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Face Recognition Attendance System

[1] Palak M Jain; [2] Shipra Singh; [3] Nikita Singh; [4] Nancy Hablani; [5] Dr. G. Paavai Anand

[1] Department of Computer Science and Engineering,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India

[2] Department of Computer Science and Engineering,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India

[3] Department of Computer Science and Engineering,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India

[4] Department of Computer Science and Engineering,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India

[5] Department of Computer Science and Engineering,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India

Abstract - In this project, we aim to build an Attendance marking system with the help of face recognition. Every institute has its own method of marking student's attendance and keeping record each and every student. Some institutes are marking attendance manually using traditional system and few of them have adopted the automatic methods of taking attendance. This system is developed for an easy way of marking attendance and to overcome the difficulty in the manual based attendance system. This paper proposes the techniques to be used in order to handle the threats. In this paper, we proposed a combination of LBP and HOG for better results and accuracy.

Keywords *– Local Binary Pattern (LBP), Histogram of Oriented Gradients (HOG).*

1. Introduction

The face is an identity of a human which have various of expressions and senses which responds faster [1].Among various of biometric technics face recognition depends on 2D image and the software work by taking face image as input and gives face print by output. Maintaining attendance record in every institute is important for checking the performance of the student. Every institute has its own way of taking attendance. Few of them use the manual way of marking attendance and some use the RFID i.e., Radio Frequency Identification for marking attendance [3]. Biometric techniques are used in different industry, banks, government agencies like passport, UID, voter's enrollments and surveillance and security. Manual systems pressurize the people to be correct in all the tasks and at all times, the problem being that people aren't perfect. With manual systems, the level of service is dependent on individuals and they must ensures the procedures have no false entry. It takes more attainment and area to keep track of formal documents and information to keep details secure. With manual or partial automated systems information may be written down or copied or may be entered more than once. Systemization can reduce the redundancy in data entry. This saves time, as well as minimizing the spread of illness due to physical contact. Once you have implemented the device there is no issue of remembering anything as the device is reliable enough to be trusted.

2. Literature Review

1. Face Detection E-attendance System. International Journal of Computer trends and technology (IJCTT) – Volume 27 No.3 – Sept, 2015.An application which helps in capturing the images of the students in a class and mark their attendance according to their presence. This system was more time consuming and also there was a possibility of faulty attendance marking

2. Face Detection and Recognition for Automatic Attendance System. International Journal of Computer

Science and Mobile Computing - April, 2006.Viola Detector and Haar – cascade extracts features quickly and it is easy to use. The compilation time of viola detector is a little time-taking. This system uses only haar cascade. We have used Local Binary Patterns with Histograms of Oriented Gradients for better accuracy and also that the compilation time is reduced.

3. Attendance Monitoring System using Face Recognition – International Journal of Emerging Research in Management and Technology Volume 5, Issue 5 – May 2016. In this paper, the problem was discussed by applying two algorithms such as Viola Jones for Face Detection and Principal Component Analysis for Face Recognition. In our system, LBP algorithm is combined with Haar – cascade which is used for detection purpose and when the LBP algorithm is applied it creates a Histogram of that image which gives minute details of each face so that it can recognize quickly and give results in less time with more accuracy.

3. System Description

The overview of the whole process diagram is based on image – based face recognition as shown in Fig 1.
Camera: The system includes a camera that captures images of the people and sends it further for the image pre – processing phase.

Face Detection: After the image is pre – processed it is then sent for face detection. Face detection module crops the facial part from the captured image.

Face Extraction: Features are extracted for differentiating face of one student from the other.

Face Recognition: Data set is required for automatic recognition. Multiple images are taken and their features are extracted and stored in the database. The image is then compared with the stored images and if the face is matched with the stored images then the face is recognized and the attendance for that particular student is recorded.

Decision: Several images are captured for every person and their features are saved in the database. The decision is based on whether the image has recognized or not. If the image is recognized by the system, then the decision is present, if not absent.

Mark Attendance: After a particular decision is made, the student's attendance is recorded.

