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Automatic Attendance System through Facial Recognition Using LBPH Algorithm

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Abstract - *Every working area whether its professional, industrial, or educational requires an attendance report. Conventionally, this report is maintained manually through physical means i.e., pen-paper. So if the amount of concerned attendants increases, then, withholding to such attendance procedure will be a tedious job and might result in over-consumption of time. These methods often constitute of human errors resulting in non-verified attendance marking. In recent years, after the advancement of automated environments, many perceptions with different technologies were proposed for instance, biometrics via fingerprint detection, iris detection or by using barcode as an ID. So the idea in fabricating the below project is to generate a time efficient, cost efficient as well as error free mechanism by using real time face detection and updating the attendance automatically inside the MySQL database. The software constitutes the dataset of students with their images which can be readily edited as well as updated. These images can be uploaded by the administrator and the mentioned algorithm detects the faces and compares it to the student image dataset in the recognition phase. The corresponding attendance is thus fetched to the database. This system rectifies the complications in physical record maintenance and results in effortless yielding of attendance.*

Key Words*: *face recognition, face detection , OpenCV face recognition, LBPH algorithm

1.INTRODUCTION

In this growing era where the domain of data is expanding enormously and the need for handling that data precisely is in demand, the conventional systems lack the integrity and legitimacy. Also, deploying these methods on a large scale proves to be cost inefficient. So the inspiration for the proposed work was to construct an effective attendance system constituting of the least possible errors and a significantly increased precision. So far, many researchers have implemented their ideas in various technologies such as:

1)Biometric scan based(fingerprint scanner, iris scanner etc.)

2) Smart-Card based (bar-code scanning)

3) Web based (manual- entry)

The basis of an automated attendance management system is to generate a system in which the students or the employees update their respective attendance just by showing their face and by no further intervention.

The given work solves the above problem without any human effort and is implemented by using face detection and updating the attendance using MySQL as database. The given system has the capability of updating, creating, editing and removal of attendance. The proposed system recognizes the faces of the employees or students by comparison with the provided dataset, and directly update their attendance inside the database through MySQL. The algorithm used in the previous mentioned work were: - Eigen faces, Line Edge Map, Histogram of oriented gradients (HOG) etc. The algorithm used in the mentioned work is LBPH and facial detection is achieved through Python's OpenCV library.

2. LITERATURE SURVEY:

2.1 Summary of Approaches:

1) Biometric scan -
Firstly students scan their respective biometrics (fingerprint or iris) which later gets matched with the dataset. For every single attendance the need for repeated biometric scanning arises.

2) ID card swipe system -
College id cards contain RFID by which persons scan their attendance in front of the barcode scanner. Students need to scan their id card in every class and database gets updated every ten minutes. The final attendance is fetched and is then updated physically or digitally.

2.2 Existing algorithms

1) Template based Methods -
Template matching is primitively related to holistic approach that attempts to identify faces using global representations (J. Huang, 1998). These methods approach the face image as a whole and extract features from the facial region and then classify the image by imposing a pattern classifier. One such method used to extract features in a holistic system, is based on statistical approaches

2) Statistical Approaches -
There are various techniques that identify, parameterize, and analyze linear subspaces. Apart from linear subspaces, there are a few statistical facial recognition techniques based on non-linear subspaces (like kernel-PCA and kernel-LDA), transformation (like DCT, DCT & HMM and Fourier Transform) and Support Vector Machine (SVM). Appearance-based approaches for face recognition like PCA, LDA, and probabilistic subspace project a 2D face image as a vector in image space.

3) Neural Network based Approaches -
Artificial Neural Network (ANN) (B. Yegnanarayana, 1999) is an impactful tool for pattern recognition problems. In Kohonen's associative map (T. Kohonen, 1998), the earliest demonstrations of neural network for face image applications is reported. Using a small set of face images, accurate recall was reported even when input image is very noisy, low resolution and dimension even when portions of the images were missing.

4) Single Layer adaptive NN -
A single layer adaptive NN (one for single person) for face recognition was reported in (T. J. Stonham, 1984). A system named Wilke, Aleksander and Stonham's recognition device (WISARD) was devised. It needs roughly around 200-400 projections for training each classifier where the training patterns inhibited translation in facial expressions. One classifier was constructed corresponding to one subject in the database.

5) Multilayer Perceptron (MLP) -
Most of the present literatures on face recognition system with neural networks present results with a small number of classes. In (D. Demers, 1993) the first 50 principal components of the images were extracted and reduced to five dimensions using auto associative neural network. The resulting representation was classified using a standard multilayer perceptron.

