendance was last updated.



	date_	time_	name	no_of_class	last_updated	usn
	Filter	Filter	Filter	Filter	Filter	Filter
1	2019-02-14	12:32:16	Rajath	1	12:38:28	131
2	2019-02-14	12:33:39	Rakshitha	1	12:38:31	134
3	2019-02-14	12:35:30	Tejus	1	12:38:31	193

Fig10: Attendance marked in the database

VI. TEST CASES

SLNo	Action	Inputs	Expected Output	Actual Output	Test Result
1	Capture Images	A person's face	Images are captured and stored	Images are captured and stored	Pass
2	Train the image dataset	Stored images of a face	Create histogram and store values	Histogram is created and values are stored	Pass
3	Face Recognition	A live stream of a person's face	Name of detected person is displayed on the screen	Name of detected person is displayed on the screen	Pass
4	Update attendance for multiple people at once	Multiple faces from a live video stream	Update Attendance for all faces detected	Attendance is updated only for a single face	Fail
5	Detect more than 7 faces	7 people facing the camera	Detect all 7 faces present in front of camera	Only 5 faces are detected at a time	Fail

Fig11: Test Cases for the implemented project

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