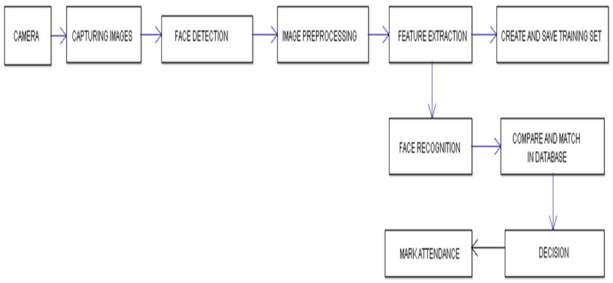


Fig.1. Process flow model

This system mainly consists of two modules,

- Face detection
- Face recognition

3.1 Face Detection

If we see from past few decades there has been a drastic change in technology, we could see many advances in technology as a part of this advancement the technology has made itself available to allow verification of individual identity [4] [5] [18]. In order to achieve precise and accurate result the designers use the position of both the eyes for assistance [6] [7] [18]. Many parameters are taken into considerations for this purpose such as the following:

1. As the picture is captured in an external environment, the lightning conditions may not be the same all the time [18].
2. Facial expressions of the person whose face is being recognized [8].
3. Person's Hairstyle.

Considering these few points the developers designed some algorithms which succeeded in recognizing the face accurately to the maximum limit. There are few steps that are to be followed for face detection in all algorithms as shown in Fig. 2.

Step 1: Detecting a face from an input picture which is from the camera of the device. Localizing the face region i.e., cropping the facial image from the other background.

Step 2: Preprocessing is a part of the process where the images are enhanced in features and unwanted distortions are suppressed. It extracts various facial features like nose, mouth, eyes, Rotation, Scaling, etc. are some types of preprocessing.

Step 3: The features are extracted from the image that is already processed in the previous step. All of the features are extracted using the algorithms LBP with HOG and then stored in the database.

Step 4: To perform the detection of faces, we use an algorithm known as HOG (Histogram of Oriented Gradients).

Step 5: Verify whether the face is then recognized by the algorithms applied.

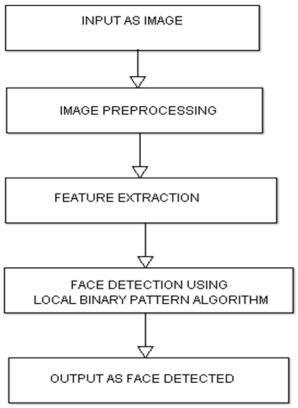


Fig.2.Face detection working flowchart

3.2 Face Recognition

Face recognition is a computer application where a digital image captured is evaluated and processed in order to recognize it by its features. The image used in processing was output from the detection and input for recognition. This recognition is performed using the algorithm known as Local Binary Patterns. In the algorithm, the image is divided into some sections and each section is further divided into 9 pixels and each pixel is allotted its threshold value. The centre value in these 9 pixels is compared with other 8 and assigned binary values to it. This binary value is converted into decimal and such decimal values formed from the sections of the image is used to form an histogram which compares the value from the image in dataset and gives the output as recognized or not, the process flow of face recognition is shown in the fig.3.

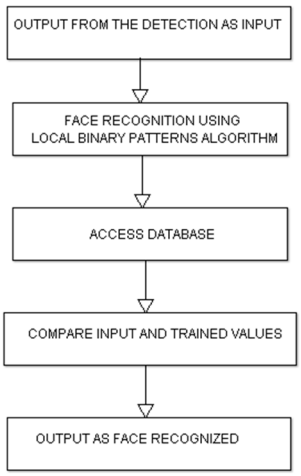


Fig.3. face recognition working flowchart

The features that are extracted from the captured image is compared with the stored images in the database. If system recognizes the features, corresponding student will be marked present.

4. Methodology

The proposed methodology has a set of stages starting from using LBP and HOG for the recognition and detection purpose.

4.1 Local Binary Patterns

LBP is used to classify the features of facial images [10]. Monotonic grey-scale facial transformation is helpful for easy computation and image processing [10]. LBP uses the center pixel value (x_c, y_c) [10] [11] as a threshold and then consider its eight neighbor's pixel value as shown in Figure 4.1.1. If the value of neighboring pixels are more than or equal to the center value then 1 is assigned else 0. Finally, the code is generated for the center pixel by combining eight 1's or 0's into binary [11].

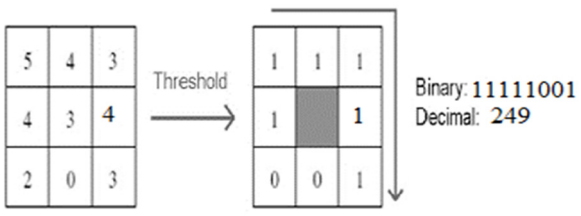
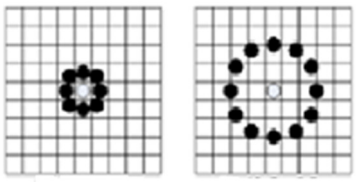


Fig.4.1.1 LBP

Later, the extension was made in LBP by using neighborhood of different sizes [11]. From the central pixel, a circle is constructed with radius R. From the edge of circle P, sample points are taken and then compared with the value of center pixel as shown in Figure.4.1.2.