6) Self-Organizing map (SOM) -
The self-organizing map describes a quantization of the face image samples into a terrain-like space. It provides dimensionality reduction and invariance to include minor changes in the face image sample. The convolutional neural network provides partial invariance to various kinds of deformation.

7) Hop-field memory model -
In (Y. Dai, 1998), a Hop-field memory model for the facial images was framed and the utmost optimal procedure of learning was concluded. A method for face recognition comprising Hop-field memory model paired with the pattern matching is proposed. It shows slightly better performance of dataset comprising of approximately 20 faces of 40 subjects.

8) Eigen face -
Set of eigen vectors used in facial recognistion is termed as eigen faces. It is used in solving problems related to computer vision. It was developed by Sirovich and Kirby in 1987. Eigen faces is used to create a covariance matrix and the set is generated by performing principal component analysis (PCA).

9) Line Edge Map -
Line Edge Map Edge Information (LEM) is a functional feature of an object that cannot be understood to illuminate changes to a certain extent. Object edge images can be used for object recognition and achieve the same accuracy as grey-level images. Takács argued that the facial recognition process could start very early and that edge images could be used for facial recognition without the involvement of higher cognitive functions. The Line Edge Map method, extracts lines from the frontal map as features. This method can be considered as a combination of template matching and geometric feature comparison. The LEM method contains not only the advantages of feature-based methods, such as the advent of illumination and the need for low memory, but also the advantage of high recognition performance of template matching.

10) Histogram of oriented gradients (HOG) -
An important assumption behind the histogram of the gradient's definition is that the appearance of the object and the position of the object within the image can be explained by the distribution of gradients by the intensity or edge directions. The image is divided into small, interconnected regions called cells, and by pixels within each cell, a histogram of gradient directions is computed. Concatenation of these histograms directs a descriptor. With improved accuracy, the local histograms can be contrast-normalized by computing a magnitude of the intensity across a larger region of the image, called a block, and then applying this value to normalize all cells in interior with the block. This often results in a better transition of light to shadow.

11) Fisher Faces Algorithm -
The Fisher Faces method is basically a class specific transformation matrix, i.e., it doesn't capture the illumination as Eigenfaces method. The pursuance of Fisher Faces algorithm is solely based on input data. For instance, if the Fisher Faces algorithm is imposed learning for well illuminated pictures only and then incident to recognize faces in bad illuminated environment, the method is most likely to depict incorrect components.
Sample paragraph Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

2.3 Application:

1)Institutions -
The most demanding place where attendance system is needed are schools, colleges, or coaching institutes where

students required to provide their attendance at least once a day. No false attendance can be generated since the face will act as a unique id.

2)Companies -
Another concerned place where attendance system is a crucial part are professional areas such as offices or industrial areas for keeping the head count of workers.

3)Hostels -
The application of attendance system is also significant in hostels where the in-charge needs to maintain an attendance report of hostelers and withhold the discipline on a daily basis. It can be very useful as the in-charge will know if the time constraint is being followed and at what time the students entered the premises.

4)Prison -
Talking in terms of national security where keeping the head count of criminals is a necessary task then an attendance system comes in handy to maintain record of their presence.

3. METHODOLOGY

The algorithm used in the given work is LBPH (local binary patterns histogram) it was first described in 1994 as LBP, which later with histograms of oriented gradients and was came to known as LBPH in 1996.
LBPH generally uses 4 parameters as:
a) Radius
b) neighbors
c) gridX
d) gridY

OpenCV is the open-source library used for image processing, training of pictorial dataset. It contains many algorithms.
Haar Cascade Classifiers is an effective object detection approach. It was proposed by Paul Viola and Michael Jones in 2001. Using Haar Cascade Classifiers through machine learning approach. In which a cascade function is trained from a dataset containing both positive and negative images. After training is done the object is detected and name gets appeared on it according to the label or the text attached on it by the user.
The reason for using LPBH algorithm is that it is one of the easiest algorithm. It gives good results.
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3.1Workflow

a) Firstly, the person faces the camera so that the camera detects his/her face and identifies it

b) Secondly, the LBPH algorithm identifies the person by comparing with the dataset present in the dataset.

c) The dataset contains the photographs of all the students/employees and at the time of face recognisation the live feed corresponds to the dataset.

d) After face recognistion, attendance gets updated automatically in the database.

e) Any student/employee can access their respective attendance at any time.