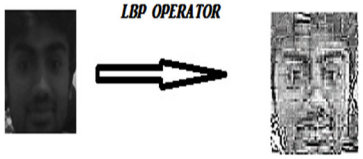
P=8 and R=1 P=12 and R= 2.5 ‹els

LBP can be expressed as:

$LBP_{P,R}(x_c, y_c) = {}^{P-1}b\,(d_n - d_c)\,2^P$

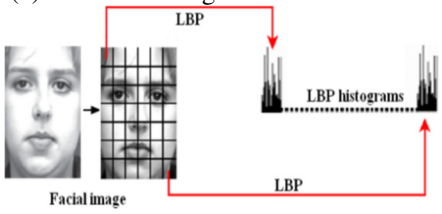
$$b(x)=\begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases} \quad (1)$$

Here, d_c corresponds to center pixel value (x_c,y_c) [11], d_p corresponds to the value of P neighbors, R is the radius of circle or distance from center pixel to corresponding neighbors. The process can be visualized by referring to figure.4.1.3.



(a) (b)

Fig.4.1.3 Image description with LBP
(a) The Original image
(b) The LBP image



LBP derivation is represented as follows, with the texture definition M whilst the gray quantities joint distribution of P + 1(P>0) image pixels.

$M = t\,(d_c, d_0,..., d_{p-1})$ (2)

Where, d_c is the gray value of center pixel of some local neighborhood.

Since d_p (p = 0,..., P -1), matches the gray values of P that are equally spaced pixels on a set of radius R where (R>0) forms a circular symmetric pair of neighbors [12] [13]. This shows three circularly symmetric neighbor sets for different values of P and R. Without losing any information, we can subtract d_c from d_p [10].

$M = t\,(d_c, d_0 - d_c,..., d_{p-1} - d_c)$ (3)

The distribution could be factorized by assuming the differences are independent of d_c:

$M = t\,(d_c)\,t\,(d_0 - d_c\,,..., d_{p-1} - d_c)$ (4)

Since t (d_c) defines the general luminance of graphics, which is not related to local image, it is ignored.

$M = t\,(d_0 - d_c\,,..., d_{p-1} - d_c)$ (5)

Although the invariance against the gray scale shifts, the differences are affected by scaling. To attain invariance with respect to the gray scale image, just the signs of the differences are taken [10].

$M = t\,(b\,(d_0 - d_c),..., b\,(d_{p-1} - d_c))$, Now, a binomial weight 2^p is assigned to each sign s $(d_p - d_c)$, transforming the differences in a neighborhood into a unique LBP code.

$$\mathbf{LBP_{P,R}}(\boldsymbol{xc, yc}) = \sum_{p=0}^{p-1} \boldsymbol{b(dp - dc)}\ \mathbf{2^p}\ (7)$$

LBP is described in two ways: Firstly, the neighbors in the typical definition are indexed circularly, providing it better to derive rotation in invariant texture descriptors. Secondly, the pixels in the 3x3 neighborhood diagonal are interpolated in our algorithm LBP. [14] [15] [16].

4.2 Histogram of Oriented Gradient

Single angle or the distribution of the local intensity gradients in orientation can be represented without accurate knowledge of the gradient. The histogram gives invariance details of the image because it is robust to lightning changes [17]. Histogram is calculated quickly because it deals less time complexity [17]. The image is divided into cells of 7x15=105 blocks in total for a 64x128 image, each block has 2x2 cells with size 8x8. Then the image is divided into 16x16 blocks of 50% overlap. Interpolation is done to find better histograms, this can be achieved by tri-linear interpolation. As each block has 2x2 cells with size 8x8 the gradient orientation is divided into 9 bins as shown in figure 4.2.2. The bins have the angles 0,20,40….180 ,θ = 0,20,40, ... 180.

The final vector will combine all the 105 (cells) histograms each one 9 dimension will become 3780 dimension feature vector. The visualization is shown in the figure 4.2.3. Where each block shows the histogram.

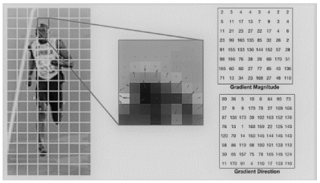


Fig.4.2.3 Visualization of HOG.