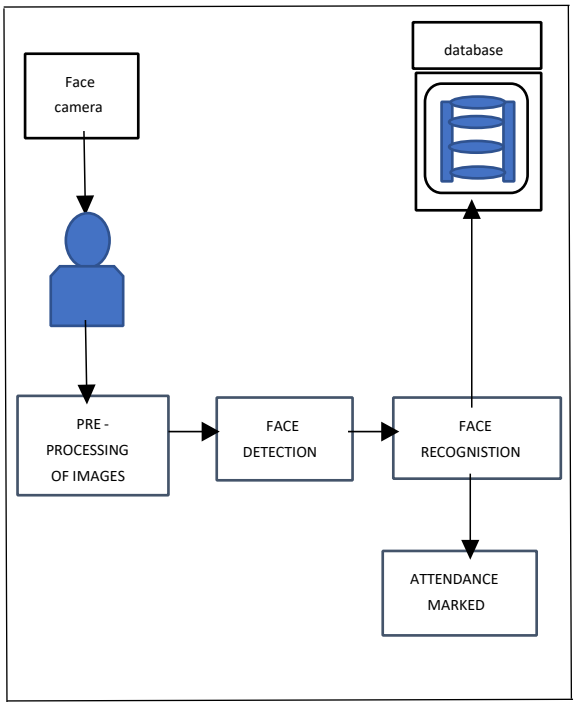

Fig -1: Activity Diagram of the System

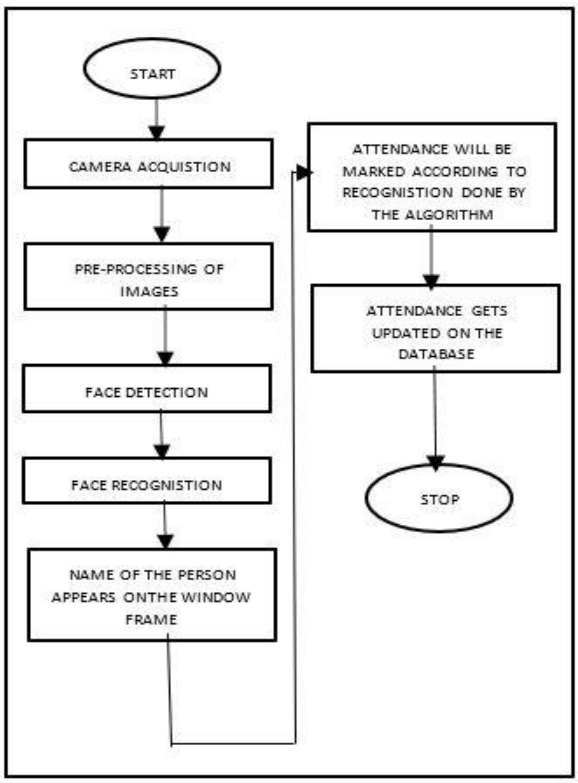

Fig -2: Flowchart of Algorithm

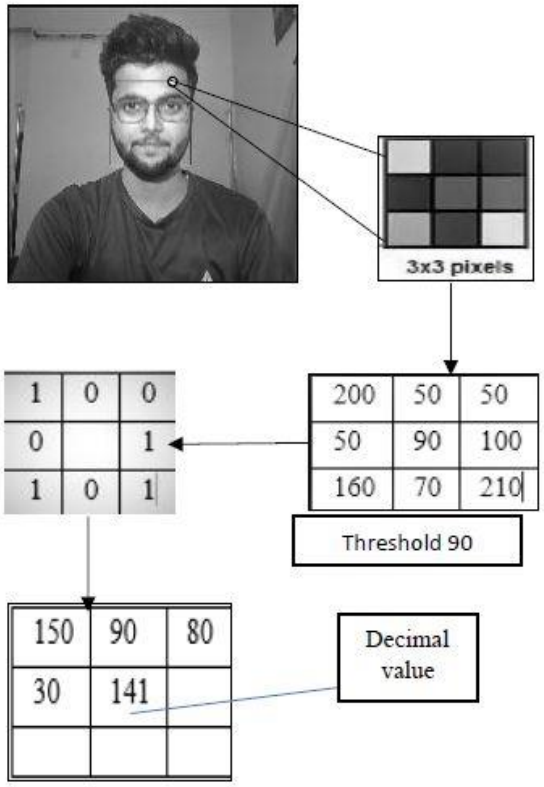

Fig -3: Working of LBPH Algorithm

3.2 Image Pre-Processing

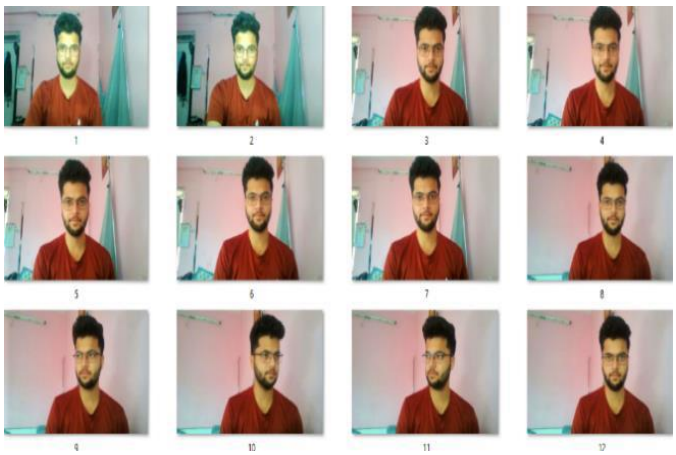

Fig -4: Example of Dataset

The trial starts with the image pre-processing in which the dataset of images is trained. Learning is directly proportional to the dataset procured. To inflate the dataset, the statistic of images in data set is increased or data augmentation is enforced. The given trial incorporate dataset of 25 students. After amassing, the accuracy of dataset is heightened by the process of data augmentation.

3.3 Face Detection

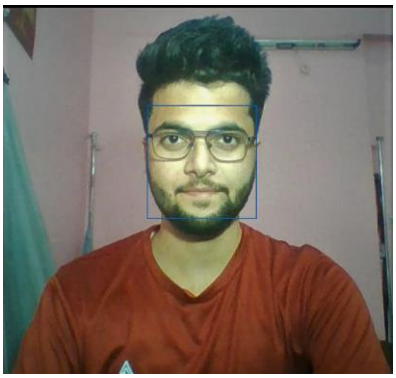

Fig -5: Detection of Face

When a character turns up in front of the camera, the recognizer detects and acquires the facial data in framed region. The facial data is then transformed to grayscale concentrated in the framed part as LBPH algorithm work effectively on grayscale images. The scale factor provided in the code imposes the limit of maximum faces that can be detected precisely. The minNeighbours attribute hampers the number of faces that can be rigorously detected in a single frame.

3.4 Face Recognition

Subsequently when the image has been acquired and the facial segment is transformed to grayscale, the **L**ocal **B**inary **P**attern **H**istogram Algorithm is held responsible

for fetching the aspects (histograms) which best exemplify the image.

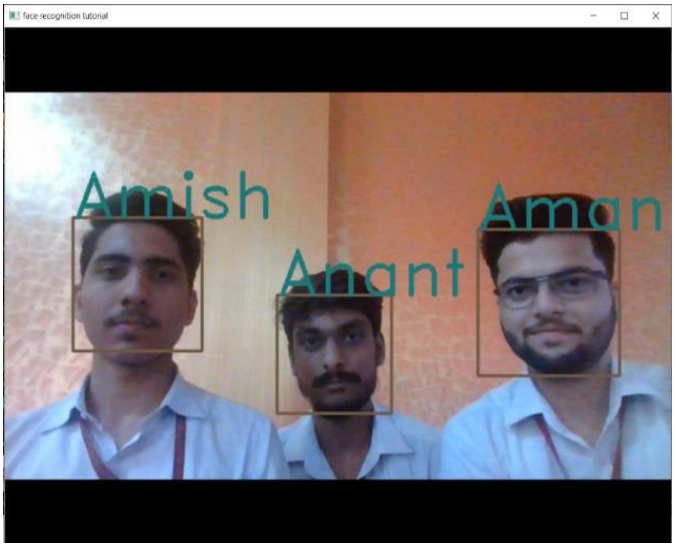

Fig -6: Face Recognition

The histogram(h1) extracted is compared to the pre-trained histogram(h2), which is stored in the file(recognizer. read(trainner.yml)) via cited approaches:

a) Euclidean Distance -

$$D = \sqrt{\sum_{i=1}^{n}(h1_i - h2_i)^2}$$

b) Chi-Square -

$$\chi_c^2 = \sum \frac{(h2 - h1)^2}{h1}$$

c)Absolute Value -

$$\text{Absolute Value} = |h2 - h1|$$

The above stated formulae return the calculated distance, here called "confidence" measurement. Note that, lower confidence yields better results.