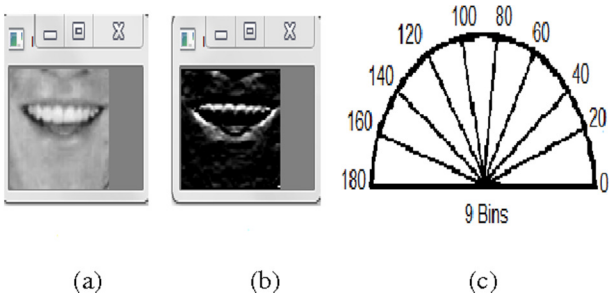


Fig.4.2.2 (a) original image (b) Hog image
(C) Bins (0 – 180).

5. System Description

5.1 Hardware configurations

This project is implemented in Windows 10.1 which has 4gbRAM and 1tb Memory.

5.2 Software requirements

We have implemented this project using openCV with Python. The IDE used to deploy this project is Jetbrains PyCharm. OpenCV(also called Open Source Computer Vision) is a standard library consisting of programming functions which utilize the real time computer vision resources such as webcams.

5.3 Dataset

Dataset usually stores the captured images from the camera .The dataset may comprise data for one or more members. The database will have the images of all the students stored on a prior basis. Multiple images of each person is captured. The images are converted into grayscale images for better recognition. The algorithm recognizes the face that is done by comparing few parameters in which the algorithm is trained in. If the face is recognized then it marks attendance to the person whose face has been recognized as shown in figure 8.

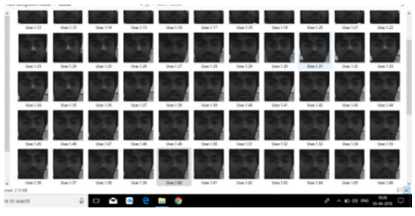


Fig.8. Dataset

6. Results and Discussion

The system is used to test the LBP-method and HOG-method performances for different kind of facial images. Various parameters like (P and R), non-weighted or weighted region dividing the regions are divided to see the effect. For doing this implementation we have collected a dataset of facial images. Then after creating the data set, it is trained and its trainer set is created. The images are captured by 2MP resolution webcam. In the proposed system, based on the algorithms the images of an unknown person is matched with the images of the dataset. The input images are mapped with the dataset and if it matches, it gives the output whether the image is successfully recognized. The following table shows the recognition rate based on database.

Table 6.1

Number of faces stored in database	Number of input images compared with database	Recognized faces	Unrecognized images	Rate of Recognition
2020	2020	2020	0	99.9%

It has been a challenging task to implement the system with face detection and recognition in unconstrained conditions. In our project “Face Recognition Attendance System” using Local Binary Pattern and Histogram of Oriented Gradients gives us an overall efficiency 98.75%.

The comparison values are presented below in the Table 6.2 [11].

Algorithms	Test Sample	Recognition matched	Recognition Unmatched	Accuracy
LBP + SVM	80	71	9	88.75%
LTP + SVM	80	75	5	93.75%
LBP + HOG	80	79	1	98.75%

Table 6.2

Drawbacks in our system:
The present system deal with a few disadvantages such as:

1. Possibility of false positives.

2. Parameters for sensing may change over a period of time [18].
3. Possibility of Data Redundancy.

7. Conclusion

These applications deals with robust and secure technologies. The chances of losing the data or faulty attendance being marked are highly reduced. The application is also handy to use and will be of a great help to the teachers as it saves time and reduces the manual effort that it is presently put into it. The intervention of a third person is also removed to maintain these databases and collectively sum up the attendance [18]. From this paper, survey on LBP and histogram of oriented gradients has been studied in detail. This method is reliable.

8. Future Scopes

The application can be further extended to other platforms present in the market. This factor also depends on the adaptability of the openCV platforms. Another proposal can also be made so as to use it in the tablets which can be stationary and can automatically detect the person who stands in-front of it [18]. Identifying twins in a same class can be a major challenge which can be handled in the future. Further we can implement the same system in CCTV cameras where it is not needed to maintain the device and the camera automatically detects the person and records the presence and is stored in the database.

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Authors -

First Author : Palak M Jain, Shipra Singh, Nikita Singh, Nancy Hablani, Student pursing Bachelor of Technology (B.Tech), Department of Computer Science and Engineering, Third year, SRM Institute of Science and Technology, Vadapalani, Chennai, Tamil Nadu.

Second Author: Dr**.** G Pavai Anand, B.E, M.E, Ph.D, Assistant Professor, Department of Computer Science and Engineering, SRM Institute of Science and Technology, Vadapalani, Chennai, Tamil Nadu.