3.5 Database

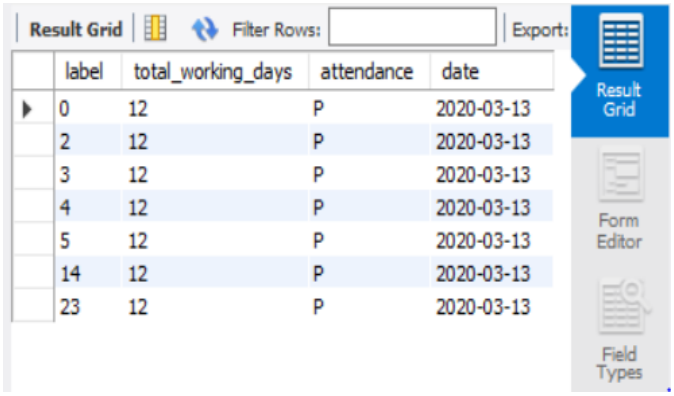

Fig -7: Attendance marked in the database

Database holds the corresponding IDs and Names of the student that are enrolled in the organisation. The backend with connection to the interface triggers actions such as updating the attendance of the individual when his/her face is detected and matched with the existing record in our dataset. The attendance of that individual is updated and incremented by count= '1' when a face is recognised. This is allowed only once a day. Total working days in the database are incremented by 1 as soon as the attendance capturing system is booted for the first time in the day and results in uniformly updating the total working days and thus incrementing the date of records by 1 day. The columns in the database depict the corresponding roll numbers of the students, their total attendance, the total working days in the organisation and the date until the database is maintained.

3.6 Graphical User Interface using Tkinter (Python Library)

Fig -7: Functioning of GUI

3.7 Experimental Result

S.NO	ACTION	INPUT	EXPECTED OUTPUT	ACTUAL OUTPUT	TEST RESU-LT
1.	Capture images	A person's image	Images are captured and gets recognised	Images are captured and gets recognised	Passed
2.	Pre-processing and Face detection	Detecting the face in front of camera	Square window appears on the face	Square window appears on the face	Passed
3.	Face Recognition	A live stream of person's face	Name of the person detected will be displayed on the screen	Name of the person detected is displayed on the screen	Passed
4.	Update attendance for multiple image	Multiple faces facing a camera	Attendance gets updated in the database	Attendance gets updated in the database	Passed
5.	Detect 5 faces	5 people facing the camera	Detect all 5 faces present in front of camera	Detected all 5 faces present in front of camera	Passed
6.	Detect more than 5 face	7 people facing the camera	Detect all the 7 faces facing the camera	Only 5 faces are detected at a time	Failed

Table -1: Test Cases With Results

3.8 Comparative Analysis

S.NO	ACTION	PROPOSED WORK	PREVIOUS WORK
1.	Detecting face in low light	LBPH allows	Eigen Faces and Fisher Faces don't allow
2.	Detecting multiple faces	LBPH depends on the quality of dataset given	Fixed no. of faces detected
3.	Maximum number of faces detected simultaneously	4 and can be increased by giving the right picture quality	2 to 3 faces are simultaneously rendered and detected
4.	Storing dataset	Secured file system	Use database and store images in blob format
5.	Storing Attendance	Attendance stored in tabular form in MySQL database	Use insecure Excel files to store attendance reports
6.	Dataset Updating	Easily updatable, since in the file system	Tedious job in blob format

Table -2: Test Cases With Data Set Results

a) The proposed work ensures facial features comparison even in low illumination since rather than a coloured image, the classifier is fed grayscale images.

b) If the quality of training images is increased, the classifier will identify all the faces.

c) The dataset is stored in file system and would be even more secure than any other dataset storing techniques if LINUX's file system is used.

d) Attendance storing and retrieving could be easily done if it is stored in database and not in excel files since they cannot be embedded in the GUI (if introduced later).

e) The no. of simultaneous faces detected can be increased by decreasing the confidence which is an LBPH virtue and denoted as difference from actual value

4. CONCLUSIONS

a) The Real Time Automated Attendance system helps in proliferating the precision and pace eventually effectuating the high-precision real-time attendance to cope up with the lessened time constraint available for the automated classroom attendance.

b) The proposed work helps capture the live stream of the students, segregate it into numerous frames, correspond it with the dataset in the file system to verify their presence or absence and inscribe attendance to the appropriate student to maintain the record.

c) The feasibility of the given work in ensured by avoiding the use of complex structures for images in database and rather using the file system for easier manipulation and retrieval.

5. RESULT

For the given dataset of images the mentioned work ensures an efficient, significantly precise and responsive environment for updating attendance through facial recognition.

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